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"LET KNOWLEDGE GROW FROM MORE TO MORE
AND THUS BE HUMAN LIFE ENRICHED."

A New Survey of Universal Knowledge

ENCYCLOPÆDIA BRITANNICA

Volume 3

BALFOUR *TO* BOTH

ENCYCLOPÆDIA BRITANNICA, INC.

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BALFOUR *TO* BOTH

BALFOUR, ARTHUR JAMES BALFOUR, 1ST EARL OF (1848–1930), British statesman, was a brilliant aristocratic intellectual who held a key position in the Conservative party (*q.v.*) after 1880 for nearly 50 years, and was prime minister from 1902 to 1905. He was born at Whittingehame, East Lothian, Scot., on July 25, 1848, the eldest son of James Maitland Balfour and of Lady Blanche Gascoyne-Cecil, a sister of the 3rd marquess of Salisbury. It was the great year of European revolution, but Balfour was to have little sympathy with the forces which that fateful year set in motion. If 82 years later militant democracy had still not succeeded in obliterating all the landmarks of the old English social order, the fact was due at least in part to the skilful, supple, yet steely leadership given by Balfour during the long rear guard action of the Conservative party. He was educated at Eton and Trinity college, Cambridge. His family background was highly intellectual and his mother, in particular, was a woman of much wit and intelligence. Balfour's father died in 1856 and Arthur succeeded to a large property and considerable wealth when he came of age. Although toward the end of his life his fortune became much impaired by surprisingly imprudent speculation, he was never personally worried about money matters.

When he first left Cambridge his serious interests were mainly philosophical, although his uncle Lord Salisbury persuaded him in 1874 to enter parliament as Conservative member for Hertford. In 1879 he published his *Defence of Philosophic Doubt* in which he endeavoured to show that scientific knowledge depends just as much as theology upon an act of faith. He regarded this as an argument in favour of theology. In the great Victorian struggle between science and religion, Balfour was on the side of religion. The majority of people, who failed to understand the book, or who read only its title, wrongly assumed that he was a skeptic. He continued to take a keen interest in scientific and philosophical problems throughout his life.

When he was 27, a romantic tragedy occurred which was to cast a shadow over the rest of his life. He was a close friend of Alfred Lyttelton, a nephew of Gladstone, and later a Conservative colonial secretary. In 1875 Balfour became unofficially engaged to Alfred's sister, May. A month later she died. Balfour never again seriously considered marriage.

In 1878 he became private secretary to his uncle, Lord Salisbury, who had recently been appointed foreign secretary, and whom he accompanied to the congress of Berlin. Two years later the general election resulted in a conclusive defeat for the Conservatives. Balfour retained his seat and became for a while a member of the so-called "Fourth party"—a group of four Conservative members of parliament, who, headed by Lord Randolph Churchill, made it their business and their pleasure to harry the official Conservative leadership with the cry of Tory Democracy. Balfour could agree with Lord Randolph in seeking to drive out Sir Stafford Northcote, the Conservative leader in the house of commons, but he had no intention of becoming involved in an attack on Lord Salisbury, who led in the house of lords. Balfour, in fact, kept closely in touch with his uncle about the activities of the rebels to whose ranks he ostensibly belonged. Throughout this period he seemed to most people a languid exquisite, rather than a man of action, an amusing and witty social figure no doubt, but one of the last people for whom political success could have been predicted. He moved in a circle of rich, clever and delightful men and women—"The Souls"—a brilliant society of which he was a central figure. Few observers of this period were able to discern the toughness which lay behind all this glitter, that streak of "cool ruthlessness" which Winston Churchill described (in *Great Contemporaries*, 1937).

In June 1885 the Liberal government fell. Lord Salisbury became prime minister and appointed his nephew president of the local government board. In the general election later that year Balfour won the seat of East Manchester which he continued to represent until 1906. In the country as a whole, however, the Liberals were victorious, but Gladstone, by announcing a policy of Home Rule for Ireland, split his party and in the summer of 1886 was defeated first in the house of commons, then in the country. On the formation of Lord Salisbury's second administration (July 1886) Balfour held the post of secretary for Scotland. In March 1887 he was made chief secretary for Ireland with a seat in the cabinet. To the outside world the promotion of a dilettante man of fashion to the most difficult administration post appeared incredible. In fact it was very successful. Balfour was an implacable opponent of Home Rule and

he suppressed Irish insurrection with great efficiency, earning the soubriquet in Ireland of "Bloody Balfour." At the same time he strongly opposed the evils of absentee landlordism, and by his Light Railways, Congested Districts, and Land Purchase acts pursued a policy of "killing Home Rule by kindness," which, though failing in its ultimate purpose, did much to improve conditions in Ireland.

Balfour had made a name for himself as a formidable parliamentary debater and on the death of W. H. Smith in 1891, he became first lord of the treasury and leader of the house of commons. He was thus officially second-in-command to Salisbury who was prime minister and foreign secretary—a family combination of uncle and nephew unique in British history. Conservative fortunes were, however, on the wane, and in the general election of July 1892 Gladstone won a narrow majority. For three years Balfour led the opposition with much skill. In July 1895 the Conservatives were back in office and he resumed his old post. But his handling of the leadership of the house of commons did not go uncriticized—flippancy and a perhaps delusory impression of laziness being the main charges against him. As time went on he came to bear more and more of the burden of government, for Salisbury was ageing and his health declining. Balfour was critical privately of Joseph Chamberlain's conduct of the negotiations which ended in 1899 in the South African War, but once war had begun he was as resolute as anyone in its prosecution. He was the only minister in London when Sir Redvers Buller telegraphed asking permission to abandon the relief of Ladysmith. Balfour promptly told him to relieve it or resign. The ineptitude of the higher command made him a keen supporter of military reform, and one of his most important actions as prime minister was to lie in this field. The "khaki election" of 1900 gave the Conservatives a new lease of power. In July 1902 Salisbury resigned and Balfour succeeded him.

His premiership lasted more than three years. It ended in political disaster and an aura of failure has hung over it ever since. But this is not a fair verdict: the period saw many constructive reforms for which Balfour deserves much personal credit. The most important were the Education act (1902), the Irish Land Purchase act (1903), the Licensing act (1904), the creation of the Committee of Imperial Defence (1904). All four measures dealt with matters long bedeviled by complicated legal, technical and emotional considerations, and well illustrated Balfour's clarity of mind, absence of prejudice and readiness to grasp unpleasant nettles. The Education act put secondary education upon a rational basis; the Licensing act solved the problem of combining a reduction in the number of public houses with fair compensation for brewers; the Land Purchase act went far toward alleviating Irish agrarian poverty; the Committee of Imperial Defence was a notable contribution to the formation of a sound strategic policy. None, however, was a vote-winner and the first by appearing to subsidize Anglican teaching out of the rates was a notable vote-loser in Nonconformist quarters. Two other episodes contributed to the decline of the Conservative party. One which Balfour could and should have avoided was the decision to meet the shortage of workers in the Rand mines after the South African War by the mass importation of indentured Chinese coolie labour. This raised not only humanitarian objections, but also the less disinterested protest of organized labour in Britain which perceived a dangerous precedent. A prime minister less lacking than Balfour in the "common touch" would not have made such an error. The second difficulty, which was not Balfour's fault, arose from Chamberlain's espousal of the cause of tariff reform. This in the name of greater imperial unity involved abandoning the free trade tradition in favour of preferential treatment of colonial imports. It split the party and produced a cabinet crisis in 1903 which resulted in numerous resignations including Chamberlain's. Only Balfour's anxiety to see the finish of the negotiation of the Anglo-French entente (1904), a major, but to the general public scarcely noticed, revolution in British foreign policy, kept him in office.

The process of doing so involved him in much elaborate procrastination and the enunciation of many hair splitting formulas to preserve party unity, with resulting loss of prestige. At the end of 1905 he resigned. In the ensuing general election the Liberals won a crushing victory and Balfour lost his own seat. He was soon back in parliament, but his party leadership, although outwardly as confident as ever, came increasingly under challenge. Certainly he was no wiser than other Conservatives over the bill-wrecking policy pursued by the house of lords, and he did nothing to discourage the decision of the upper house to reject Lloyd George's budget in 1909. The two general elections of 1910 left the Liberals still in power though much reduced in strength, and the passage of the Parliament act of 1911 seemed to many Conservatives final condemnation of Balfour's policy. In Nov. 1911, stung by repeated criticisms, he resigned the leadership, his successor being Andrew Bonar Law.

Balfour was now 63 and his political career might well have seemed almost over, but World War I changed this. When H. H. Asquith was obliged to form a coalition in May 1915, Balfour succeeded Winston Churchill as first lord of the admiralty—not a position to which he was suited. When the second great political crisis of the war occurred in Dec. 1916 Balfour moved with impeccable correctitude but none the less surprisingly from support of Asquith who had always defended him to support Lloyd George who had been a severe critic. By accepting the foreign office in the new government he did as much as anyone to consolidate Lloyd George's position. The prime minister's dominant personality and the limitations imposed by war prevented Balfour from making any great mark on foreign policy, although his visit to the United States in April 1917 did much to smooth Anglo-American relations. The Versailles peace negotiations of 1919 were almost wholly conducted by Lloyd George and Balfour had little responsibility for the outcome. One important event during his tenure of the foreign office was his decision in favour of the Zionist aspirations for the creation of a Jewish national state in Palestine and its embodiment in the Balfour declaration of Nov. 1917 (*see* ZIONISM). In Oct. 1919 he became lord president of the council, and in the same year was elected chancellor of Cambridge university. In March 1922 he was made a knight of the Garter, and in May he accepted an earldom. He supported the Conservative coalitionists at the Carlton club meeting of Oct. 1922 and refused to join Bonar Law's or Stanley Baldwin's first administration. But in Baldwin's second cabinet, in 1925, he became lord president again. He was largely responsible for the negotiations which led to the definition of relations between Great Britain and the dominions which were to be expressed in the Statute of Westminster in 1931. He died at Woking on March 19, 1930.

See also Index references under "Balfour, Arthur James Balfour" in the Index volume.

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BALFOUR, FRANCIS MAITLAND (1851–1882), British animal morphologist who discovered fundamental facts concerning the development of the vertebrate nervous and urogenital systems, was born at Edinburgh on Nov. 10, 1851, the younger brother of Arthur James Balfour (1st earl). At Harrow school he was encouraged by George Griffith in natural history pursuits. Balfour entered Trinity college, Cambridge, in 1870 and studied natural sciences. Lectures on embryology by Michael (later Sir Michael) Foster attracted him to animal morphology, and after taking his tripos (honour examinations) in 1873 he occupied a research seat at the Naples zoological station. His work there afforded him material for a series of papers (published as a monograph in 1878) on the elasmobranch fishes, which threw new light on the development of the urogenital and nervous systems in the vertebrates. His treatise on *Comparative Embryology* was published in two volumes, the first (1880) dealing with the invertebrates, the second (1881) with the vertebrates. This work won wide recognition for its scientific validity and for the large amount of original research contained in it. It also formed an admirable digest of previous investigations. Although invited to succeed

George Rolleston at Oxford and Sir Wyville Thomson at Edinburgh, Balfour preferred to remain at Cambridge, and in 1882 a special professorship of animal morphology was instituted for him. Owing to an attack of typhoid fever he never delivered a professorial lecture. Going to the Alps to regain his health, he died, probably on July 19, 1882, attempting the ascent of the Aiguille Blanche, Mont Blanc, at that time unscaled. (J. Rm.)

BALFOUR, SIR JAMES (of Pittendreich) (*c.* 1525–1583), Scottish judge, was pre-eminent among his political contemporaries through the adroitness and frequency with which he changed sides. A son of Sir Michael Balfour of Montquhanny, he was educated for the priesthood possibly at St. Andrews (1539 or 1540) and probably Wittenberg (1544). He was in St. Andrews castle when it surrendered to the French (June 1547) and he subsequently became a galley slave. Released in 1549 by abjuring his Calvinism, and having been made official of Lothian (*c.* 1555) he then supported the party of Mary of Lorraine, rejoining the reformers in 1559 in order to spy on them. He was appointed parson of Flisk in 1560. After Mary Stuart's return to Scotland he was nominated an extraordinary lord of session (1561), an ordinary lord (1563) and chief commissary of Edinburgh (1564). He was made a privy councilor in 1565 and was knighted and made clerk register in 1566. Now a Lutheran, he was a prominent adviser of Mary and his death was planned along with that of David Rizzio (March 1566). An adherent of the earl of Bothwell, Balfour was principal counselor and deviser of Lord Darnley's assassination: at Craigmillar, he drew up and signed the murder band; he assisted the entry of the assassins to Kirk o' Field—a house which he had recently given to his brother; and he purchased gunpowder for the explosion. On the night of the deed he left Edinburgh in order to establish an alibi. Thereafter he was made captain of Edinburgh castle. When the lords rose against Bothwell in June 1567, Balfour not only changed sides and surrendered the castle to the earl of Moray in exchange for a pardon along with money and the priory of Pittenweem, but also betrayed Mary's military plans and surrendered the casket letters (*q.v.*) to the lords. Part of his reward was the lord presidency of the court of session (Dec. 1567).

Balfour fought against Mary at Langside in 1568. He was imprisoned briefly in 1569 for his part in Darnley's death but was released by bribery. However, when Darnley's father, the earl of Lennox, became regent in 1570, Balfour joined the armed supporters of Mary and was forfeited (Aug. 1571). He took an active part in the ensuing civil strife and had a hand in the death of Lennox (Sept. 1571). In 1573 after the earl of Morton became regent, Balfour was restored, paying for his remission with French money intended for the rebels. The same year he negotiated the pacification of Perth. Balfour's forfeiture of 1571 was renewed in 1579 and he fled to France, where he conferred with the Roman Catholic party but also offered his services to Elizabeth of England (to whom he professed a desire to hear Protestant preaching) and to Mary. He was recalled secretly to Scotland (Dec. 1580) to give evidence of Morton's complicity in Darnley's death. Balfour himself was acquitted of his part in this. He died between July 31 and Oct. 26, 1583.

Against Balfour's treachery must be set his judicial competence, his diplomatic skill and his legal writings. His edition of statutes, *The Actis and Constitutiounis of the Realme of Scotland* (1566), received contemporary praise; and his *Practicks* (published 1754) have been judicially referred to as "of undoubted authority."

See P. G. B. McNeill, "Sir James Balfour of Pittendreich," *Juridical Review*, new series, vol. v (1960). (P. G. B. McN.)

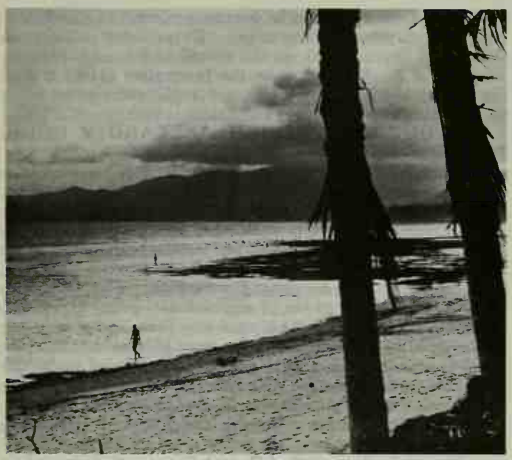
BALFOUR, ROBERT (in Latin Robertus Balforeus; 1550?–after 1625), Scottish classical and patristic scholar, described by his compatriot Thomas Dempster as "the Phoenix of his age; a philosopher profoundly skilled in the Greek and Latin languages; and a mathematician worthy of comparison with the ancients," was born in Forfarshire and educated at St. Andrews. A convinced Catholic at the time of the Reformation in Scotland, he went to France, distinguished himself in disputations in the University of Paris and was invited to Bordeaux to teach in the Collège de Guienne, where he became professor of Greek and later (probably in 1586) principal. He published editions of Gelasius of Cyzicus' work on the council of Nicaea (1599), of Theodore of Raithu's treatise on the Incarnation (1599) and of Cleomedes' *Meteora* (1605; reprinted 1820) and commentaries on Aristotle's *Organon* (1616) and *Ethica* (1620).

BALFOUR OF BURLEIGH, ALEXANDER HUGH BRUCE, 6th Baron (1849–1921), Scottish administrator chiefly remembered for his work as a committeeman, in which capacity he rendered considerable services to the state, especially in Scotland, was born at Kennet, Alloa, on Jan. 13, 1849. He was a descendant of Robert Balfour, 5th Baron Balfour of Burleigh, who had been attainted for Jacobite activities in 1716. The title was restored in 1869. Educated at Loretto, Eton, and Oriel college, Oxford, he plunged immediately into public life, becoming in 1876 one of the 16 representative peers of Scotland in the house of lords. But his place in politics lay not so much in the debating chamber as in the committee room where his sound business sense and calm, judicial turn of mind made him invaluable. For more than 40 years (he sat on his first commission when he was 26) he was in constant demand for royal commissions, committees of inquiry and courts of arbitration. Many of the blue books of the period bear his mark. He also played a part in the revival of Scottish Conservatism, becoming, in 1895, secretary for Scotland in Lord Salisbury's cabinet. He discharged the duties of his office with great distinction, particularly in the sphere of administration, although he was also responsible for much useful legislation. In Sept. 1903 he left the government on the tariff reform issue at the same time as Joseph Chamberlain, but was deeply divided from him both as a confirmed free trader and in his belief in administration as the basis of government. Thereafter he played a diminishing part in politics, and his moderate views on the budget crisis of 1909 separated him further from the majority of his party. He devoted himself increasingly to the Church of Scotland, in the affairs of which he had always played a leading part, and wrote *An Historical Account of the Rise and Development of Presbyterianism in Scotland* (1911). It was largely due to his patient advocacy that the union between the Church of Scotland and the United Free Church, which came soon after his death, was achieved. He died in London on July 6, 1921.

See Lady Frances Balfour, *A Memoir of Lord Balfour of Burleigh* (1925). (M. Sh.)

BALI, an island of the Lesser Sunda group, Indonesia, lies east of Java. Its area is 2,147 sq.mi., and its length 95 mi. between the shallow Bali strait on the west and the deep Lombok strait on the east, the latter marking the edge of the Sunda platform (*see* Malay Archipelago). The extreme width is 50 mi. Bali is a separate province and is divided into eight districts, corresponding to the traditional princely states, each administered by a council of which the chairman is usually the reigning local *radja* or his heir apparent.

Geographical Characteristics.—Most of the island is mountainous and consists of volcanic formations. The narrow western section, Djembrana, is a wild, almost uninhabited upland. The central highland, of recent volcanic formation, rises to 7,775 ft. on Mt. Batukau, or Tabanan peak, and has three crater lakes, Bratan, Bujan and Tambelangan. The eastern highland has the majestic volcanic cone of Mt. Agung, or Bali peak (10,108 ft.), and to the northwest of it a grandiose *caldera*, having within its rim the crater lake Batur and the active volcano of that name. North of the mountains lies only a narrow lowland fringe, slightly indented; during the northwest monsoon shipping finds little protection from the strong winds, and the roadstead of Buleleng, the port of Singaradja, is often unsafe. The main lowland lies to the south of the central mountains. There numerous rivers emerge from the ravines they have cut in the soft volcanic rock, and flow across a composite plain of their own making. The rivers are unsuitable for navigation. Practically dry at one season, they become choked and are likely to flood during the period of heavy rainfall. The barren limestone peninsula of Tafelhoek is connected with this alluvial plain by



EWING GALLOWAY

VIEW ALONG ONE OF THE BEACHES OF BALI

a 1 mi.-wide isthmus. Southeast of Bali lies Nusa Penida, another limestone upland, an old convict settlement. Heavy seas run on the south coast during the southeast monsoon. The only safe anchorage is at Benua, the port for Denpasar, between the northward projecting spur of Tafelhoek and its isthmus, though only accessible to small ships because of the narrow and tortuous entrance between coral reefs. Bali's airport is on the isthmus. The southeast monsoon, from May to November, is the dry season, but more pronounced on the north than on the south side of the island. Singaradja has a mean rainfall of 45 in., Denpasar almost twice as much.

Bali belongs to Java in flora and fauna. It has a luxurious vegetation. Among the many palms is the palmyra or lontar palm, the leaves of which formerly were used as writing paper. There are many delicious tree fruits, some of them peculiar to the island. Teak occurs, though not in abundance. Giant waringin trees are held sacred by the Balinese. Tigers are known in the west, but not the rhinoceros or wild buffalo; deer and wild pig exist in considerable numbers and damage crops.

The People.—Since early times people from Java have migrated to Bali, bringing their Hindu-Javanese culture. The island was a part of successive Javanese empires. When Islam gained victory over Hinduism on Java (16th century), Bali became a refuge for many nobles, priests and other intellectuals. Since then the small island has remained the only stronghold of Hinduism in the archipelago and a repository of ancient Javanese civilization. Racially the Balinese resemble the people from east Java, although mixture with the indigenous folk has obviously taken place. In the interior there are a few walled villages, inhabited by descendants of the aboriginal, animisitic people (Bali-Aga). The Dutch made no serious attempts to control Bali until 1882, when the north coast was occupied, followed in 1908 by the conquest of the south; even thereafter the Dutch government interfered as little as possible with local customs. It is the Hindu-Javanese way of life, reminiscent of Java in pre-Islam days, combined with the natural beauty of the island, that has made Bali renowned as a treasure house of old Indonesian culture. As Bali is drawn into closer contact with the outside world, traditions are challenged by modernization and standardization, but beyond the towns the old way of life persists to a surprising degree. The Balinese are a handsome people, although the evidence is less obvious since pressure and example from the outside has induced many women to dress like their Muslim compatriots. The Balinese are frank though courteous in conduct, less servile than the Javanese, gay and witty, fond of music, poetry, dancing and festivals, extraordinarily able in arts and crafts, and passionately fond of games of chance, particularly betting at cockfights. By the 1960s there had been a decline in the number of festivals, partly because social attitudes were changing, partly because economic progress was not keeping up with the rising population.

Population.—Bali's population increased from about 1,101,000 in 1930 to 1,782,529 in 1961. Since few people live in the mountains, this means that the population density in the lowlands is more than 1,500 per sq.mi. Emigration to less populated islands might be a solution, but the Balinese are so deeply attached to the social-religious life of the community that leaving it is like going into exile. Since World War II, annual emigration may have averaged about 3,000.

Besides the Hindu Balinese, there is a small number of Muslims mostly on the northern and western sides. The towns have a number of Chinese business people. There are almost no Christians among the native population, and missionary activity is restricted. European and American artists have flocked to Bali in considerable numbers; Ubud in the foothills north of Denpasar became the centre of the colony.

Social Conditions.—Most Balinese children go to school at least for a few years and are taught the national Indonesian language. Public health projects, with the assistance of international agencies, work toward control of malaria, yaws and other diseases, but in the early 1960s there was a chronic shortage of doctors.

The Balinese village is laid out in a regular manner. Each family lives in its own compound, surrounded by earthen or stone walls. A narrow gateway leads into the shady courtyard which is usually divided into three sections, containing respectively the rice granaries and cattle sheds, the sleeping quarters and kitchen, and the house temple. The living quarters have walls of clay and roofs of thatch or palm leaves. All villages have temples and an assembly hall, usually located on a square which serves for festivals and markets. The larger ones have also residences (*puri*) of feudal overlords, which are elaborate variations on the basic home architecture. The larger towns, in addition to Singaradja and Denpasar (Badung), are Klungkung, centre of wood carving and gold and silver industries, Gianjar with a lively market and Ubud with a fine art museum.

Religion.—Balinese life centres upon religion: Hinduism, more especially Sivaism, fused with Malay ancestor cult and other animistic and magical beliefs and practices. Places of worship are everywhere, from the "mother temples" at Besakih, half way up the slope of the holy mountain Agung, to family shrines in each courtyard. The Balinese firmly believed in reincarnation. Cremation is the occasion of a joyous and most sacred duty to liberate the soul. Formerly it was common, at least among the higher classes, for the widows to be also burned with their husbands' corpses, but the Dutch government put an end to this custom. Caste is observed, though far less strictly than was the case in India. Since over nine-tenths of the population belong to the Sudra, or lowest caste, there is little formality among the villagers. The nobility is divided into priests (Brahmanas), the ruling royalty (Satrias) and the military class (Wesias). A man may not marry a woman of higher caste. There is elaborate etiquette concerning rank, including different modes of speech. The Balinese language is distinct from that of east Java, but the upper-class form contains many Javanese and Sanskrit words. There are numerous other social organizations besides caste. Each village (*desa*) is a self-contained community, bound together by veneration of common ancestors, and usually subdivided in co-operative ward societies (*bandjars*) whose members are bound to assist each other in temple maintenance, festivals and family rites. Each village or ward has its yearly commemoration for a temple, a magic ceremony to expel evil spirits, an anniversary for all the livestock, for food plants and so on. Each celebration requires either a banquet or a *gamelan* (orchestral) concert or dancing, if not all of these, and always carefully prepared offerings to the gods or spirits. The economic cost is high, but so is the social return in community spirit.

Arts and Crafts.—The Balinese orchestra is similar to that of Java, but has a richer sound and is more vigorous. It consists of

various percussion instruments, a two-string violin and a flute. Every village has its *gamelan* club, giving concerts or, more often, accompanying stage plays, shadow-plays and dances. The plays present parts of the ancient Hindu epics or are Balinized versions of Malay legends and love stories. Dancing is an equally integral part of Balinese life, serving magico-religious purposes or telling stories by pantomime. Modern influence has led to the addition of purely demonstrative dances and musical comedies, all, however, in genuine Balinese style. The artistic temperament is also evident in sculpture, painting, silver work, wood and bone carving, in the ephemeral beauty of votive offerings made of cut palm leaves and flower arrangements, and in the multifarious ritual accessories on the great bamboo towers and the animal-shaped wooden coffins in which corpses are carried to the cremation ground.

The Economy.—Balinese farmers are among the most skilful in Indonesia. Rice is the main crop; in order to flood the fields, the hills and sloping plains have been transformed into terraces wherever possible. Farmers are organized in co-operative water control boards (*subak*), which build and maintain the ingenious irrigation systems and supervise the equitable distribution of water. The average Balinese farm is 2.7 ac., of which 0.7 ac. is irrigated land, the remainder being used for dry crops such as yams, sweet potatoes, cassava and corn. Most farmers grow coconuts and fruits, and some have small oil palm and coffee plantings. In spite of intensive farming, the island has to import food for its growing population, and many people must eat starches other than rice, the preferred food. Land tenure problems aggravate the land shortage. Bali has a large cattle population, a handsome breed of deerlike animals, and also pigs, geese, ducks and chickens. There are several meat processing and canning plants. The typical Balinese dislikes the sea, and fishing is thus a minor occupation. Agricultural exports consist of beef and pork to Java and Singapore and small amounts of copra, coffee and palm oil. Important items in Bali's balance of trade are the sale of craft articles and the tourist business. The latter could be much larger than it is, were it not for the discouraging hotel facilities and the cumbersome controls by the central government. Bali has an extensive, though poorly maintained, road net.

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BALIKESIR, a town of Turkey and capital of the *il* of the same name, is situated on rising ground above a fertile plain which drains to the Sea of Marmara. Pop. (1960) 61,012, having grown from 13,000 at the close of the 19th century. At or near Balikesir the Roman town of Hadrianutherae was founded, as its name commemorates, by the emperor Hadrian, but no trace of the ancient town remains. The older part of the present town, with the bazaar, occupies the upper slopes, while the lower part is well developed and has a modern appearance; it includes the administrative buildings, the railway station, a teachers' training school and residential areas. The town is linked by rail with Izmir and with Ankara via Kütahya, and is well served by main roads. In comparison with the severe climate of inner Anatolia, Balikesir has a mild winter and early spring. These conditions, allied to the rich soils of the plain, have made the town the centre of an abundant agricultural area, with a varied production of cereals, vegetables, fruit, sesame, opium and even cotton. Its industries include cotton textiles, flour-milling and the making of rugs and leather products.

The *il* of Balikesir, the greater part of which lies in the basin of the Susurluk river (Simav Cayi), extends from the Kapidagi (Cyzicus) peninsula in the Marmara region to Edremit on the Aegean coast. Besides its agricultural wealth, it is rich in minerals: iron ore is worked at Edremit and boracite at Susurluk. Area 5,626 sq.mi. Population (1960) 671,218.

(N. Tu.; S. Er.; E. Tu.)

BALIKPAPAN, a bay and seaport in East Kalimantan (Indonesian Borneo). Pop. (1959 est.) 29,800. It is the site of a refinery (annual capacity 3,000,000 tons) owned and operated by Bataafse Petrolem Maatschappij, N.V. (Royal Dutch/Shell), which processes both imported and local crude oils. There are producing oilfields operated by the same company both at Balikpapan and in the coastal region stretching about 60 mi. toward the northeast. The first refinery on the site started operation in 1899 but the installations erected before World War II were destroyed in Jan. 1942 in the face of the Japanese invasion. A new plant was erected after World War II.

BALKAN ENTENTE. The Balkan entente of Feb. 9, 1934, the statutes of which were adopted on Nov. 2, 1934, was established by Greece, Turkey, Rumania and Yugoslavia for the purpose of mutual defense against attack by another Balkan state and for other common purposes. Essentially the object was to guarantee the territorial integrity and the political independence of the signatory states against the improbable eventuality of an attack by either Bulgaria or Albania, not against the likelihood of aggression on the part of a major power such as Germany or Italy. Despite the professions of unity by members of the Balkan entente when the danger seemed somewhat afar, one by one the Balkan states became victims of axis aggression during World War II.

During the early war years, Rumania was brought under the domination of Nazi Germany (1940), and British attempts to reconstitute some form of Balkan unity, with the participation especially of Greece, Turkey and Yugoslavia, failed to bring about material results. Similarly, a project for Balkan union signed by the Greek and Yugoslav governments in exile on Jan. 15, 1942, which provided for political, economic and military co-operation, could not be implemented, partly because of Soviet opposition. Following World War II projects for Balkan union among the newly established Communist states of Bulgaria, Yugoslavia and Albania failed, largely because of Soviet opposition, although various bilateral treaties of alliance and co-operation were signed (1945–47). The latter ceased to be operative as regards Yugoslavia when the Yugoslav Communist party was expelled from the Cominform (1948).

A new Balkan entente, however, came into being on the basis of treaties signed on Feb. 28, 1953, and Aug. 9, 1954, among Yugoslavia, Turkey and Greece. These agreements provided for political, social and economic collaboration and for mutual defense, under article 51 of the United Nations charter, against possible aggression. The treaty of alliance was concluded for a period of 20 years. After 1954, however, there was considerable question as to the efficacy of the new entente. On the one hand, Greece and Turkey became members of the North Atlantic Treaty organization (1952), while Yugoslavia tended to pursue a more uncommitted policy. On the other hand, the controversy between Turkey and Greece over Cyprus rendered relations between those two countries difficult. Though projects for Balkan unity or entente were common, given the varying political and social systems, the conflict in national aspirations and the varying ethnic strains, a practicable entente remained a matter for future realization. *See* also BALKAN PENINSULA. (H. N. H.)

BALKAN PENINSULA. Since the early 19th century this name has been given to the most easterly of the three southern prolongations of the European continent. Balkan is a Turkish word meaning mountain, though in modern usage it is applied only to a particular mountain belt running east-west through Bulgaria. The countries comprising the peninsula are Albania, Bulgaria, Greece, Turkey in Europe and most of Yugoslavia. The area possesses certain basal resemblances to the Iberian and Italian peninsulas, particularly in its relation to the folded mountain chains of southern Europe and in its structural elements. But these resemblances depend upon fairly detailed points, mainly of interest to the physical geographer, and coexist with well-marked and obvious differences. The term Balkan peninsula would not have acquired its present familiarity to the general public if it had connoted only certain structural features. During the 19th century, when geographers and geologists were acquiring new knowledge of the interior of the region and were coming to regard it as an entity, not merely as a background to Greece and Byzantium, great political changes were taking place within it. The people, submerged by the Turkish advance, began to organize themselves

into national states and, as the Turkish empire contracted, new names appeared on the map. The growth of the new states was accompanied by much turmoil, which had reflex effects outside the peninsula limits, however these be drawn; but the essential point is that it drew general attention to the region. It became increasingly clear that all the older European states, if in varying degree, were interested in the delimiting of Balkan boundaries, and thus the facts disclosed by detailed geographical study had more than purely technical importance.

No mountain barrier separates the peninsula from the continental mainland. There is thus no sharp break of continuity such as is experienced when the Alps are crossed and a new world is disclosed in Italy. A convenient northern limit (from east to west) is constituted by the line of the Danube, its tributary the Sava and the small feeder of the latter called the Kupa, from which an imaginary line is drawn to the port of Rijeka (formerly Fiume). This limit has a certain justification, if not a complete one. The Danube-Sava line, easily recognized on a map, served for a period as a boundary to the Turkish empire and thus as the frontier of Christendom. For a time also the Sava-Kupa-Rijeka section, which has a certain air of unreality, did at least approximate to the frontier between Austria and the Turk. However, a geographically satisfactory frontier in this northwestern section is difficult to draw. Even the Danube-Sava line, at least to the west of the Danube's Iron Gate, has never been a limit so far as people are concerned; it bears no relation to political frontiers, and the post-1918 state of Yugoslavia extends well beyond it into the Hungarian plain and the Alpine mountain belt. Historically and politically, Rumania (not considered here geographically as part of the peninsula) north of the Danube is closely associated with the Balkan states. The first point about the Balkan peninsula is that on the north there is no real separation between it and central Europe. This physical continuity is accentuated by a notable increase in the width of the peninsula toward the north. Thus the distance in a straight line from the mouths of the Danube to Rijeka is about 750 mi., whereas, by comparison, the line by which the Iberian peninsula is attached to the continent measures only about 250 mi. from sea to sea, the Pyrenees being continuous throughout and leaving but a small gap at either end.

The second outstanding feature is the peculiar structure that causes the peninsula to fall into two very unequal and very dissimilar parts. To the south is Greece, a secondary peninsula, with an average width of only about 125 mi. Although both sections are highly mountainous, not only is the Greek section much narrower but also it has a peculiarly dissected coast line that brings sea influences within easy reach of nearly every part. The broad, continental northern section, on the other hand, is largely removed from the surrounding seas because of its width, the nature of its shore lines and, in part, of the direction of its mountains. In climate, in vegetation and in possible crops, it differs profoundly from Greece. No less profound was the effect of the actual remoteness from the sea routes so freely open to the people of the south. It is this division into two parts—one sharing to the full the life of the Mediterranean peoples, the other cut off from it—rather than the absence of a definite northern limit which made the European world so slow to recognize the existence of a Balkan peninsula. Until the peoples of the continental segment awoke, the whole northern area tended to be regarded only as a broader equivalent of the Alps or Pyrences: the real peninsula was the Grecian one.

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I. GEOGRAPHY

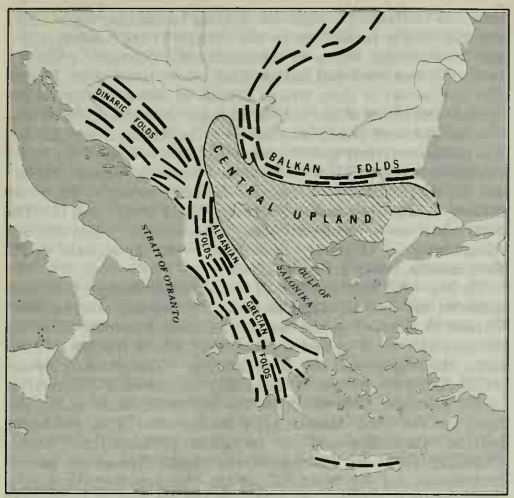
1. Structure and Relief.—It is the presence within the peninsula of young fold mountains that makes it essentially similar to the Iberian and Italian peninsulas. Two separate series of these can be recognized, one, of transverse direction, lying to the east, and the other, which is longitudinal, in the west. The Transylvanian Alps (*q.v.*) swing around in a great curve, the Danube breaking through at the Iron Gate at the western apex of the curve, and are continued in the Balkan mountains (Stara Planina), which have a roughly parallel direction. Fingering out eastward into several separate ranges and breaking off steeply on the shores of the Black sea, these rise to a maximum height of nearly 8,000 ft., and the most noted of their passes, the Shipka pass (*q.v.*) has a summit level well above 4,000 ft.

At first sight it might seem as if the crest of these mountains should be taken as the northern limit of the peninsula, rather than as the line of the Danube. But northward they sink gradually to a limestone tableland, presenting a marked contrast to the alluvial Walachian plain (Cimpia Romina) beyond the river, and the presence of this tableland means that the northern slopes as far as the passes, relatively high though these are, are gentle. The Balkans have indeed proved in practice much less of a barrier to human movement than would appear from a map.

Just as the Balkans are a continuation of the Carpathian branch of the Alpine chain, so the main chain itself bends down the western side of the peninsula. From the Julian Alps north of Trieste a series of mountains runs in a southeasterly direction close to the coast and parallel with it. These, to which the general name of Dinaric Alps may be given, rise to 8,274 ft. in the peak Bolotov Kuk of Durmitor; but their significance as a barrier does not depend upon their height. They are characterized by the great development of massive limestones, particularly extensive in the area lying behind the peninsula of Istria (*q.v.*). These limestone areas, called Karst (*q.v.*), display to a very marked extent certain peculiar relief features, dependent on the effect of rain water on their constituent rocks. Thus the surface soil is very thin, bare rock being frequently exposed; running water is usually absent at the surface, most of the rivers sinking, after a short course, into cavities of the rocks; caves and sinks are common, as well as elongated depressions called locally *polje*, or fields, because only in them as a rule is there sufficient depth of soil to permit cultivation.

The combination of these features makes the Karst areas difficult to cross, because continuous river valleys to serve as natural routes are generally absent and, where they occur, as in the case of the Neretva (Narenta) river, the stream tends to flow in steep-sided canyonlike gorges which form a great obstacle to transverse movement. Further, not only do these lands form a barrier between the sea and the interior but also they can as a rule support only a scanty and scattered population, for the local resources are small.

In places the limestone mountains rise steeply from the shore of the Adriatic, but a certain amount of subsidence has occurred, with the result that numerous islands fringe the coast. Because the mountain folds run parallel to the shore, the islands tend to be elongated in the direction of the coastline, and the straits and inlets tend to have the same direction. The islands are usually fertile and there is often a strip of productive land fringing the inlets. Water is also easy to obtain, for the streams which were lost on the heights above emerge as full-grown rivers where the rocky hills descend in cliffs to the sea margin, or springs even bubble up on the sea floor itself. In contrast with the dry and barren lands above, therefore, there is a possibility of cultivation and settlement on the shore. But the coastal areas are too narrow and the difficulties of communicating with the interior too great to



PHYSICAL STRUCTURE OF BALKAN PENINSULA

have allowed for the rise of indigenous civilizations there. The scattered towns on this Dalmatian coast represent islets of ancient but alien (Venetian) culture and, until relatively recent times, scarcely influenced the interior of the peninsula. They arose as offshoots of areas enjoying much greater advantages.

The Dinaric Alps may be said to extend to the neighbourhood of the mouth of the Drin in Albania. There the coast changes in direction, trending almost north-south, and the mountain belt thins out and draws back from the coast, so that the Albanian lowland intervenes between it and the sea. This triangular area, with its inland apex at Elbasan, extends southward to Vlore (formerly Valona); it shows another contrast with the Dalmatian area farther north in that several large and permanent rivers flow from the mountains across the lowland to the sea; there, then, access to the interior becomes at least relatively easy.

Another peculiarity is the proximity to southeastern Italy. Vlore is about 80 mi. distant from Brindisi, the Strait of Otranto being about 50 mi. wide. The combination of this nearness to an area of old civilization and of natural routes to the hinterland was of great significance in the past, and, with Albania very much under Russian influence, it remains so at mid-20th century.

Vlore, with the adjacent sheltering peninsula ending in Cape Linguetta (Albanian Kep i Gjuhezes), marks the beginning of a new change. The coast reassumes a southeasterly direction, the fold mountains become more conspicuous as the Pindus (*q.v.*) range, which extends through peninsular Greece. Beyond the down-faulted Gulf of Corinth, in the Peloponnesus, the ranges diverge like fingers, leaving narrow triangular plains in between. In the eastern part of the Greek peninsula several ranges diverge eastward or southeastward from the Pindus, and between them lie the well-watered open plains which, like those of the Peloponnesus, nourished early centres of civilization.

The central core of the Balkan peninsula is an old crust block, roughly triangular in shape, with its apex pointing toward Belgrade and its broad base approaching the shore of the Aegean sea. That sea is believed to overlie a former extension of the crust block that has sunk beneath its waters. The numerous Greek islands represent fragments of the surface of this lost land which remained above sea level when the remainder sank. The narrow straits of the Bosporus and Dardanelles are also regarded as flooded parts of the courses of rivers which crossed the old land.

The central core of the peninsula, though it has retained a position above sea level, has been greatly modified as a result of the formation of the fold mountains on its margins. The narrowed northern region, constricted between the Dinaric Alps and the curve of the Balkans, is a broken hilly country traversed by a continuous longitudinal depression through which the Morava river flows on its way to the Danube. South of Nis (Nish), Yugoslavia, however, and extending to the Gulf of Salonika is a region of great structural complexity which seems to have received the full force of the thrust. Faults are innumerable, and closed basins alternate with short and steep highland belts. The basins tend to be elongated in a longitudinal direction, and the major river courses —for example the Vardar—consist of alternating basins and gorges. Many of the basins have formerly been lakes, and since they are floored with fertile soil, they are fitted to become centres of population; but their isolation from each other has had very important human effects.

In contrast with this fractured and much subdivided region, the southeastern part of the triangle, that lying between the Balkans and the Aegean, shows relative simplicity. There the core reaches its greatest height (9,596 ft. in the Rila mountains), and there also is the broadest unbroken mass of elevated ground. The general name of Rhodope (Rodopi) may be given to the whole block, though the separate parts have local names. The Rhodope upland is separated from the Balkan mountains by a considerable lowland, the Rumelian plain, watered by the Maritsa river. This is one of the most considerable tracts of lowland within the peninsula and is continued, beyond the Maritsa, into an undulating tract extending to the shores of the Sea of Marmara. There is also an interrupted belt of plain in Thrace, between the Rhodope and the Aegean, the total result being to make the southeastern part of the peninsula much less continuously hilly than the northwest, where lowlands are virtually absent.

2. The Bearing of Terrain on the Political Map.—In the above account emphasis was on the distinction between the fold mountains on the one hand and the central crust block on the other. The contrast is a geological one, based on the characters of the constituent rocks in the two cases, and is not readily apparent on a relief map, where land is classified on the basis of its height above sea level. The essentials of structure are worth note because the build of the peninsula has influenced the routes and the areas of settlement within and the zones of effective contact with adjacent lands outside. But it is the ordinary atlas map which affords the most familiar representation of the area, and it is necessary to correlate the facts shown there with those obtained from the survey of the broad structural features, and particularly to connect the political and administrative units with the general lie of the land.

Yugoslavia.—An orographical map shows an almost continuous area of high ground on the west, continued into the Grecian peninsula, which is mostly mountainous. In the northwest the way in which the high ground within the peninsula passes into the Alps proper means that the Danubian plains have no natural, easy exit to the Adriatic. But the mountain belt thins out in the Karst of the Slovenian Juliske (Julian) Alps, and beyond this narrowed section lies a tract of undulating country, mostly outside the peninsula as usually defined, for it extends beyond the Sava-Kupa line, but still within Yugoslavia, whose frontier with Hungary is the Drave river. This area is a continuation of the plains of the Danube and, where the Drave and Sava converge toward one another, in Slavonia, it includes a considerable area of true plain. Although the mountain belt that separates it from the Adriatic is neither wide nor lofty—it does not rise much above 5,000 ft.—yet because of its karstic nature it forms a very effective barrier. The chief elements of the belt are the Velika Kapela and Velebit mountains, both remarkably waterless and barren. This whole area of mountain and plain was once the kingdom of Croatia-Slavonia; from a physical standpoint it is a transition region between central Europe and the Balkan peninsula. Until the creation of Yugoslavia it had little direct relation to the Adriatic, though economic and political causes led to Hungary's making great efforts to develop Rijeka (Fiume) as a grain port during the later 19th century. In the past, Croatia-Slavonia was politically, economically and culturally attached to central Europe, but ethnically it belongs to the Balkan peninsula.

Northwest of Croatia-Slavonia, in the region where the Dinaric

Alps in the larger sense pass into the Julian Alps, lies the former Austrian crownland of Carniola, a Karst area, again lying outside the peninsula proper but having a considerable Balkan element in its population.

To the south of the Velebit mountains a narrow strip of coastline, with the mountain crest behind, forms Dalmatia. But the historic Dalmatia (*q.v.*) is really an interrupted series of maritime towns, Zadar, Sibenik, Trogir, Split and Dubrovnik (respectively the former Zara, Sebenico, Trau, Spalato and Ragusa) being among the most important. Until the creation of Yugoslavia these towns had little connection with the interior; their Roman antiquities, the Venetian lion which still decorates some of their old buildings, are visible indications that their position in relation to the peninsula had little effect on the life of their inhabitants.

The actual mountain belt, from the borders of Croatia-Slavonia to the confines of Greece, extends through the territories formerly known as Bosnia, Hercegovina and Montenegro (*qq.v.*) to Albania. In Bosnia the limestone rocks of the coastal area give place to others, including sandstones, which at once allow for the development of deeper soils and of a more normal drainage system. Numerous rivers drain into the Sava, and Bosnia can be reached from that river, and thus from the Danubian plains, with relative ease. Other route lines connect it with the interior. Hercegovina is a karstic area with only one important river, the Neretva, which flows to the Adriatic. Montenegro is essentially a mountain aerie, a refuge that withstood invasion in the past as much perhaps because of its worthlessness as of the difficulty of conquest.

Access to the Adriatic coast from the Sava and Danube plains was much improved by the Yugoslav government between World Wars I and II. A new standard-gauge railway (the Lika line) was built to connect Zagreb and Split, and the narrow-gauge line from Brod via Sarajevo to Dubrovnik was connected to Belgrade.

Eastern Yugoslavia comprises the western part of the crust block, with its marked contrast between the northern section, draining into the Danube mainly by the Morava, and its complex southern section, draining into the Gulf of Salonika by the Vardar. West of the Morava the country is undulating and lowlands fringe the southern bank of the Sava. The Western Morava, a tributary entering the main stream from the west, also helps to define a block of land which affords possibilities of settlement. This was the nucleus of 19th-century Serbia, with Belgrade, at the junction of the Sava and Danube, as its capital. East of the Morava the surface is more elevated, the rocks of the crust block abutting upon those of the Balkan mountains. The complex southern region is Macedonia, with its jumble of people, its long history of turmoil and disorder. The western side of the crust block is much broken, and the relatively inhospitable mountain areas are interrupted by plains, once lake basins, which in turn are linked one to another by river gorges. Such are the Metohija basin and the plains of Kosovo, Tetovo, Skopje and Bitola (Monastir).

Albania.—Albania, with its coastal lowland, formerly malarial, and its mountainous hinterland, is a region of much interest. As already seen, it affords the possibilities of routes to the interior by the Drin, Shkumbin and Vijose valleys and might be supposed a prize worth having. But the inhabitants, who are mostly mountaineers with little interest in the sea or in sea traffic, have preserved a striking measure of individuality since very early times. The natural routeways that traverse their lands have never been of great value to them and their territory is not particularly productive. The strongly manifested individuality of the Albanians long prevented the growth of an indigenous political system and encouraged alien control. Twenty years of experiment in self-government, after liberation from the Turkish yoke, proved insufficient to develop a stable organization, and in 1939 the country came under foreign rule once more, this time Italian. The defeat of Italy in World War II allowed a Soviet-dominated Communist Albanian government to take over.

Greece.—Peninsular Greece comprises three relief elements: (1) the Pindus ranges in the centre and in the west, continuing southward beyond the Gulf of Corinth into the four-fingered Peloponnesus; (2) the western coastal belt, which is more broken than that of Dalmatia, while the off-lying Ionian islands are larger and exhibit less parallelism to the coast; (3) the eastern ranges and plains, which belong in the north (Mt. Olympus, 9,570 ft.) to the old crust block and farther south are offshoots of the Pindus. The continental or truly Balkan portion of Greece comprises the uplands and plains of southern Macedonia and Thrace, which provide an east-west passageway between the Rhodope and the sea. The plains are largely spread around the lower courses of the major rivers—the Axios (Vardar), Strimon (Struma), Nestos (Mesta) and Evros (Maritsa). They were formerly swampy, but many drainage works were executed between World Wars I and II. The ports that serve them—Salonika (Thessalonike), Kavalla and Alexandroupolis (formerly Dedeagatch)—are in no case at the river mouths, which are badly silted.

Turkey.—All that remains of the Ottoman empire that once extended far into central Europe is a triangular area (modern Turkey in Europe) in the rear of Istanbul, extending from the Istranca (Istranja) upland and the Black sea to the Sea of Marmara, the Aegean and the lower Maritsa. The Istranca upland, which rises to 3,400 ft., is essentially an eastward continuation of the Rhodope; between it and the Sea of Marmara on the one hand and the lower Maritsa river on the other is an undulating lowland, steppelike and of no great productivity. Edirne (Adrianople), on the Maritsa after it breaks through the narrow neck connecting the Rhodope and the Istranca, was the natural centre of that eastern part of Thrace, but its relative importance has been lessened by the proximity of the Greek and Bulgarian frontiers.

Bulgaria.—Bulgaria has as its northern frontier the Danube, except where the river takes its great bend to the north; there the frontier leaves it and runs slightly south of east to the Black sea, much of the steppelike Dobruja (*q.v.*) being included in Rumania. Southward Bulgaria extends to the Rhodope crest, and is thus nearly bisected by the Balkan mountains. Soña, the capital, lies in a small basin between the Balkan mountains and a northwesterly prolongation of the Rhodope, the basin being drained by the Iskur river, which breaks through the Balkans to enter the Danube. South of the range, and separated from it by a longitudinal depression, lies a parallel upland, the Sredna Gora ("middle forest"). The intervening depression (known, from its principal product, as the "Valley of Roses") is watered by the Tundzha (Tunja) river, which seems to be making for the Black sea near the port of Burgas, but turns instead sharply southward, breaks through the western end of the Istranca and joins the Maritsa at Edirne.

The upper Maritsa, on which stands Plovdiv (Philippopolis), flows through the wider depression which has been called the Rumelian plain. These two fertile lowlands, with their bounding uplands, form Eastern Rumelia, which was not united politically to north Bulgaria until 1885. Geographically the important point is that this region, with southern Macedonia, formed the granary of Turkey in Europe, as it did of the earlier Eastern empire. The Maritsa depression shows certain analogies to the valley of Andalusia in Spain, both in its position between fold mountains and a crust block and in its value to an invader.

3. Routes and Lines of Communication.—Greece within its peninsula, Serbia in the Morava region, Bulgaria astride the Balkan mountains all became independent states while Turkey still held Thrace, Macedonia, Albania and, at least nominally, a large part of the northwest. That the progressive contraction of Turkish territory led to such bitter and prolonged conflict was largely the result of the nature of the routes within the continental section of the peninsula, and particularly of the difficult access of both Bulgaria and Serbia to open water. Thus the natural route lines demand careful consideration. But the routeways which were important in the historic or even the recent past are not necessarily those of most value, for the political subdivision of the peninsula at mid-20th century and in particular the interposition of "iron curtain" frontiers across the routeways materially lessen their significance.

On the northern, southern and eastern margins of the peninsula respectively are situated the three nodal points of Belgrade,

Salonika and Istanbul, all owing their importance to the land and water routes which converge upon them and all linked together by rail. That all are marginal and that, with the partial exception of Sofia, no focal point of similar importance exists within are highly significant facts.

Belgrade is situated at the junction of four great routes: from the north and the east, the Danube valley; from the south, the Vardar-Morava corridor; from the west, the Sava valley. The Danube is continuously navigable, despite the partial interruption of the Iron Gate, downstream to the Black sea as well as upstream. The Sava, though not a first-class waterway, can be used by steamers as far as the Kupa confluence at Sisak. Apart from the waterways, no less than seven railway routes converge on the city; the most important are the Orient Express routes from western and central Europe to the Aegean and the Bosporus—from France and Italy via Zagreb and the Sava valley, from Belgium and Germany via Budapest and the Danube plain; to Athens via the Morava and Vardar valleys, to Istanbul via the Morava valley and Sofia and to Bucharest via Vrsac. The last-named route lost its international significance after Rumania became a Soviet satellite. An important narrow-gauge railway leads southward across the mountains to the Adriatic coast at Dubrovnik.

Salonika is the only good port on the northern coast of the Aegean and is the best exit to open water for much of the interior. Three major land routes and some minor ones converge upon it. The first group consists of the meridional furrow indicated by the direction of the Morava and Vardar rivers, the route from Istanbul by the Thracian lowland and the route to Athens.

The Morava-Vardar furrow is followed by the railway from Belgrade to Salonika by way of Nis and Skopje. Although the headstreams of the two rivers, despite their contrary direction, actually interjoin in wet weather, it must not be assumed that a continuous valley line extends from the Danube to the Gulf of Salonika. The Morava, upstream from Nis, the Vardar, downstream from Skopje, both pass through gorges which offered considerable resistance to through communication in prerailway days. The Morava gorge at Vranje was actually the Serbian frontier at one stage in the development of that state and at the time the railway was built (1887)—a clear indication of the break in the furrow there. The Belgrade-Skopje section of this route was effectively duplicated in 1931 by construction of a railway which leaves the Morava valley at Lapovo and proceeds via Kragujevac, the Ibar valley and the Kosovo Polje.

The second major route entering Salonika runs through the Thracian plains and hills from Istanbul. It dates from 1895 and was essentially strategic in character—it was built at least 12 mi. from the coast to be beyond the then range of naval bombardment, and the two major ports which it served, Salonika and Dedeagatch, were both provided with bypass lines. It has had relatively little international significance, though it remains a possible route from central Europe to Istanbul, avoiding the crossing of the "iron curtain" frontier of Bulgaria. The third route is the southward continuation of the Orient Express route, from Salonika to Athens. This, sometimes called the Greek Longitudinal railway, was completed after the Balkan Wars, in 1916, but its functioning as an international route was delayed by World War I and its aftermath until 1920. It is a difficult route, alternately crossing plains and mountain ranges; its ruling gradient is 1:50.

The westward communications of Salonika are less important. A railway runs to the Florina basin and then turns north, crossing the Yugoslav frontier to Bitola and eventually linking with the Vardar valley line at Titov Veles. The road to the Adriatic, though of no significance at all in modern times, was an important Roman route—the *Via Egnatia*—leading from Bitola, Lake Ohrid (Ochrida) and the Shkumbin valley to Durres (Italian Durazzo, Roman Dyrrachium).

The fact that Salonika is politically Greek and not attached either to Yugoslavia, despite the presence of the Morava-Vardar furrow, or to Bulgaria, despite the relative nearness of Sofia, is explicable rather by the strength of a cultural and historical tradition than by purely physical facts. It is an Aegean port of much importance in the modern world, and to the Greeks the idea that control of Aegean trade is their national right is one that admits of no argument. Part of its basis is of course the geographical fact that their somewhat barren land could not support them unless supplemented by the sea trade for which they have always shown natural aptitude.

Istanbul, with a superb natural position where the waterway from the Black to the Aegean sea crosses the land route from Asia Minor to the Balkan peninsula, is connected to Belgrade by a diagonal furrow, certainly as important as the north-to-south one from Belgrade to Salonika. The route follows the Morava valley to Nis, ascends the Nisava tributary and crosses the Dragoman pass (2,550 ft.) to the basin of Sofia, then by another pass it reaches the Maritsa valley and follows this past Plovdiv and Edirne until the valley of the Ergene enables it to turn east toward Istanbul.

The main international railway routes through the Balkan peninsula were conceived in central Europe about 1869, when Turkey still held a large part of the peninsula. The wars of 1876–78, which materially altered the political map, upset the plans, but the main lines, Vienna-Belgrade-Sofia-Constantinople and Nis-Salonika, which in any case were to be international and not local avenues of transport, were opened in 1888. Subsequently, the political boundaries changed several times, more notably after the Balkan Wars of 1912–13 and after World War I, and the creation of a railway network thus responded to different national and local stimuli at different times. For its size and economic development, Bulgaria has a fair system, with important lines linking Sofia with the Danube and with the Black sea ports of Varna and Burgas, an important though difficult route across the Balkan mountains and many branch lines. After World War II the construction of a bridge across the Danube at Ruse made possible a through route to Moscow. Yugoslavia, assembled like a jigsaw from Serbia, parts of Austria-Hungary and what remained of Turkey, had to create a national railway system from a series of fragments—and largely succeeded in doing so between World Wars I and II. Its main needs were for better communication between the capital and the Adriatic ports of Split and Dubrovnik, for more railways in the south and for bridges across the Danube and Tisa (Tisza) rivers.

4. Climate.—Next to the relief and to the presence of the great highways, the factor which has most deeply influenced human life within the peninsula is the climate, acting mainly through its effect on natural vegetation and cultivated crops. The outstanding peculiarity is that the perfectly typical Mediterranean climate has a very limited extension, as compared with the central European type, which prevails through the greater part of the broad northern section of the peninsula and even extends into the centre of the northern part of the Greek section. While, therefore, five major climatic regions can be recognized, by far the largest of these is that which is in reality only an extension of the greater region lying to the north. In other words, no notable difference in climate separates the peninsula proper from the adjacent Danubian lands.

The Mediterranean climate is of peculiar interest because it is so closely linked to a particular type of culture showing a very delicate adaptation to local conditions. Three essential features differentiate the Mediterranean climate: the winters are warm in relation to latitude and the greater part of the rain falls during that period; the summers are hot and dry and one or more months may be practically rainless; throughout the year the skies are clear and there is abundant sunshine, for the winter rains come in heavy showers of short duration. Before these characteristic features can develop, there must be at once shelter from land influences and full exposure to sea ones. Further, there must be no great elevation above sea level, because with increasing height the winter temperatures become lower, the skies are cloudier and rains occur in summer as well as in winter. These conditions mean that the typical climate is best developed on coastal lowlands, particularly on islands and in narrow peninsulas penetrated by long sea inlets. Two regions within the peninsula show typical Mediterranean climate, but are regarded as distinct from one another because latitude and position bring about differences in the distribution of the rainfall throughout the year without affecting its

marked periodicity.

One of these is made up by the Greek islands, the Peloponnesus, the margins of the northern part of the Greek peninsula and a narrow strip on the coast of Albania. Even within the region so defined, however, elevation above sea level, as in the mountains, or an upland girdle, as in the plain of Thessaly, may produce local modifications. Athens and Corfu (Kerkyra) may be taken as representative places within this region. Athens, on the eastern side of a peninsula, largely sheltered from rain-bearing winds, has a much smaller total rainfall than the island of Corfu, which faces the wet winds of winter; but despite the difference in the amount of rain in the two places, its distribution is closely similar. At both places winter temperatures, as far as monthly averages are concerned, do not fall below 48°–50° F. Summer temperatures range from 78° to 81° F. (July averages), which permits the ripening of subtropical fruits. In Athens, July and August are practically rainless and only about 23% of the total fall occurs in the period April to September, so that more than three-quarters of the total falls in the cooler half of the year. More than one-third falls in the two rainy months of November and December. Corfu has a rainfall four times as great as that of Athens, and although only July can be described as practically rainless, only about 20% of the total rainfall occurs in the period April to September.

A narrow strip along the coast of Dalmatia is regarded as forming a second major region. Dubrovnik may be taken as typical, bearing in mind, however, that it is the most southerly of the important towns of Dalmatia. The winter temperatures there are closely similar to those experienced in the Greek region, much of Dalmatia being remarkable for its mild winter climate. The summers are not quite so hot as in Athens or Corfu, but the real distinguishing feature is the less-marked periodicity of the rainfall. There is now no rainless month, although July continues to be the driest period of the year. More than 30% of the total rainfall occurs during the period April to September, so that summer drought is far less marked. Oranges can be grown without irrigation, and their coexistence with the olive is a distinguishing feature. Not only, however, is the strip with this typical Mediterranean climate very narrow, but changes occur with considerable rapidity toward the north. Except where, as in Split, the form of the coastline gives shelter, the more northerly places are often exposed to the blast of the bora, or cold northerly wind of winter, which is at once a danger to shipping and excludes the more delicate Mediterranean fruit trees. When Trieste is reached on this eastern Adriatic coast, the somewhat cold winters (January average below 40° F.) and the fact that the period April to September shows rather more than half the total amount of rain, with a rainfall maximum in October and a secondary one in June, mark the transition from the Mediterranean climate to the central European one. The northerly Dalmatian towns and the coast of Croatia show stages of the transition. Usually it is easier to exaggerate than to underestimate the significance of this second, or Dalmatian, climatic region.

Southern and eastern Macedonia and western Thrace fall into a third region, characterized by notable modifications of the Mediterranean climate. Salonika may be selected as a representative locality. The winters are cold for the latitude (average January temperature 41° F.) because of the bitterly cold northerly winds which blow down the Vardar valley, and this feature is accentuated as the coast is left. But the summers are hot and the range of temperature between summer and winter is greater than at any of the places already discussed. There is no rainless month, and though July is still the driest period and November and December are the wettest months, there is a much more even distribution of rain throughout the year, the six colder months having very little more rain than the six warmer ones. The colder winters, especially where there is exposure to wind, again limit the distribution of the more delicate Mediterranean fruit trees, and growth even of hardy plants is checked during winter. On the other hand the high summer temperatures and the fairly heavy summer rainfall, with the possibility of irrigation from the mountain snows, make it possible to grow crops demanding both heat and moisture but being indifferent to winter cold because of their annual nature. Among such are cotton, rice, tobacco, maize (corn) and opium poppy.

Passing northward from Salonika into the interior of the peninsula, the change in this fourth region, from this modified Mediterranean to the true central European climate is rapid and is accentuated by the relief. The general features of that climate are the cold winters, the temperatures then showing little relation to latitude, the warm summers and a rainfall well distributed throughout the year, but with a tendency toward an early summer maximum. Skopje, in a latitude somewhat lower than that of Dubrovnik, though in a more elevated position, has mean January temperatures well below the freezing point and fully 18° lower than those of Dubrovnik. This means that there is a definite winter stoppage of agricultural activities, December, January and February all being too cold even for the growth of grass. On the other hand, despite its elevation, the summer temperatures at Skopje are not more than a few degrees lower than those of Dubrovnik. The rainfall is fairly well distributed throughout the year but May, June and October are the rainiest months, the maximum fall coming in May when temperatures are already fairly high (more than 62° F.). Belgrade, considerably farther north but less elevated than Skopje, has a very similar temperature range, but November is already a winter month. June instead of May is the rainiest month and the summer rainy period lasts for the three months of May, June and July, again with a second rainfall maximum in October. Broadly speaking, this climate, with summer heat and summer moisture coinciding, is one well suited to maize among cereals. With local variations caused by height above sea level and by degree of exposure, this type of climate prevails throughout the greater part of the interior of the peninsula, which thus falls into a fourth or central major climatic region. The total rainfall shows a tendency to increase toward the northwest, in Bosnia and northwestern Serbia; it diminishes toward the east.

As a fifth major region, eastern Thrace and the plains of Bulgaria may be included. Over much of this region, especially in Thrace, the total rainfall is very small, giving the landscape a steppelike appearance, and the winters are very cold as a result of exposure to winds from the Russian plain. But the Maritsa valley allows Mediterranean influences to penetrate into southern Bulgaria, where also the Balkans give a certain amount of shelter from the cold winds of winter. Parts of the valley plains of Bulgaria have in consequence much milder winters than northern Macedonia or Serbia, and as there is a tendency for the winters to be wetter than the summers, the climate is sometimes described as modified Mediterranean. The dry, sunny summers favour wheat rather than maize, and the vine is grown in sheltered places. Cotton and rice are grown with irrigation.

To this general division of the whole area into five climatic regions, of which the central one covers by far the greatest area, it may be added that the fact that so much of the surface is elevated introduces numerous modifications in detail. Because of the cold winters of the central area, much of the winter precipitation falls as snow. No mountain within the peninsula rises in the strict sense above the snow line, but the higher peaks of the Rhodope are only snow-free for about one month in the year, and even the Balkan mountains show some snow until July. This long persistence of parts of the winter snow cover has much influence on the flow of streams and thus on the possibility of the use of irrigation water. (M. I. N.; S. H. Br.)

5. Vegetation.—The flora of the Balkan peninsula is one of the richest in Europe and consists of about 6,600 species of vascular plants. The largest families, on the basis of numbers of species, are the Compositae, Leguminosae, Caryophyllaceae, Labiatae, Gramineae and Cruciferae. The genera with most species are *Centaurea* (knapweeds), *Silene* (campions), *Dianthus* (pinks), *Trifolium* (clovers), *Campanula* (bellflowers), *Carex* (sedges), *Verbascum* (mulleins) and *Thymus* (thymes). Floristically, Greece is the richest area. Apart from the actual number of genera and species the flora of the Balkan peninsula is botanically noteworthy for the number of its endemics (plants found nowhere else

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FIVE MAJOR CLIMATIC REGIONS OF THE BALKAN PENINSULA

in the world). The central portion of the Balkan peninsula is geologically old and has been a land surface at least since the advent of the flowering plants. Moreover, the effects of the Ice Age were much less drastic than in northern and central Europe and many plants found a refuge in the peninsula. There are, therefore, a considerable number of old relict types in the flora. Examples are *Ramonda* and *Haberlea* of the Gesneriaceae, related to western Chinese genera, the Serbian spruce (*Picea omorika*), the Balkan yam (*Dioscorea balcanica*) and *Forsythia europaea*, the only native European species of this well-known garden genus. In contrast, there are many species that are most probably of relatively recent origin and may have partly originated by hybridization following the clearance of woody communities by man. Thus many of the pinks, campions, mulleins and thymes are closely related one to another and appear still to be evolving new microspecies.

Given the old Tertiary basis of the flora, the chief migration routes have been from the north and the east. From the north there was an extension of central European species, especially with the oncoming of the glacial period. The Aegean sea is of recent geological origin and plants from Asia Minor undoubtedly contributed to the floristic wealth of the Greek mainland and islands.

The vegetation of the Balkan peninsula clearly demonstrates the controlling influence of climate on plant life. In the northern and central parts the climax communities are deciduous forests up to about 1,500 m. (4,921 ft.), then coniferous forests to about 1,800 m. (5,905 ft.) and above these are high mountain scrub, herb and mat associations. In the southern and western coastal districts evergreen Mediterranean woods and brushwoods naturally dominate, with oak and conifer forests at the higher altitudes. Throughout the peninsula there has been great destruction of the woody vegetation by man. (W. B. T.)

6. Animal Life.—The animals of the Balkan peninsula are a strange entanglement of three major elements. Mediterranean forms dominate along the southern and western borders of Greece, Albania and Yugoslavia; eastern steppe species in the lowlands of the east; and central European forms in the interior. Some of them are widely distributed in Europe, mainly in the mountains, whose peaks still have an Alpine element.

Among Mediterranean mammals are wild goat (bezoar), jackal, porcupine and several kinds of bat. Eastern elements include the ground squirrel (*Citellus*), some forms of hamster, the mole rat (*Spalax*), etc. The mole, lynx and wildcat, marten, wolf and fox, bear, hare, boar, red and roe deer are some of the central European mammals, while the chamois is an example of the Alpine element. The same types of distribution are found among the breeding birds. In the south and in Dalmatia, Mediterranean forms predominate, with the great cuckoo, the melodious warbler (*Hippolais*), etc.; and these also penetrate some of the great river valleys (*e.g.*, the Vardar) far to the north. Central European forms include chaffinch, creeper and some thrushes; among eastern types are the little bustard, the lesser gray shrike and the red-footed falcon; among Alpines are the mountain lark (*Eremophila alpestris*) and the Alpine ptarmigan. The big birds of prey include the golden imperial eagles and several kinds of vulture. The red-legged partridge (*Alectoris*) and the stork are common.

Among reptiles various forms of lizard are known, especially in seaside regions, and a certain number of species of gecko, turtle and snake among which are three kinds of poisonous viper. There are amphibians belonging to the Palearctic fauna, *e.g.*, the true toads, while central European fauna include true frogs, spade-foot toads and salamanders. There are also some Mediterranean forms. The fishes of lakes and rivers include carp, barbel, small salmon, wels or sheatfish (*Silurus*), etc.

The same zoogeographical entanglement is found in the invertebrates. Among harmful plant insects are tussock moths and Moroccan, Italian and migratory locusts. After World War I the San José scale and the Colorado beetle were brought to Europe from America. The Colorado beetle, which did not reach the Balkans until after World War II, spread quickly.

In low-lying land near water, domestic buffaloes are not uncommon. The important meat animal is the pig and the chief milk and meat animals are cattle and sheep. Hens and turkeys are common among domestic birds.

Very special and peculiar faunas, not discussed here, live in the delta of the Danube, in the island of the Aegean sea and in Crete. *See* also the physical geography and economy sections of ALBANIA; BULGARIA; GREECE; YUGOSLAVIA. (AN. LU.)

II. ETHNOLOGY

The ethnology of the Balkan peninsula is more involved than that of either the Italian or the Iberian; first, because this peninsula has a more fragmented geography; second, because it is open to entry from more directions. On the northwest the plains of the middle Danube afford a way to central Europe; on the northeast there is a wide corridor through Moldavia from the steppes of the Ukraine; on the east, an easy passage is possible from Asia Minor across the Bosporus and through Thrace; while the coasts of Greece are accessible to all the eastern Mediterranean basin, and those of Dalmatia, though cut off by mountains from the interior, are easily approached by water from across the Adriatic. People entered the Balkans from all these directions and left vestiges of racial types and customs derived not only from many parts of southern and central Europe but also from wide areas of central Asia and the near east.

The main ethnic divisions of the Balkans are based on linguistic and religious differences rather than on true racial distinctions. Yet it is remarkable that in many cases the cultural group has clearly recognizable physical features which it may have acquired through long isolation and inbreeding. Moreover, despite repeated immigrations into the peninsula from the heart of the continent, certain racial types have persisted there and absorbed the new blood from outside. Thus there is little doubt that the Slav-speaking folk who poured into the Balkans from the 3rd century A.D., and particularly after the 6th century, were predominantly of Nordic race; yet the present day Southern Slavs belong principally to the Dinaric race—tall, dark, and with high and broad head and prominent nose—a type that is probably very ancient there and that is also found farther west in a highland zone extending through northern Italy and southern Germany as far as Austria and Switzerland.

In this section each ethnic group which is distinguished on cultural or political grounds will be considered in turn, and an account given of its historical origins, of the reasons for its separation from its neighbours in the Balkans and of its physical features.

1. The Southern Slavs.—These people, separated by the intru-

sive Magyars from their linguistic kinsfolk to the north, are united by ties of language and political allegiance. They are, however, subdivided by differences of religion, the Croats and Slovenes being Roman Catholics, the Serbs proper and Montenegrins mostly Greek Orthodox. Moreover, among the Dalmatians, Bosnians and Hercegovinians, who are normally classed with the Serbs, there are in addition to the Greek Orthodox Christians considerable Roman Catholic minorities, and in the last two cases also a fair proportion of Muslims.

The Slovenes of Carniola are physically very similar to their Austrian neighbours. They are of low height, with small round heads of Alpine type, and include a good number of fair individuals. Among the Croats to the south, however, there are on the average more tall individuals and more broad heads, dark colouring and prominent noses; and farther south still, among the Serbs, these Dinaric features become even more pronounced. Among the Serbs there is a preponderance of high broad heads, giving a mean cephalic index of about 85; the face tends to be long, the colouring of eyes and hair to be dark and the nose to be high-rooted and straight or convex, with a downward-turning tip.

The Bosnians and Hercegovinians are, like the Serbs, on the average tall and broad-headed; but there is an interesting physical difference between the Roman Catholic and Muslim communities, doubtless the result of protracted inbreeding within each group. The former includes a larger proportion of tall, fair and very broad-headed individuals.

Along the Dalmatian coast, the extreme broad-headedness of the population of the mountainous interior is not found, and among the inhabitants are more long-headed individuals of the Mediterranean race. Proceeding southeastward along the coast, from Istria to the borders of Albania, the population becomes on the average progressively taller and more dark in complexion.

In physique and culture, the Montenegrins, who live in rugged and isolated limestone mountains, are the most distinctive of the Southern Slavs. Although they speak a Slav Serbian language, they resemble the Albanians in their loyalty to their exogamous clans. They are probably the tallest people in Europe, the men averaging 178 cm. (about 5 ft. 10 in.) in height, and at the same time they are thickset and very heavily built. Their heads tend to be broad and high-backed and their noses large and beaked. In these respects they resemble the Dinaric type which seems to be very old-established in the western Balkans. But they differ from the standard Dinaric type in having broad rather than high faces, a high proportion of light eyes and, in particular, a preponderance of red hair, red beards and freckling.

2. Albanians.—This group numbers more than 2,000,000, of whom more than half lives outside the boundaries of Albania, for the most part in Yugoslavia. They are distinguished from the Slavs by language in the first place, the Albanian tongue being a mixture of elements from Illyrian, Thracian, Latin, Slavonic and Turkic. They are also separated from their neighbours by religion and general culture, and there is no doubt that they represent the survivors of the native inhabitants of the Balkans in classical times, the Thracians, Macedonians and Illyrians, who were driven back into isolation by the invading Slavs. Later, the Albanians became even more alien to the Slavs by adopting Islam from their Turkish conquerors in the late 15th century. At mid-20th century nearly all the Albanians in Yugoslavia and 70% of those in Albania were Muslim.

There are two distinct groups of Albanians, each with its own dialect, costume and customs. These are the Tosks in the south and the Ghegs in the north and on the plain of Kosovo. The Ghegs comprise ten tribes, each of which is subdivided into political groups known as *bairaks*, and on a quite separate system into exogamous patrilineal clans or *fis*. This *fis* system often leads to inbreeding within small areas, through the institution of cross-cousin marriage, with the result that the physique of the Ghegs varies from district to district. In the north, near the borders of Montenegro, a tall thickset type, like the characteristic Montenegrin, is found, while to the east the population includes more individuals of the Atlanto-Mediterranean strain, tall but not very heavily built, with long head, dark hair and dark brown eyes. But the most characteristic physical type among the Ghegs, which there as elsewhere is probably by origin a hybrid, is the Dinaric, commonest in the tribe of Dibra. This type is of medium height, with a characteristically narrow and convex nose, light brown eyes and dark brown hair, and above all with a very broad and flat-backed head. This extreme occipital flattening may be partly artificial, resulting from the use of a hard cradle, but it appears that this is not the whole explanation and that it is also an inherited racial character.

The Tosks, like the Ghegs, are extremely broad-headed; in fact, the mean cephalic index measured in a Tosk district of southwestern Albania, 90.8, is the highest recorded in Europe. But the broad-headed character of the Tosks is of a different type from that of the Ghegs. The head is globular in shape, with high and bulbous forehead, and the back of the head is not flattened. In addition, the nose lacks the high bridge and depression of the tip which are often observed among the Ghegs. The Tosks, in other words, belong to the Alpine variety of the broad-headed people of Europe rather than to the more specialized Dinaric variety, and in this respect resemble closely the inhabitants of southern and central France. They are very given to emigration and have set up colonies in America.

3. Greeks.—These people also have long been accustomed to emigrate and although many exiled groups have returned since the beginning of the 20th century, particularly from Asia Minor, important sections of the Greek population are still to be found outside the political boundaries of Greece, not least in America. Furthermore, even inside Greece the population is by no means homogeneous. Whole districts, even as far south as Attica, still speak Albanian, and wide pastures on the Pindus mountains are still the preserve of Rumanian shepherds. The common loyalty of the modern Greeks, therefore, is linguistic and religious rather than territorial.

Among the Greek-speaking peoples can be traced a variety of communities of different physical types. These physical distinctions are doubtless the result of segregation and inbreeding within the various small compartments into which the territory of Greece is naturally divided, and it is likely that these distinctions were equally noticeable in classical times. Differences of head form from region to region afford a good illustration. In the high western slopes of the Pindus mountains or the district of Epirus, as well as in Macedonia, the Greek population, like their Tosk neighbours in Albania, is extremely broad-headed, with mean cephalic indexes of about 85–88. In the Peloponnesus, Attica and the Ionian Islands on the other hand, the populations have a mean cephalic index of 81 or 82, while in Thessaly the inhabitants are comparatively long-headed, with a mean cephalic index of 77. There is also a regional variation in the colouring of the complexion, the Macedonian Greeks, for example, being noticeably fairer than those of the Ionian Islands and the Peloponnesus.

Briefly, three main types can be traced within the Greek population. The first, with heavy and dark beard, strong brow ridges and eyebrows which run together, clearly belongs to the Alpine race. The second is taller, with a fairly long head, straight nose and dark brown hair and eyes, and represents a tall variety (Atlanto-Mediterranean) of the Mediterranean race. Third, much less common than the others, is a Dinaric element, with very dark hair, flat back to the head and narrow facial features. Very occasionally also a blond Nordic strain can be observed.

The Greek population, therefore, is of mixed ancestry. Yet to judge from measurements taken in a Greek community in Boston, Mass., there are certain special physical features which have become characteristic of these people and serve to distinguish them from their neighbours in the Balkans. Such are the broad jaws, high nasal bridge, wide cheeks and broad nose with a tendency to turn up rather than down at the tip.

4. Bulgarians.—These people were members of a heathen Ugrian tribe who entered the Balkans from eastern Russia in the wake of the Slavs and soon afterward adopted Greek Orthodox Christianity and abandoned their language in favour of the Slavic tongue of their predecessors. Later, the country fell under Turkish rule, and Tatar and Circassian settlers entered in considerable

numbers. Despite these repeated incursions, however, the bulk of the population of modern Bulgaria still belongs to the very ancient tall variety of the Mediterranean stock, usually known as the Atlanto-Mediterranean type, which inhabited the territory in Neolithic times. The chief characteristics of this type are dark colouring, moderate to tall stature, narrow face and, above all, a long head. The Bulgarians, on the average, are among the longest-headed folk of the Balkans, and only in the west, in the region of Macedonia where they come into contact with the Albanians, is there any significant broad-headed element in the population. The second chief racial constituent in the Bulgarian population is the Neo-Danubian, a moderately broad-headed race, generally of light complexion and with a characteristic concave snub-tipped nose. A slight flattening of the face suggests Mongoloid admixture, though the basic element of this type is undoubtedly Nordic. It is found also in central Finland and in the black earth region of Russia, and was probably introduced into Bulgaria during the Slavic and Ugrian invasions.

5. Rumanians.—These people, who are locally called Vlachs, are the most scattered of all the people of the Balkans. They have a common language, of Latin derivation, and a common pastoral nomadic economy, but their racial type varies widely from region to region. In Walachia, for example, the main element in the population resembles that of Bulgaria to the south, being of medium height, with dark hair and eyes, narrow forehead and nose and head of medium breadth. These features indicate a tall variety of the Mediterranean race. Farther north in Moldavia, where the Rumanian plain abuts on the black earth region, there is a higher proportion of individuals of the Neo-Danubian race, fairer and with flatter and broader faces and more snub noses. To the west, however, just over the crest of the Carpathians in Bukovina, the Vlach population belongs to the Dinaric race. Their heads are appreciably broader and larger than those of the plainsfolk, their stature taller, their faces longer and broader, their noses larger and more prominent and the backs of their heads much flatter. The Vlachs of Macedonia and Istria appear also to belong substantially to the same tall, dark, prominent-nosed and broad-headed Dinaric race.

In short, the Vlachs have no racial uniformity but represent the descendants of the aborigines who, during the 150 years of Roman rule in the province of Dacia, in the 2nd and 3rd centuries A.D., adopted something of the language and civilization of their rulers. After the withdrawal of Roman rule they were scattered by the various incursions of Goths, Slavs, Bulgars and Turkic peoples, but survived in isolated mountain districts in many parts of the Balkans, especially in Macedonia, northern Greece and southern Albania, where they took to a pastoral, seminomadic economy. Their physical features no doubt varied from one district to another at the time when they first came under Roman influence, and have since become even more localized as a result of intermixture of the various groups with their immediate neighbours.

The Slavic word *Vlach* means "foreigner," and it appears to be related to the terms Welsh and Walloon in western Europe.

Not only are the Vlachs or Rumanians proper, as defined by language and culture, widely scattered through the Balkans outside Rumania, but the inhabitants of Rumania itself are very mixed, and in the district of Dobruja, for example (a small plateau enclosed between the Black sea and the lower reaches of the Danube), E. Pittard remarked, besides the Vlachs, representatives of the following peoples: Bulgars, Ottoman Turks, Gaguz, Armenians, Kurds, Circassians, gypsies and Jews. These last two groups form important minorities throughout the Balkans, and since they are particularly concentrated in Rumania, it will be convenient to consider them at this point.

6. Balkan Jews.—The Jewish communities in the Balkans are predominantly made up of Spaniols or exiled Sephardim, that is, the descendants of those driven out of Spain in the persecution of 1492. They still speak a form of Spanish known as Ladino, and preserve a dress and various customs which recall their origins in Spain. Their number in the Balkans and in Turkey has been estimated at 300,000. Physically they must be classed, there as elsewhere in southern Europe and the near east, as a variety of the small Mediterranean race. The chief type is slender and delicately built and is of moderate stature with fairly long head, long narrow face, straight or convex nose and dark colouring. A second type has a shorter and broader face, well-developed chin, thicker lips, short and straight nose, heavy eyebrows and deep-set eyes, and is altogether of coarser and more muscular build. From one district to another the physique of the Jewish communities naturally varies slightly as a result of intermarriage; in Bukovina, for example, a district of broad-headed folk, the mean cephalic index of the Jewish population is as high as 84. But generally the Jewish communities have preserved their racial characters, which are the outcome of a stable combination of several varieties of the brunette Mediterranean race. Although darker than most of the people of central Europe, they are fairer than their neighbours in Rumania. Among the Jews of Salonika, one-sixth are of blond colouring, although in other physical features they are no different from their coreligionists. Probably this blondness is an occasional tendency inherent in the Jewish stock.

7. Balkan Gypsies.—The gypsies (*q.v.*) of Europe are especially concentrated in the Balkans, and of the 1,000,000 or so in the world, more than half are estimated to live in Rumania and Hungary, and at least 150,000 in Bulgaria, Macedonia and Yugoslavia. A great many have now settled and have interbred to a varying extent with their neighbours. But wherever they retain their nomadic habit, the original racial type can still be traced. This type is of short stature, with long and low-vaulted head, small and fairly long face, narrow nose, straight black hair and very dark eyes and complexion. The Balkan gypsies are characteristic specimens of the dark-complexioned small Mediterranean racial type, which is at home in India, and this identification is confirmed by their language and traditions. Their speech is basically Indian, a derivative of Sanskrit, though it includes words borrowed from the languages of numerous countries, such as Iran, Armenia and Greece, across which they traveled on their way through the near east or during their wanderings in Europe. They appear to be the descendants of pariah tribes of northern India who moved to the west early in the present millennium and entered Europe about A.D. 1300. In the Balkan countries some of them were made landed serfs, while others were allowed to wander and to practise their traditional trades as tinkers, wood-carvers, gold panners, minstrels and sorceresses.

8. Turks.—The communities of Turkish-speaking Muslims in the Balkans, relics of the long period of Ottoman control, were being rapidly depleted at mid-20th century because of migration back to Turkey. There has been a particularly large exodus from Bulgaria, whence more than 50,000 departed in 1950 alone. Away from the small area of European Turkey, it is unlikely that many of these Balkan Turks are racially akin to the Ottoman conquerors. This is shown clearly by the range of physical types that is found among these European Turks. For example, those of Bosnia-Hercegovina belong to the local tall and very high- and broad-headed Dinaric race; while a series of measures taken in Sliven (Slivno) in central Rumelia showed, on the contrary, that the Turks there were long-headed and in this and other respects very akin to their Bulgarian neighbours. Manifestly, very many of the Balkan Turks are indigenous folk whose ancestors, from compulsion or self-interest, adopted the Turkish language and religion.

An exception must probably be made for the Yuruks or semi-nomadic shepherds, such as inhabit the southern slopes of Mt. Ograzden in Yugoslavia. There as in Turkey, these people preserve in a very pure form the language, economy and customs, and probably also the physical type, of the old Turks who emigrated from central Asia.

The Bektashi communities of Turks, however, are much more clearly of local origin, as is suggested by their doctrines and institutions, many of which are compromises with the practices of Greek Orthodox Christians. Such are their belief in the Trinity and their celebration of Christmas Eve. Since the dissolution of the dervish orders in Turkey in 1925, the Bektashi communities of the Balkans, in particular of Albania and parts of Yugoslavia like the district of Strumica, have become the main survivors of this enigmatic sect. A colony was also established in New York

by immigrants. The true Bektashis are the members of an order of Muslim dervishes, who follow the rule of Haji Bektash, their 14th-century founder; but the villages which take instruction from these dervishes also adopted this name. The chief ways in which the Bektashis differ from orthodox Muslims—although they arrogate to themselves the title of Sunni—are in their devotion to Ali and to his children Hasan and Husain, in memory of whose martyrdom they fast for the first 12 days in the month of Moharram; in the privileges they accord to their women, who are even allowed to become dervishes; in their religious proceedings; in their custom of worshiping in tekkes (monasteries) and turbehs (mausoleums) rather than in mosques; and in their open compromises with the feasts and customs of their Christian neighbours.

9. Ethnic Survivals in the Balkans.—The Bektashi villages provide an example of the very mixed cultural traditions of the Balkans. In this peninsula people with varied customs and beliefs have come together, and though they often preserved their old racial and political differences and rivalries, they have at the same time interchanged ideas, beliefs, crafts and artistic symbols. These countries may indeed be regarded as a somewhat disorderly ethnological museum, in which traces of numerous people are haphazardly preserved. Mary Durham's studies of Balkan jewelry and tattoo patterns, for example, demonstrate how there are often retained side by side designs from Muslim and Christian sources, and even from ancient Illyrian and Mithraic sun cults. *See* also ALBANIA; BULGARIA; GREECE; RUMANIA; YUGOSLAVIA.

(WM. C. B.)

III. POPULATION

Five major ethnic groups or races are to be found in the Balkan peninsula. These are the Albanians, the Greeks, the Bulgarians, the Southern Slavs (Serbs, Croats, Slovenes, Montenegrins) and the Turks. All of them, with the possible exception of the Southern Slavs, have at one time been spread over wider areas than those they now occupy. This is particularly true of the Turks, who for several centuries were primarily the governing occupiers of most of the peninsula. They also fairly effectively colonized certain parts of it, particularly in Thrace, Macedonia and in northeastern Bulgaria, and were finally ousted after World War II. This is also true of the Bulgarians, who at one time extended throughout much of Macedonia and Thrace. World Wars I and II, and the resultant frontier adjustments and population exchanges, have given the political map a much closer resemblance to the map of nationalities than it has ever had before. Except on the northwestern fringes of the peninsula, where some Rumanians, Hungarians, Austrians and Italians are included in Yugoslavia, the Albanians of the Kosovo-Metohija Autonomous Region are probably the only important minority left inside the territory of another country. The most mixed region is undoubtedly Macedonia —whose variety of people has given rise to the culinary term "macédoine" for a mixture of vegetables. There, ethnic differences have been confused by differences of religion, and adherents of the Greek Orthodox Church were long regarded as Greek, whatever their ethnic heritage; similarly, all Muslims were formerly regarded as Turks, whether they were of Bulgarian, Albanian or Southern Slav stock.

On the basis of censuses or projections therefrom, the population of the Balkan peninsula in 1960–61 was about 36,300,000, distributed as follows: Yugoslavia 18,500,000, Greece 8,390,000, Bulgaria 7,800,000, Albania 1,600,000. Substantial reductions in both birth rates and death rates have taken place during the 20th century, as the following table shows:

Country	Birth rate %			Death rate %		
	1906–10	1921–25	1962–63	1906–10	1921–25	1962–63
Yugoslavia	39	35	21	25	20	9
Bulgaria	42	39	16	24	21	8
Greece	—	21	17	—	15	8
Albania	—	—	39	—	—	11

These figures are largely the result of increased medical services, but are probably also in part due to the decreasing isolation of rural communities and to the rising standards of living, particularly among the ever-increasing proportion of the population which is urban-dwelling. In Bulgaria, for example, the proportion of the total population living in towns rose from 26% to 35% in the decade following World War II.

Population density within the four countries of the peninsula is relatively low, compared with most of central and western Europe: Yugoslavia 187 persons per square mile, Bulgaria 182, Greece 166, Albania 144 (compare Switzerland 341, Belgium 775). This is, of course, largely the result of the still essentially rural character of the population, the relative scarcity of really large towns and the complete absence of industrial conurbations. But such figures conceal wide differences within the countries, from region to region, which result from differences in altitude, relief and agricultural productivity. In most of the mountainous areas, but particularly in the Greek Pindus ranges, in northern Albania and in Montenegro, densities of much less than 100 per square mile prevail, while the greatest densities are reached in the plains of northern Yugoslavia (particularly the former Serbian area) and in the plains and basins of central Bulgaria. *See* also ALBANIA; BULGARIA; GREECE; YUGOSLAVIA. (S. H. BR.)

IV. HISTORY

The Balkans emerge from prehistory in classical times, with the history of Greece (*q.v.*) and with the Greek and Roman contacts with the various states and peoples of the central and northern regions of the peninsula. The northern hinterland of the Aegean was the kingdom of Macedonia (*q.v.*), with Thrace (*q.v.*) on its eastern frontier. For the Adriatic hinterland in ancient times *see* EPIRUS; ILLYRIA; for the inland area south of the Danube *see* MOESIA; also VLACHS. For the peripheral countries of the north *see* DACIA; PANNONIA. All these regions were eventually incorporated into the Roman empire.

The successive partitions of the Roman world ended with the Balkan provinces all in the Eastern half (*see* BYZANTINE EMPIRE). The period of the great migrations (*see* EUROPE: *History*) opened for the Balkans with the invasion of the Goths (*q.v.*) in the 4th century A.D. This, however, left no such permanent mark on the racial configuration of the peninsula as did the arrival of the Slavs (*q.v.*), who began to penetrate the peninsula at the end of the 5th century and continued to spread over it for the following 100 years. The Avars (*q.v.*), though their main seat of power was north of the middle Danube, also made incursions southward in the 6th century. Finally, in the 7th century, the Bulgars arrived from the Volga region. For the great new empires that emerged in the early middle ages from settlement of the invading people, *see* BULGARIA; SERBIA. For lesser states *see* BOSNIA-HERCEGOVINA; CROATIA. For the states formed by the remnants of indigenous people *see* ALBANIA; and for Walachia, RUMANIA.

The 11th century saw further invasions of the Balkans by people from the Volga region, namely the Pechenegs and the Kumans (*qq.v.*). At the beginning of the 13th century, however, Greek Byzantine rule over the south of the peninsula was replaced, except in Epirus, by Latin, through the diversion of the 4th crusade to Constantinople (*see* GREECE: *History;* also CRUSADES). For the Venetian occupation of the Adriatic coast *see* DALMATIA.

The Ottoman Turks (*see* TURKEY: *History*) began their onslaught on the Balkans in the 14th century and by the end of the 15th had occupied the whole peninsula with the exception of some coastal areas on the Adriatic and Montenegro (*q.v.*). Turkish power, however, began to decline in the 18th century, and schemes for the partition of its Balkan dominions between local states or between the great powers of Europe became the subject matter of the Eastern question (*q.v.*). Greece was recognized as independent in 1829 (*see* GREEK INDEPENDENCE, WAR OF), and the autonomy of Serbia was confirmed in 1830. Russian designs on the Balkans (*see* RUSSO-TURKISH WARS) culminated in the treaty of San Stefano in 1878, which created a greater Bulgaria extending from the Danube to the Aegean and from the Black sea to Albania, but at the congress of Berlin (*q.v.*) in the same year the other European powers, alarmed at this ex-

tension of Russian influence, redrew the map: Bulgaria was limited to the country between the Danube and the Balkan mountains; Serbia received Nis, Pirot and Vranje; the Dobruja (*q.v.*) was ceded to Rumania; and Austria-Hungary was accorded the right to occupy Bosnia-Hercegovina provisionally. Serbia and Rumania at the same time became independent principalities, while the independent status of Montenegro was recognized.

In 1881 Greece secured Thessaly and Arta (*qq.v.*) from Turkey. The Bulgarian occupation of Eastern Rumelia (recognized in 1878 as an autonomous Turkish province) in 1885 was followed by the Serbo-Bulgarian War (*q.v.*). The Greco-Turkish War of 1897 led to a rectification of the Thessalian frontier in Turkey's favour. In 1908 Austria-Hungary formally annexed Bosnia-Hercegovina.

In 1912–13 the Balkan league of Greece, Serbia, Bulgaria and Montenegro attacked and defeated Turkey, this war being followed by a second between Bulgaria and its former allies (*see* BALKAN WARS). Greece received southern Macedonia with Salonika; Rumania the southern Dobruja; Bulgaria the Aegean coastline from Xanthi (Eskije) to Alexandroupolis (Dedeagatch); Serbia northern Macedonia. Serbia and Montenegro partitioned the sanjak of Novi Pazar, and an independent Albania was created.

After World War I (*q.v.*) Bulgaria lost the coast of Thrace to Greece and a strip along its southeast frontier to Serbia (*see* NEUILLY, TREATY OF); Turkey was confined to the province of Eastern Thrace with Edirne (*see* SÈVRES, TREATY OF; LAUSANNE, CONFERENCES OF). A Serb-Croat-Slovene kingdom was constituted, comprising Serbia, Montenegro, Bosnia-Hercegovina, Croatia and other Southern Slav regions taken from Austria-Hungary, together with northern Macedonia (*see* YUGOSLAVIA). Italy received the extreme northwest coast of the Balkan peninsula up to and including Rijeka and, in addition, certain of the Adriatic islands. Population exchanges on a large scale were carried out in order to stabilize the new frontiers. Efforts, encouraged by Great Britain and France, to preserve the independence and identity of the Balkan states were typified in the Balkan entente (*q.v.*) of 1934.

After World War II the Allied peace treaty with Italy, Rumania and Bulgaria concluded in Paris on Feb. 10, 1947, introduced the following changes in the international frontiers: (1) the greater part of Venezia Giulia, as well as the enclave of Zadar and all the Adriatic islands were ceded by Italy to Yugoslavia; (2) a Free Territory of Trieste (*q.v.*), demilitarized and neutral, was formed; and (3) the transfer of southern Dobruja to Bulgaria, to which Rumania had agreed in 1940, was confirmed. At the same time British and French influence gave way largely to Russian in the formation of "people's republics" in Albania, Bulgaria, Rumania and Yugoslavia. Greece, however, after a civil war, became a member of the North Atlantic Treaty organization; and Yugoslavia, though Communist, broke with the Soviet bloc. In 1954 Trieste was partitioned between Italy and Yugoslavia. For later history *see* the articles on the independent Balkan states of the second half of the 20th century: ALBANIA; BULGARIA; GREECE; RUMANIA; YUGOSLAVIA; *see* also Index references under "Balkan Peninsula" in the Index volume.

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BALKAN WARS. The Balkan Wars of 1912–13 deprived the Ottoman empire of almost all its territory in Europe, with the exception of part of Thrace and the city of Edirne (Adrianople). The Balkan allies, Serbia, Greece and Bulgaria, quarreled over the partitioning of their conquests, with the result that war broke out in 1913 between Bulgaria on the one hand and Serbia and Greece, joined by Rumania, on the other.

The Balkan Wars had their origin in the discontent produced in Serbia, Bulgaria and Greece by the disorders in Macedonia. The Young Turks' revolution of 1908 (*see* TURKEY: *History*) brought into power in Istanbul a ministry determined on reform but insisting on the principle of centralized control. There were, therefore, no concessions to the Christian nationalities of Macedonia, which consisted not only of Macedonians but also of Serbs, Bulgars, Greeks and Vlachs. The Albanians, moreover, who had been the mainstay of Turkish rule in the Balkans, were likewise discontented with the Young Turk's centralist policy. The Internal Macedonian Revolutionary organization (I.M.R.O.; V.M.R.O. in Macedonia), founded in 1893, organized bands to resist the Turkish administration. Clashes not only exacerbated feeling within Macedonia but also roused public opinion within Bulgaria itself in favour of intervention. The I.M.R.O. became a powerful factor in Bulgarian politics. A similar development occurred in Serbia, where the patriotic society Narodna Odbrana ("National Defense"), invigorated by the infiltration of the "Union or Death" group (founded in May 1911 and better known as the Black Hand), was active not only within the Serbian administration but also in organizing Serbian resistance in Macedonia. The activity of the Bulgars in Macedonia had led, in Sept. 1903, to the formation of an armed band in defense of Greek interests, but the Greek government was equally determined to obtain extension of its territory in the Aegean islands and to secure union with Crete (*q.v.*). At first, Greeks, Serbs and Bulgars frequently acted in opposition to one another, but the events of 1911 brought them to realize that the main enemy was the Turk and that they could in the first instance achieve freedom only by a common understanding.

International circumstances were of considerable importance. Austria-Hungary had, in Oct. 1908, annexed Bosnia-Hercegovina, territory legally part of the Ottoman empire but under Austro-Hungarian occupation and administration after 1878 (*see* BERLIN, CONGRESS OF); the Austro-Hungarian government, moreover, had a treaty right to occupy the sanjak of Novi Pazar, which separated Montenegro from Serbia. Deeply resentful of Austria-Hungary's action, which excluded an eventual union of the inhabitants of Bosnia-Hercegovina with their fellow Serbs, the Serbian government nevertheless realized that it could not challenge one of the great powers and therefore turned its attention to Macedonia, where a weak power like Turkey could more easily be attacked, if an alliance could be achieved with Bulgaria. The Agadir crisis of 1911, moreover, revealed that the two great power groupings, the triple alliance and the triple entente, were evenly balanced, so that the small powers might exercise some measure of individual initiative.

The Balkan League, 1911–12.—An opportunity for an effective alliance was presented when Italy declared war on Turkey on Sept. 29, 1911 (*see* ITALO-TURKISH WAR). While the Turks were preoccupied in Tripolitania, the Balkan states could attack them in Macedonia and Thrace. With Russian encouragement Serbia and Bulgaria began to draw closer together in the autumn of 1911. Ivan E. Geshov, the prime minister of the pro-Russian government that had come to power as a result of the Bulgarian elections of June 1911, met the Serbian foreign minister Milovan Milovanovic, in great secrecy on Oct. 11, 1911, and discussed the principles of an alliance. After protracted negotiations a treaty of alliance, ostensibly against Austria but actually against Turkey, was concluded on March 13, 1912. The Russian foreign minister, S. D. Sazonov, intended this alliance to be a counterweight to Austro-Hungarian influence in the Balkans, for which reason in the secret annex it was stated that Russia should have the power to veto any action which the two powers proposed. The second article of the secret annex, however, provided for the partitioning

of Macedonia as the result of an offensive war. Serbia and Bulgaria were to divide Macedonia on the principle that Serbia should make no claim southeast of a line from Mt. Golema to Lake Ohrid, while between this line and the Sar mountains the Russian emperor was to act as an arbiter between the two parties.

This agreement was supplemented by an alliance between Greece and Bulgaria, concluded on May 29, 1912. Eleutherios Venizelos, who had become prime minister of Greece on Oct. 18, 1910, was a Cretan and saw that the liberation of Crete from Turkish suzerainty could best be achieved by military action in Macedonia in concert with Bulgaria and Serbia; it was, moreover, imperative that Greece should be a party to any partitioning of Macedonia in view of the extensive nature of Bulgarian claims.

The fourth state in the Balkan peninsula, Montenegro, concluded an alliance with Bulgaria on Oct. 6, 1912, and one with Serbia on Oct. 24. Secure from danger of early defeat in his mountain stronghold, King Nicholas I undertook to anticipate the three other powers' declaration of war on Turkey in order to provide a diversion.

The First Balkan War, 1912–13.—The internal situation of Turkey was favourable for the action of the allies. Discontent had mounted against the administration of Said Halim Pasha (appointed on Oct. 4, 1911), with the result that the government dissolved the chamber of deputies on Jan. 18, 1912. Fresh elections gave an overwhelming majority to the Young Turks, but their methods caused further discontent, especially in the army. On July 23 a new ministry was formed under Ahmed Mukhtar Pasha, with only partial representation of the Young Turks. To achieve some political stability the war minister, Nazim Pasha, undertook a purge of unreliable elements in the army, which seriously reduced its efficiency.

The great powers realized, in the summer of 1912, that a crisis was imminent in the Balkans. The French prime minister Raymond Poincaré discovered the offensive nature of the Serbo-Bulgarian treaty during his visit to St. Petersburg (Aug. 9–16). Poincaré saw that hostilities in the Balkans might lead to a general European war but was equally conscious that opposition to Russian policy might shake the Franco-Russian alliance. On Aug. 13 the Austro-Hungarian foreign minister, Leopold Berchtold, issued a circular to the powers, urging that they should concert to induce Turkey to adopt a policy of decentralization for the Christian nationalities of Macedonia—precisely that policy which was unacceptable to the Young Turks. On Sept. 22 Poincaré proposed to Great Britain and Russia that they and France should agree on a common policy and transmit their suggestions to the powers of the triple alliance, but Sazonov, then on a tour of western Europe, and Sir Edward Grey, the British foreign secretary, objected to this on the grounds that it would divide Europe into two camps and would prevent a real concert of the powers. On Sept. 28, therefore, Poincaré approached Germany for an understanding, to which Alfred von Kiderlen-Wächter, the foreign minister, agreed, provided that Austria-Hungary was associated with any steps the powers might take. The slowness of the powers' action and the recommendation which they were to make barely met the needs of the situation. They proposed that the *status quo* should be maintained and that Turkey should institute reforms, but this in effect meant that the Balkan powers were given a guarantee against loss of territory if they lost the war, while sentiment would be strongly against the restoration of Christian territory to Turkey if they won. Any reforms undertaken in European Turkey, moreover, could be carried out only on the basis of decentralization, which the Young Turks would not concede. On Sept. 21, 1912, Stoyan Danev, the Bulgarian foreign minister, had met Nikola Pasic, the Serbian prime minister, and the decision was taken to go to war.

The action of the powers was thus too late. On Oct. 8, 1912, Austria-Hungary and Russia made representations in the Balkan capitals and on Oct. 10 all the powers made a *démarche* in Istanbul, but on Oct. 8 Montenegro declared war on Turkey and opened hostilities. On Oct. 17 Turkey, to forestall declarations of war by Serbia and Bulgaria, broke off diplomatic relations; on Oct. 18 Greece declared war against Turkey and the three powers opened hostilities.

The Turks launched an offensive against the Bulgars with troops disorganized by Nazim Pasha's purge. Heavily defeated at Kirk-Kilise (Lozengrad or Kirklareli) on Oct. 22–23 and again at Lule Burgas (Lüleburgaz) on 29–31, they were thrown back to the Chatalja (Catalca) lines. There they proved much stouter opponents when the Bulgars attacked them in their defensive positions on Nov. 17–18. The Bulgars failed to penetrate the Turkish lines and were repulsed with heavy casualties. In the meantime the Serbian army achieved a great victory at Kumanovo on Oct. 23–24, which enabled it to penetrate deep into Macedonia and to capture Monastir (Bitola) on Nov. 18. The Montenegrin militia advanced and laid siege to Scutari (Shkoder). An assembly of Albanian notables at Valona (Vlone) declared the independence of Albania on Nov. 28, but on that very day the Serbs occupied Durazzo (Durres). On Nov. 8 the Greeks entered Salonika, arriving only a few hours before the Bulgars. The Turkish collapse was so complete that all parties were willing to conclude an armistice on Dec. 3.

The London Conference.—While the fighting was in progress the great powers still sought for a settlement. It was Austro-Hungarian policy to prevent the aggrandizement of Serbia, because a strong Serbia would constitute a threat to the southern frontier of the Habsburg empire. The key to the situation, therefore, was what Austria-Hungary would accept. Berchtold, following his predecessor Aehrenthal's policy, decided not to exercise the treaty right to occupy the sanjak of Novi Pazar, which might have prevented Serbia and Montenegro from obtaining a common frontier. Instead he submitted to the powers on Nov. 4, 1912, the conditions that Albania should be erected as an independent state and that Serbia should not be allowed to reach the Adriatic. This proposal displeased Serbia, and both Austria-Hungary and Russia took military measures in view of the tension. On Dec. 12 Gen. Franz Conrad von Hötzendorf, well-known for his view that only offensive action could settle the Southern Slav question, resumed the duties of Austro-Hungarian chief of staff. Russia avoided provocative action, but retained third-year conscripts with the colours for an additional period.

On Nov. 18, 1912, Kiderlen-Wächter proposed that the powers should meet to discuss a settlement on the basis that they reserved to themselves the settlement of Albania, the question of Adrianople (Edirne) and Istanbul, Mount Athos, the Aegean islands and Rumanian demands for compensation. It was agreed that the ambassadors of the powers should meet in London to work out the details of an agreement, but this disposition to seek a peaceful solution was accompanied by consultation in the two great alliance groups lest there should be a breakdown of international relations. On Nov. 4 Poincaré had made it clear to Russia that he would abide by the Franco-Russian alliance if the need arose. On Nov. 22–23 Sir Edward Grey and the French ambassador, Paul Cambon, exchanged letters defining the military commitments of France and Great Britain. The archduke Francis Ferdinand, heir to the Austrian throne, received assurances of German support during his visit to Berlin on Nov. 22–23 and these were made more definite by a public statement in the *Reichstag* by the chancellor Theobald von Bethmann Hollweg on Dec. 2.

The conference of ambassadors opened in London on Dec. 16 under Sir Edward Grey's chairmanship. Agreement on the principle of Albanian independence was quickly reached, but Austria-Hungary favoured a larger Albania than Russia did. While negotiations were proceeding in London the Turkish government, on Jan. 22, 1913, submitted to an assembly of Ottoman notables the question whether or not Turkey should make peace. The council pronounced in favour of peace, but on Jan. 23 a *coup d'état* was carried out by a group of Young Turks under Enver Pasha to prevent the surrender of Adrianople to Bulgaria. On Feb. 3 the Balkan allies denounced the armistice and re-opened hostilities. The Bulgars did not, however, attempt again to force the Chatalja lines, but concentrated on the reduction of Adrianople, which did not capitulate until March 26. The Montenegrins likewise continued to besiege Scutari.

On March 21, 1913, Austria-Hungary agreed to a compromise solution on the northern frontier of Albania, but it was difficult to force the Montenegrins to accept peace. Only a threat of military action by Austria-Hungary on May 4 compelled Montenegro to abandon Scutari, which had fallen on April 22. On April 21, the Balkan allies agreed with bad grace and with some reservations to negotiate on the principles established by the London conference, but only a sharp warning to their representatives in London on May 27 from Sir Edward Grey that they must either accept the powers' terms or go home brought about final agreement to the preliminaries of peace on May 30. The powers therefore reserved to themselves the Turkish European frontier question, the limits of Albanian territory and the disposition of the Aegean islands, leaving the Balkan powers to distribute among themselves the remainder of European Turkey. Albania was therefore established as an independent neutralized state on July 29, 1913, under international control and the sovereignty of Prince William of Wied.

The Second Balkan War, 1913.—The territorial settlement produced discords among the Balkan allies, while Rumania laid claim to the town of Silistra and to an area of the Dobruja. Friction in Macedonia induced the Greeks to form an alliance with the Serbs on June 1, 1913, for the division of Macedonia on different lines from those agreed to by Serbia and Bulgaria in their alliance of March 13, 1912. At the same time Greece began negotiations for a definitive peace with Turkey in the hope of obtaining Turkish support against Bulgaria. Bulgaria had antagonized Greece by laying claims to Salonika, while the Serbs demanded that the towns of Prilep, Kichevo and Ohrid, which they had previously assigned to Bulgaria, should now be allotted them—on the flimsy grounds that Bulgaria had not honoured the letter of the military convention and that Serbia had originally expected an extension of territory to the Adriatic and ought now to receive compensation in Macedonia. Tension was so great that Geshov, the Bulgarian prime minister, resigned on May 30, 1913, rather than take further responsibility for the negotiations and his place was taken by the foreign minister Danev. The Russian government used its influence to obtain agreement, and the emperor himself sent telegrams to the kings of Serbia and Bulgaria asking for conciliation. Sazonov therefore, under the impression that they would accept Russian arbitration, on June 21 invited Serbia and Bulgaria to submit within four days their rival arguments. This demand produced a crisis in Bulgaria. The Bulgarian field commander, Mikhail Savov, declared that the army would be satisfied with nothing less than the line of division agreed to in the original treaty of March 13, 1912. On June 22, 1913, a ministerial council in Sofia pronounced in favour of conciliation, but on the same day a conference of Danev and Savov with King Ferdinand I at Vranje decided to ask Russia to arbitrate upon the basis of the original 1912 treaty. An award, moreover, was demanded within seven days. This demand, submitted on June 24, 1913, so annoyed Sazonov that he declared that he could not give Bulgaria further support. Ferdinand, probably expecting a quick victory and convinced that Austria-Hungary would support him, ordered Savov on June 28 to launch an attack upon the Serbs and the Greeks in Macedonia. The Bulgarian cabinet had not authorized this order and on July 1, countermanded it. Savov, though he had already begun the advance, now refused to act on his own interpretation of the situation and was accordingly on July 3 relieved of his command by Ferdinand for refusing to obey an order and replaced by the Russophil general Radko Dmitriev.

The consequences of Ferdinand's action were disastrous for Bulgaria. Austria-Hungary, anxious to favour Bulgaria as a counterweight to Serbia, might have offered support if Bulgaria had met Rumanian claims on the Dobruja. On June 27 the Rumanian government had given warning that it would mobilize in the event of war. A quick victory over the Serbs and Greeks would have enabled Bulgaria to face Rumania, but without support Bulgaria was at the mercy of the Rumanian army, which began to advance into the country on July 11. Rumania was in the fortunate position of having both Austria-Hungary's friendship and the knowledge that Russia would refrain from hostile action in the hope of subsequently obtaining Rumania's allegiance to the triple entente. On July 12 the Turks violated their armistice with the Bulgars and began to advance into Thrace, recapturing Adrianople on July 22. The position was now hopeless for Bulgaria. Danev's pro-Russian ministry had resigned on July 15 and was replaced by the pro-Austrian cabinet of Vasil Radoslavov. On July 18 it was agreed that a conference should open at Bucharest to settle the terms of peace, though it was not until July 30 that the Bulgars obtained an armistice from the Serbs, Greeks and Rumanians.

The Treaty of Bucharest and the Turkish Treaties.—Under the treaty of Bucharest (Aug. 10, 1913) between Bulgaria on the one hand and Serbia, Greece and Rumania on the other, Bulgaria obtained a coastline of about 25 mi. on the Aegean, including Dedeagatch (Alexandroupolis), an extension of the southern frontier to include Petrich and Strumitsa and a small rayon of territory on the Black sea, but was compelled to cede to Rumania part of the Dobruja north of a line from Turtucaia to Balchik.

Bulgaria, moreover, failed to obtain the Enez-Midye (Enos-Midia) frontier in Thrace. Although this frontier had been awarded to Bulgaria by the London conference, the peace signed between Bulgaria and Turkey in Istanbul on Sept. 29, 1913, left Adrianople and a belt of territory on the right bank of the Maritsa river to Turks. Greece, which had enjoyed diplomatic support from Germany, obtained considerable extension of the northern frontier—which now ran from Cape Stylos (in the Corfu strait) northeastward to Lake Prespa and thence east to the lower Maritsa river to include Serrai, Drama and Kavalla—was also awarded the islands of Thasos, Samothrace, Lemnos, Lesbos, Chios, Samos, Icaria and Crete. Extensions of Serbian territory in Macedonia included the towns of Prizren, Uskub (Skopje) and Monastir (Bitola), while the sanjak of Novi Pazar was partitioned on Nov. 7 between Serbia and Montenegro. Greece concluded peace with Turkey in Athens on Nov. 14, 1913, and Serbia, with Turkey in Istanbul, on March 14, 1914. The territorial settlement was not, however, complete in every detail before the opening of World War I in 1914.

The Results of the Wars.—The political consequences of the Balkan Wars were considerable. Apart from Turkey, the real loser was Austria-Hungary. The partitioning of the sanjak of Novi Pazar between Serbia and Montenegro made it impossible in the subsequent crisis of June–July 1914 for Austria-Hungary to intervene in the Balkans by occupying the sanjak according to the Berlin treaty of 1878; the Austro-Hungarian ultimatum to Serbia on July 23, 1914, was thus made to appear naked aggression. The wars likewise altered the structure of alliances in the Balkans. Dissatisfied Bulgaria henceforth looked to Austria-Hungary for support, while Rumania tended to move out of the influence of the triple alliance toward the entente. The Turks, moreover, began to put their house in order and secured, in Nov. 1913, the services of the German general Liman von Sanders, with a group of technical advisers to strengthen the organization of their army. The most alarming aspect of the war was the growth of tension between Austria-Hungary and Serbia. Serbia had extensive claims upon Albanian territory. Having obtained an assurance of German support, Austria-Hungary delivered an ultimatum on Oct. 17, 1913, to compel Serbia to withdraw from the Albanian borderlands. This however did not solve the Southern Slav question for Austria-Hungary, which emerged again in an acute form with the assassination of the archduke Francis Ferdinand (*q.v.*) on June 28, 1914, in Sarajevo, Bosnia. *See* WORLD WAR I; *see* also Index references under "Balkan Wars" in the Index volume.

BIBLIOGRAPHY.—For a full survey *see* E. C. Helmreich, *The Diplomacy of the Balkan Wars 1912–1913* (1938). *See* also I. E. Geshov, *The Balkan League*, Eng. trans. (1915); R. Poincaré, *Au service de la France*, vol. ii, *Les Balkans en feu 1912* (1926), vol. iii, *L'Europe sous les armes 1913* (1926); A. M. Zaionchkovski, *Podgotovka Rossii k imperialisticheskoi voine* (1926); L. Albertini, *The Origins of the War of 1914* (1952); and the various national collections of documents on the foreign policy of the period. (R. F. LE.)

BALKARIA: *see* KABARDINO-BALKAR AUTONOMOUS SOVIET SOCIALIST REPUBLIC.

BALKH (WAZIRABAD), a village of north Afghanistan, in the province of Mazar-i-Sharif, is about 14 mi. W. of Mazar-i-Sharif city. It is generally agreed to represent the ancient Bactra, capital of Bactria (*q.v.*). It is situated about 1,250 ft. above sea level, on the Balkh river, which formerly flowed into the Amu-Darya (Oxus), about 45 mi. to the north, but is now drawn off into 18 irrigation channels which water the surrounding lands. There are from 500 to 1,000 houses: the major elements of population are Usbeks and Tajiks, but there are also recently settled Pathans.

The modern town, Wazirabad, is situated amid extensive ruins. The outer walls, more than 7 mi. in circumference and in places built on great earth ramparts concealing older defenses, are probably Timurid. Slightly later (16th century) is the Sabz Masjid (Green mosque), which lies near the centre of the town and is now sadly depleted. North of the mosque is the Bala Hissar (citadel) and in its southern corner the *arg*, an imposing mound approximately 50 ft. in height. About 1 mi. E. of the mosque is another big mound, the Tepe Zargaran, lying just inside the defenses. About 1 mi. S. of the town are two large ruins, known as Top-i-Rustam and Takht-i-Rustam, which comprise a great Buddhist stupa and associated buildings, probably monasteries which may be identified with the *Nau Vihara* (new monastery) whose paintings excited the Arab travelers.

Lying on a once fertile plain, near the main routes from India to China and Central Asia, and within easy reach of the main routes from China to Iran and the Mediterranean, Balkh has had a stormy history. The earliest references are in the Avesta and the Achaemenid inscriptions. Odd finds of pottery of types known from Soviet Central Asia indicate the presence of a settlement *c.* 500 B.C. The city was captured by Alexander the Great and thereafter became the centre of the Bactrian Greek kingdom. It was also known as Zariaspa. About 125 B.C. Bactria succumbed to nomadic invaders from the north and the east (*see* YUE-CHI), from whom it derived its name Tokharistan. During the next centuries arose the Kushan power which invaded India but ruled, at least in the north, from Balkh; in the 5th century further invasions of Hephthalites (*q.v.*) occurred. Balkh was later held by the western Turks, although challenged by the Sassanids (*q.v.*) and in 653 raided for the first time by the Arabs. Constant fighting followed until the Muslim general Qutaybah took the city in 715. Balkh became the capital of Khurasan (*q.v.*), and under the Abbasids and Samanids its fame as a capital and centre of learning earned it the title "mother of cities." In the 11th century it was the scene of bitter fighting between the Seljuks and the Ghaznevids and in 1206, fell for a few years to the Khwarizm shah, only to suffer destruction in 1220 at the hands of Genghis (Jenghiz) Khan (*q.v.*). Thereafter Balkh lay ruined until, after its capture by Timur, it was rebuilt early in the 15th century and recovered its prosperity. But in 1480 the alleged miraculous discovery of the tomb of Ali in Mazar-i-Sharif heralded Balkh's decline. In the following century it passed into Usbek hands and later for a brief spell to the Moguls, finally falling to Ahmad Shah Durrani (*q.v.*) in 1752. Since 1841 it has been under Afghan control. *See* also AFGHANISTAN.

BIBLIOGRAPHY.—A. Foucher, *La Vieille Route de l'Inde de Bactres à Taxila* (1942); the article "Balkh," with further bibliography, in *Encyclopaedia of Islam*, new ed. (1959); F. R. Allchin, "The Culture Sequence of Bactria," *Antiquity*, pp. 131–141 (1957). (F. R. A.)

BALKHASH, a town in the Karaganda *oblast* (province) of the Kazakh Soviet Socialist Republic, U.S.S.R., lies on the northern shore of Lake Balkhash. Pop. (1959) 53,031. It is the second largest industrial centre of the *oblast* after Karaganda. It owes its existence to the large copper refining plant started in 1928 for the Kounradski mines (10 mi. N.). Apart from this it has ferrous metal rolling mills, fish canning, building materials and other plants. It was at first known as Bertys, and until 1937 as Pribalkhash. (G. E. WR.)

BALKHASH, LAKE (BALKHASH OZERO), a lake in the Karaganda and Alma-Ata *oblasts* of the Kazakh Soviet Socialist Republic, U.S.S.R., is located about 100 mi. W. of the Sinkiang-Uigur (China) border and 600 mi. E. of the Aral sea. It is 376 mi. in length and 46 mi. wide and the fourth largest inland sea in the U.S.S.R. with an area of 7,300 sq.mi. The lake is shallow (average depth 22 ft.) and its water though brackish can be used for irrigation and is potable. This relative freshness is due to the recent formation of the lake, but salinification is proceeding. From November to March the lake is frozen. During the rest of the year it is open to shipping and there are shipyards at the mouths of the Karatal, Lepsa and Ili rivers.

The fauna of the lake and of its feeder tributaries, which excludes the common frog, is more akin to the fauna of the Tarim (*q.v.*) basin rivers in Sinkiang-Uigur than to that of the Aral sea (*q.v.*). It seems probable that Lake Balkhash stood formerly in communication through Lakes Ebi Nuur and Telii Nuur with the lake that formerly filled the Lukchun, or Turfan, depression (in longitude 89° E. and latitude 42° N.), but researches show that any connection with the Aral sea, at least in recent times, was improbable.

The economic importance of the lake greatly increased during the Soviet regime. The Petropavlovsk-Karaganda-Balkhash railway line now reaches it from the north and the Turksib from the east. A large copper refining plant was built near the Kounradski copper mines. This necessitated the development, after 1933, of water transport on the lake and there is now a regular shipping service between Pristan Bertys and Balkhash. Fishing (carp and perch) is significant, especially at Burlyu-Tobe and Burubaital. (G. E. WR.)

BALL, ALBERT (1896–1917), outstanding British fighter ace of World War I who won 43 victories in air combat, was born on Aug. 21, 1896, at Nottingham. He was educated at Trent college, which he left in 1913. On the outbreak of World War I, he joined the army. During the summer of 1915 he learned to fly at his own expense at Hendon, Middlesex, obtaining his pilot's certificate in Oct. 1915, and transferred to the royal flying corps. Having served in France as an army co-operation pilot from Feb. 1916, he was posted in June to No. 11 fighter squadron (flying Nieuport Scouts) and later to No. 60 and 56 squadrons (flying S.E.5s). In spite of his skill and daring Captain Ball was shot down and killed over Annoeullin, near Lens, on May 7, 1917, in an encounter with a German fighter squadron led by Manfred von Richthofen. He won the Victoria cross, among many other honours. (D. CR.)

BALL, SIR ALEXANDER JOHN, BART. (1759–1809), British rear admiral, directed the naval blockade of Malta (1798–1800) and was civil commissioner there from 1802 to 1809. He entered the navy at an early age and was promoted lieutenant in 1778. From 1781 he served under Sir George Rodney and was present at his great victory of April 12, 1782, in the West Indies. Two days later Ball was promoted commander; in 1783 he became a captain. He then spent a year in France with the double purpose of learning the language and of living economically while on half pay. He did not receive a command until 1790, but thereafter he was continually employed. In 1798 he saved Nelson's flagship from running ashore after being dismasted, and the two became close friends. Ball served under Nelson at the battle of the Nile (Aug. 1798), and his ship, the "Alexander," was a particular opponent of Admiral de Brueys's flagship "L'Orient," which blew up. Two months later he was ordered to the blockade of Malta, which was kept up almost without a break for the next two years. After the fall of Malta (Sept. 1800), Admiral Ball did not return to naval service, in spite of Nelson's entreaty that he should continue afloat. In May 1801 he was made a baronet. As civil commissioner he endeared himself to the Maltese by his regard for their interests and by his opposition to the policy of treating the island as a conquered dependency. He died in Malta on Oct. 25, 1809. Ball befriended Samuel Taylor Coleridge, who was his secretary during 1804, and is highly praised by him in *The Friend*. (O. M. W. W.)

BALL, JOHN (d. 1381), one of the leaders of the Peasants' Revolt (*q.v.*; 1381) in England, was a priest at York, later at Colchester, and was an agitator for about 20 years before the

uprising began. There is no evidence that Ball was influenced by the doctrines of John Wycliffe, but he gained notoriety by inflammatory sermons advocating a classless society. He was cited in 1366 to appear before Archbishop Langham of Canterbury and the faithful were forbidden to hear him preach. His arrest as an excommunicated person was ordered in 1376 and he was several times imprisoned. Shortly after the outbreak of the uprising in June 1381, Ball was rescued from prison at Maidstone by the Kentish rebels whom he accompanied to London, preaching at Blackheath from the already popular text "Whan Adam dalf and Eve span, Wo was thanne a gentilman?" According to the *Anonimalle Chronicle*, which incorporates an eyewitness account of events in London during the rebellion, he urged the killing of all the lords and prelates and members of the monastic orders. After the collapse of the uprising Ball was captured at Coventry. He was tried and hanged at St. Albans on July 15, 1381. Knowledge of Ball's career is derived almost entirely from prejudiced chroniclers. Froissart calls him "the mad priest of Kent."

See G. R. Owst, *Literature and Pulpit in Medieval England* (1933). (T. B. P.)

BALL, THOMAS (1819–1911), U.S. sculptor whose best-known work is probably the equestrian statue of George Washington in the public gardens in Boston, Mass., was born at Charlestown, Mass., on June 3, 1819. After starting, self-taught, as a portrait painter he turned his attention in 1851 to sculpture, his earliest work being a bust of Jenny Lind.

At the age of 35 he went to Florence for study. There, with an interval of work in Boston (1857–65), he remained until 1897, when he returned to the United States and lived in Montclair, N.J., with a studio in New York city. His work includes many early cabinet busts of musicians (he was an accomplished musician himself). Josiah Quincy in City Hall square, Boston; Charles Sumner in the public gardens of Boston; Daniel Webster in Central park, New York city; the Lincoln "Emancipation" group at Washington, D.C.; Edwin Forrest as "Coriolanus," in the Actors' home, Philadelphia, Pa.; and the Washington monument in Methuen, Mass., are other examples which had a marked influence on monumental art in the U.S. and especially in New England. In 1891 he published an autobiographical volume, *My Three Score Years and Ten*. He died at Montclair on Dec. 11, 1911.

BALL. The ball is probably unrivaled in the long history of recreation. From prehistoric times the ball has been used, and ball play engaged in by young and old. The ball is mentioned in the earliest recorded literatures and finds a place in some of the oldest graphic representations. Homer and other early writers reported that the ancient Greeks found ball play particularly appealing and that it came to be much valued as a means of giving grace and elasticity to the figure. Homer was appealing to a sympathetic audience when he described, in the *Odyssey*, how the Princess Nausicaa and her maidens "fell to playing at ball" in Scheria (Corfu), that far-off land of the Phaeacians washed by the utmost tides of ocean; and again, when the wanderer reaches her father's palace, how Halios and Laodamas played a ball game, accompanied with dancing, before Alcinous and Odysseus. Though the Hebrews were the least athletic of races, Isaiah must have been sure of his simile being understood when he wrote: "He will surely turn and toss thee like a ball"; and some form of ball game is portrayed on early Egyptian monuments. Even among the Romans, who disliked participation sports, ball play was extremely popular. The Roman baths had an apartment set aside for ball play, and many gentlemen had ball courts in their private villas.

From early descriptions, both literary and graphic, and from models recovered in archaeological explorations, it is known that the ancient ball was usually made of leather strips sewn together and filled with various materials. The smallest, the *harpastum*, was a hard ball stuffed with feathers. The largest, the *follis*, was truly pneumatic in that it contained an air filled bladder and was quite similar to a modern soccer or basketball.

Many early games were merely variations of catch ball and required no fixed number of players. The ball was simply thrown back and forth among a group of individuals. Comparatively recent archaeological discoveries, however, have revealed the existence of genuine team games and competitions among the Greeks. Ball games were especially popular at Sparta, and the name "ball-player" was in use as a designation for youths who engaged in these games. A game popular among both Greeks and Romans was called *harpastum*, after the ball with which it was played. Basically, the game involved passing the ball from one player to another so as to avoid a third player between from gaining possession, but whether this was a true team game or merely a participation sport is uncertain. An analogy between this game and Rugby football has been claimed, but the resemblance is very slight.

Another early game known as *episkyros* is perhaps a truer anticipation of Rugby football, at least in the arrangement of the playing field. This game involved the use of two teams of equal numbers. In the centre ground between the two teams a white line was laid out, and at some distance behind each team another line was marked. The play consisted in throwing the ball back and forth until one team in the exchange was finally forced back over its rear line. One relief that has been recovered actually depicts this game.

There is no doubt that ball playing also was of great antiquity in western Europe. While it is difficult to discover the specific origin of various games played during the middle ages, it is known that a number of games, football, tennis and golf (*qq.v.*) for example, came to enjoy a high degree of popularity during the 15th and 16th centuries. Lacrosse (*q.v.*) was well established in the new world before Columbus sailed the Atlantic.

On examination, the early games are seen to be rather loosely defined, and accordingly the varieties of balls in use were few and comparatively simple. It is only through the development and refinement of skills required in games using the ball alone, and more particularly in games involving the use of various implements for striking it, that the specialization resulting in the modern multiplicity of ball types was reached.

The weight and circumference of various balls have been changed as the rules of the individual sports have been refined and developed over the years. Many sports have made certain changes in their ball specifications on advice from manufacturers, participants and spectators. Athletic officials have also agreed to changes in specifications in order to conform with alterations in other equipment used in a sport. A number of changes in ball construction have been made in order to increase the interest of the spectators. An example of this is the change made in the American football from the egg-shaped Rugby ball to a more elongated shape which was easier to throw with accuracy. This change increased the opportunity for diversification in the style of play and changed the sport from a rather dull and endless running game to one in which the forward pass played an exciting role.

A somewhat similar change took place in baseball which, prior to World War I, was a tightly played game of defense which resulted in lower scores. A livelier ball was introduced about 1920 so that offensive play would be dominant.

In many sports the specifications of the ball have remained unchanged, except for minor adjustments, since the inception of the particular sport, the governing bodies of the various sports having adhered to the earlier ball specifications as much as possible in order to conform with the original playing areas and the original implement if one is used. There has been an increasing use of man-made in place of natural materials in the manufacture of balls.

For specifications of balls used in various sports *see* BASEBALL; BILLIARDS; BOWLING; FOOTBALL; TENNIS; etc.; *see* also Index references under "Ball" in the Index volume. (HY. W. J.)

BALLAARAT (BALLARAT), a city of Grenville and Grant counties, Victoria, Austr. It includes the borough of Sebastopol and portions of the shires of Ballaarat, Bungaree, Buninyong and Grenville. It is situated at a height of 1,416 ft. in the central highlands of the state, astride the valley of the Yarrowee river, 70 mi. W.N.W. of Melbourne by road and 74 mi. by rail. Pop. (1954) 39,945. Its name is derived from two aboriginal words meaning "resting place." The largest inland city of Australia Ballaarat has an Anglican and a Roman Catholic cathedral, a

school of mines and industries containing an art school, an art gallery, a historical museum and 1,787 ac. of reserves and recreation grounds, including Lake Wendouree near the heart of the city. The South Street eisteddfod takes place every year and the begonia festival is celebrated annually in March. Ballaarat is the centre of a rich agricultural and pastoral district whose chief crops are potatoes and oats and whose merino wools have always had a high reputation. It is also an industrial and commercial centre, producing woolens, agricultural and industrial machinery, flour, leather goods, bricks, chemicals, valves and art paper.

Gold was discovered in 1851 and Ballaarat quickly became one of the foremost mining towns of Australia. Its early history was marred by the incident of the "Eureka stockade" in 1854, when about 30 local miners, who were among those demanding the abolition of licences and political reform, were killed in a pitched battle with the military. Although the miners lost the day, they won their democratic rights within the state parliament. The "Welcome" nugget, weighing 2,217 oz., was found in shallow ground at Bakery Hill in 1858 and was only one of a number of large nuggets unearthed. However, the surface (alluvial) deposits were soon worked out and afterward reef mining, to depths of 2,000 ft. and more, prevailed until *c.* 1910 when the industry ceased. (H. R. MA.)

BALLAD. The name is given to a genre of narrative song perpetuated by oral tradition; the genre is characterized by certain features of style and treatment, being simple, concrete and unimpassioned in diction, fairly uniform in metre and rhythm, compressed in narrative scope, objective and impersonal in presentation, usually dramatic in structure and suggestive of the elemental and archetypal in its effect. The melody is repeated for each stanza, which is usually of four verses (*i.e.,* lines). This form of song is shared by most European peoples and has been carried to other areas such as the English, French and Spanish-speaking parts of the new world. Since ballads exist as orally transmitted songs, they have been preserved only by fortuitous noting down and printing, or in modern times by concerted efforts at collection. Much that we wish to know about them has been irretrievably lost.

Since they are handed down traditionally, we know them only as anonymous compositions. But their anonymity extends beyond the mere loss of the authors' names, for in successive performances many singers have worked their changes upon any one ballad. The fluidity of musical and textual substance is at the heart of the nature of a ballad. This fluidity operates within traditional restraints, for the changes made by the tradition-bearer are devoid of artful niceties and individualistic turns. Compare Browning's "The Glove," or the poems by Leigh Hunt and Schiller about the same incident, with the ballad "The Lady of Carlisle" for an illustration of the differences between traditional ballad and the poet's poem. Arnold's "Forsaken Merman" and Goethe's "Erlkönig" use themes from ballads—the poems owe their being to folk song—but they are unmistakably not ballads. Many an author has tried to imitate the ballad; his trade-mark is usually discernible. The marks of the ballad are the structural, rhetorical and stylistic necessities imposed by the process of oral transmission; although its origin may be obscure and it may tell a story, a song lacking the shaping effects of traditional rendering is not a true ballad.

Since the word "ballad" has at various times been applied to many kinds of popular verse, students of folk song frequently choose to qualify the term by the adjectives "popular" or "traditional." Ballads are a variety of folk song, but they are sufficiently a group in themselves to be classed separately. The distinction was first argued by William Shenstone in 1761 in letters to Bishop Thomas Percy, where he suggested use of the term ballad to distinguish the narrative of "action" from songs that were expressions of sentiment. Shenstone professed to be merely following "the ordinary opinion of the world, at last," and the distinction has been confirmed by later usage. Percy conceded the distinction, for "Ancient Songs and Ballads" appeared as the running title in his *Reliques of Ancient English Poetry* (1765), the first significant publication in British balladry. The word derives from late Latin *ballare,* "to dance," which has helped to confuse the history of the ballad with dance song. "Ballad" was used indiscriminately after the 15th century to refer to any kind of simple or popular song; before that it had been used in English to describe a poem of complex structure, French in origin (*see* BALLADE). Since the 18th century the word has been used increasingly in the particularized sense. Conversely, what we now call a ballad went by many names—song, tale, ditty—during earlier centuries. In other languages various names are used: in German, *Volkslied;* in Danish, *Folkevise;* in French, *chanson populaire,* or *romance* after the Spanish usage; in Russian, *bylina.*

Critics hesitate to define the genre too narrowly, for by its very nature it is hard to circumscribe precisely. It differs in important respects from one linguistic area of Europe to another, and yet Spanish *romances,* Russian *byliny* and Scottish ballads belong to the same genre in spite of differences. Even within a single language community like the English-speaking one, there is considerable diversity in the body of narrative folk song comprehended by the term "ballad." Describing ballads by example, W. P. Ker said (in his lecture *On the History of Ballads, 1100–1500,* Proc. of the Brit. Acad. IV, O.U.P., 1910): " 'What is a ballad?'—'A ballad is *The Milldams of Binnorie* and *Sir Patrick Spens* and *The Douglas Tragedy* and *Lord Randal* and *Childe Maurice* and things of that sort.' " These all appear early in the most important collection of ballads in English, Francis James Child's *English and Scottish Popular Ballads,* 5 vol. (1883–98). A ballad is also "Jesse James" and "John Henry" and "Frankie and Johnny" and "The Jam on Gerry's Rock" and "Springfield Mountain" and things of that sort, to name a few ballads native to America and unknown to Ker in 1910. A ballad is also "Ridderen i Fugleham" and "La belle dans la tour" and "Graf Friedrich" and "Donna Lombarda" and "Djuk Stepanovič" and things of that sort, if we choose to consider the term in its full import.

Chief Characteristics.—*Narrative.*—Ballads all tell stories. The narratives are usually concentrated (Thomas Gray remarked that "Childe Maurice" began in the fifth act of the play); episodic, leaping from one link to the next in the narrative chain ("Sir Patrick Spens"); suggestive rather than explanatory ("Edward"). They often proceed by dialogue interchange, which gives them a dramatic air ("The Maid Freed From the Gallows"). Usually the narrative is held back by the lyrical devices of repetition and refrain.

Ballads seem to take up any story, but certain themes appear frequently. By far the commonest subject is love, usually with tragic consequences—love requited ("Sweet William's Ghost"), unrequited ("Barbara Allen"), stolen ("Little Musgrave and Lady Barnard"), betrayed ("Lord Randal"), complicated by family entanglements ("The Twa Sisters"). Other favourite subjects are superstitions of shape shifting (*i.e.,* weird and monstrous changes in the appearance of a person under the spell of a supernatural being) ("Tam Lin," "Kemp Owyne") and ghosts ("The Wife of Usher's Well," "The Unquiet Grave"), fights and forays ("Kinmont Willie"), romance themes ("Sir Lionel," "The Marriage of Sir Gawain"), riddles and tricks ("Captain Wedderburn's Courtship"), broad and gross humour ("Our Goodman"), religious legends ("The Cherry Tree Carol"), adventures at sea ("Sir Andrew Barton") or in the greenwood ("Robin Hood and Guy of Gisborne") and accounts of history and policy ("The Death of Queen Jane," "Lord Derwentwater"). The romantic and tragic ballads and the ballads of magic are among those with international analogues; the more strictly national ballads are those revealing a background of minstrelsy or based on historical events.

Oral Transmission.—In spite of their diversity of subject, ballads have a family likeness, for both the language and the music reveal that they are spread and passed on by word of mouth. The treatment of subject, the narrative technique, the rhetorical devices of repetition and commonplace, the off rhymes, the use of dialect, these are all concomitants of oral tradition. Ballads are shaped by such tradition, like folk tales, except that the formal devices of song such as line length, stanza structure and rhyme hold the ballad's phrasing in check.

International Connections.—Ballads differ greatly in their geo-

graphical spread. Some are confined to an area like the Scottish Border country; others are widely distributed throughout Europe and America. An example is "Lady Isabel and the Elf-Knight," also known as "The Outlandish Knight," the most widespread of ballads. About a quarter of the Child ballads, it is estimated, are international. In these, not only is the narrative shape maintained in versions of the same ballad from different countries but the similarities of verbal phrasing underscore the relationships.

Ballad Tunes.—Sir Walter Scott heard the tunes to the ballads that he recorded and later published in his *Minstrelsy of the Scottish Border* (1802–03), but he did not write them down. Attention to the melodic side of ballads came late. In Child's collection the "Airs" from manuscript sources number only 55 and are relegated to an appendix. The vast store of tunes that we now possess is the work in the 20th century of field collectors who have come to the understanding that ballads are half tune. The first collector to realize this fully was Cecil J. Sharp (*q.v.*), who collected about 5,000 oral records from singers in England and in the United States. Two others responsible for great collections of tunes were Gavin Greig in Scotland and Phillips Barry in New England. Sharp spurred collecting in other regions of America by his success in garnering melodies from the Southern Appalachians. The tunes of the British and the American ballad tradition have been painstakingly brought together, grouped and edited by B. H. Bronson in *The Traditional Tunes of the Child Ballads* (vol. 1, 1959).

The analysis of tunes and of the families into which they may be grouped is a new direction in ballad study. Tunes in tradition undergo changes just as do texts. The modality of a tune may change, the melodic contour also; phrases may be transposed, repeated or replaced; one tune may influence another; the tonal range may be altered and the rhythm shifted. The scales to which ballads are sung indicate a medieval musical heritage, for they correspond to the ecclesiastical modes named after Greek tribes by Glareanus in 1547. Ballad music does not derive from ecclesiastical music, a frequent misconception; folk music and church music alike used the only scales, the modes, that were known in the middle ages. The modality of a tune depends upon the position of semitones in a seven-toned scale; their absence makes for gapped six- and five-toned scales. Most tunes collected from tradition are in the Ionian mode, our major diatonic scale, but whether the Ionian mode was more prevalent than the Mixolydian, Dorian, Aeolian, etc., in former centuries is a matter for conjecture. It may be that the others have given way to the seven-toned major scale. The rhythm of ballad tunes is usually in double time, conforming with and dictating the dipodic verse rhythm. Tunes and texts have a close interdependence, formal features such as line length, stanza length and *abcb* rhyme all being held in check by the structure of the melody. Stressed tones in the melodic contour tend to coincide with the important words in the text, an aspect of the control that oral delivery has upon the ballad. The variants of a single ballad are by no means always sung to the same tune or tune family, and conversely a tune family will serve as the musical vehicle for many differing texts. One cannot speak of an original or right tune for any narrative. The tunes are not international in scope to the same degree as the texts.

The Age of the Ballads.—Considerable debate has taken place as to the dating of ballads and their place in the history of literature. The matter of dating involves three separate questions: "When did ballads make their first appearance in western Europe?" "What are the dates of the manuscripts and early printings that provide documentary evidence of ballads?" and "In what period did the ballads flourish?"

Some scholars at the turn of the 19th century, among them Francis B. Gummere, used the then new anthropological evidence to demonstrate that primitive peoples sang and danced to impromptu narrative verses suggestive of ballads. This school of thought equated ballads and the ballad dance with the beginnings of poetic expression in any society, and consequently the ballad in European languages was viewed as a retention of a primitive form that had its roots in prehistory (*see* F. B. Gummere, *The Beginnings of Poetry,* 1901). A less hypothetical approach to the evidence was bound in time to displace such a theory, and the tendency in accounts about ballads has been to assign a later date to the beginning of the genre. The oldest ballad recorded in any language exists in English, in a manuscript dating from the latter half of the 13th century. Some would deny that "Judas," in the Trinity college, Cambridge, manuscript is a true ballad; its way of treating a biblical story, its dialogue and repetitions, however, all suggest the ballad. The next record is two centuries younger, and by actual count fewer than 10 complete ballads are preserved in English in sources before 1600. The documentary evidence about balladry is then preponderantly from modern times. Early historians of poetry thought of the form as medieval, and in chronological surveys it became conventional to treat the ballads as if they belonged to the 15th century, the transition period between the middle ages and modern times. Such relegation of the ballads to a medieval limbo, treating them as "the literary debris of the middle ages," is not accepted by later scholars. Louise Pound demonstrated, for instance, that the historical materials in English and Scottish balladry are largely from the 16th and 17th centuries, and American ballads reveal the emergence of an entire ballad tradition in relatively modern times. Like a number of American ballads, "The Cowboy's Lament" or "The Streets of Laredo" dates from the era of western expansion; but it derives from earlier British songs with antecedents that have been traced to the 18th century. The vigorous "Sam Hall" has its roots in even earlier British song. It would be foolhardy to say arbitrarily that any one age is a ballad age.

In later centuries it is clear that ballads have been a living tradition in rural and backwoods communities, but at times they have also been perpetuated by upper levels of society. The beginnings of the ballad as we know it cannot be pushed back beyond the emergence of rhyme in English about 1100. Since actual ballads cannot be cited from a period earlier than the 13th century, it would seem unreasonable to date the inception of the genre before then. Tacitus mentioned the *cantilenae* of Germanic tribes, but there is little reason to believe that they resembled the ballads. The documentary evidence for British ballads increases the nearer one approaches modern times. Not until the late 18th century does the evidence become sizable, and not until the 19th does it become rich. In the 20th century the number of variants of ballads uncovered by assiduous collecting has increased tremendously; the collector does not find new ballads so much as add to the store of variants of known songs.

How many ballads are there in tradition? The question has been complicated by the shifting notions about ballads and by the classifications different editors and critics have employed. From the mass of popular verse that his predecessors had collected and published, Francis James Child for his standard edition chose 305 ballads with their variants. Issue is taken at times with his procedures of inclusion and exclusion, some arguing that he admitted too many, others that he admitted too few. Native American balladry has greatly increased the number of ballads in the English language, although no one has chosen to establish a count. Denmark's ballad account in *Danmarks gamle Folkeviser* (edited first by Svend Grundtvig, who issued vol. 1 in 1853) closes with the number 539, and the Danish collection purports to be almost entirely medieval song. The Danish ballad record is considerably earlier than the English (excepting "Judas"), for in the 16th and 17th centuries it was the practice of the Danish gentry to write ballad texts into commonplace books. The ballads provided song accompaniment for the aristocratic long dance (in our own time a *gesunkenes Kulturgut* in the Faeroe Islands). The earliest of these books is known as the Karen Brahe manuscript; it contains 203 ballads written down about 1550. In 1591 Anders Vedel published his *Hundredvisebog* and Peder Syv in 1695 published an edition of 200 ballads. The manuscript and printing traditions for ballads in Denmark are thus comparatively early.

Printing and Ballads.—Ballads have entered the area of more formal literature in two ways: as material for the broadside press and as models for the literary or imitation ballad written by the poet. Broadsides (the printer's term for single, large sheets of paper) containing all forms of popular verse were issued by the

commercial presses almost from the time of the earliest printers. From the 16th to the 19th centuries there is a horde of such ephemeral verse, much of it of interest only to the historian and student of popular taste. The printing of traditional ballads on such broadsides preserved copies of songs or variants of songs that might otherwise have been lost. The poetasters on occasion reworked the substance of ballads for printing, and their handiwork can be recognized. Comparison of a traditional version of "Riddles Wisely Expounded" (no. 1 C in the Child collection, taken down from recitation by William Motherwell early in the 19th century) with the 17th-century broadside copy in the collection made by Samuel Pepys (Child no. 1 A) reveals the false notes of supposed elegance and rectitude that the broadside poetaster is responsible for. The bathos of phrasing, the latinate vocabulary, the abstract terms, the moralizing conclusion, the intrusion of the "maker" into the song, all these are marks of an alien influence on traditional verse.

The widespread story of a revenant coming on horseback to seize and carry off his grieving love in a wild ride to his grave exists in English in a broadside form under the title "The Suffolk Miracle." Since it was such a fine ballad in other European tongues, Child included it in his collection in spite of thinking that it might "be classed with the vulgar prodigies printed for hawkers to sell and for Mopsa and Dorcas to buy." This ballad has since Child's time been collected from tradition in variants markedly superior to the earlier known broadside. Whether the oral texts are derived ultimately from the broadside printings of the 17th century is hard to say; Phillips Barry thought that the Scotch-Irish oral tradition of this ballad was independent of the broadside and doubtless older. "The Suffolk Miracle" demonstrates the relations of broadside printing and a tradition of song orally transmitted. Printing has crossed oral tradition, and probably few ballads are free of this helpful crutch to memory and the editing and "improving" that printing has usually entailed. The tale of "The Suffolk Miracle" was turned by Gottfried August Bürger (*q.v.*) into the famous literary ballad "Lenore," thus illustrating the other contact between the popular ballad and literature. At the end of the 18th century men of letters developed a great interest in folk song. The term "ballad revival" is used to describe this interest, which ranged in time from Percy to Scott. The literary ballad became a fashion with the romantic school in Germany and Great Britain particularly. The language of the common man, the narratives of wonder and superstition, the four-lined stanza, these became hallmarks of a poetic tradition that Herder, Goethe, Scott, Coleridge, Keats and others derived from the ballads.

The Study of Ballads.—The main activity in ballad study since the beginning of the 19th century has been collecting and editing. Collecting may be a separate task, as in field collecting (often with phonograph or tape recorder). The fruits of such collecting increase the holdings of such repositories as the Folk Song archive of the Library of Congress, the libraries of the British Broadcasting corporation and of Cecil Sharp house in London, Das Deutsche Volksliedsarchiv in Freiburg, and Dansk Folkemindesamling in Copenhagen, to name only a few. The editor is also a collector, however; Grundtvig and Child thought of themselves primarily as collectors, although the first great analytical contributions are also found in their editions. Collections are made in libraries as well as in the field. There have been three main phases in this era of collection. The first extends to the mid-19th century. It is characterized by the gentleman amateur preserving "reliques of antiquity" for a "polished age," atoning for rudeness of style and taking liberties with the text. The second period is the age of emergence of scrupulous editing and scientific scholarship; it is dominated by the work of Grundtvig and Child. In this period the significance of the variant is recognized. The third era results from Sharp's insistence on the music as of equal importance with the text. There has been a comparable scholarly development in other lands, although the Anglo-American, Danish and German ballads are more adequately edited and presented for scrutiny than those from elsewhere.

During the early part of the 20th century there took place a fierce scholarly debate, now only of historical interest, on the origin of ballads. The case for a communal origin of ballad poetry, championed by Gummere, was based on the assumption that ballads represent that variety of spontaneously created poetry that a throng might produce in co-operative dance and ritual observance. His ideas were compounded of too narrow an interpretation of German romantic asseverations like Uhland's *die Völker dichten,* (too literally read by Gummere as "the folk compose"), together with the application of the evolutionary principle to literature with the ballad regarded as the primal protoplasm. There were many attacks on the communalists, the most direct being that by Louise Pound in her *Poetic Origins and the Ballad* (1921). The "ballad war" proved of value primarily because of its by-products: scholars came to understand ballad style and language better, they perceived differences in narrative structure, they documented such stylistic devices as "incremental repetition" and they examined all the external historical evidence available. A balanced position between the communalists and the individualists is that taken by G. H. Gerould, summed up by the phrase "communal re-creation," by which is stressed the shaping effect of oral transmission.

Other major concerns of scholars include cataloguing and classifying of the materials collected and the preparation of bibliographic aids for further study; study of individual ballads and their changes through time; analysis of international connections and the dissemination of ballads. But ballads are not of interest only to the scholar; since the 1930s the general public has been receptive to a growing avalanche of recorded ballad music that bespeaks a 20th-century ballad revival. Discographies (lists of recordings) appear in most modern editions of ballads. The new and wide interest in ballads raises new questions of classification and judgment of performance and of the song performed—the authentic as opposed to the commercialized folk song, purism as opposed to eclecticism.

See FOLK DANCE; FOLKLORE; FOLK MUSIC; *see* also Index references under "Ballad" in the Index volume.

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BALLADE, a fixed form of verse best exemplified in French literature, allowing considerable variation within precise limits and capable of great complication (*ballade laie; ballade triple; ballade balladant; ballade équivoque, rétrograde et léonine*). Basically it consists of three stanzas and an envoy, the final lines of each stanza and of the envoy being identical (the refrain). The whole poem is constructed on three or four rhymes, masculine and feminine mixed, for preference, recurring in the same order in each stanza, the rhymes of the second part of the stanza being repeated in the envoy. These rules, gradually evolved from Guillaume de Machaut (*c.* 1300–1377) onward, are set out in Jean Molinet's *Art et Science de Rhétorique* (printed in 1493), where it is further laid down that the length of the stanza is determined by the number of syllables in the refrain. An eight-syllable refrain, for example, requires eight-line stanzas; thus a possible four-rhyme pattern for a *huitain* would be *ababccdD* or *ababcdcD*. François Villon does not always observe this correspondence between syllables and lines (*e.g.,* in his "Ballade et

Oraison": "Père Noé . . ."). The envoy is sometimes omitted in both French and English ballades (as by Charles d'Orléans and Villon; Chaucer and many others); it may vary in length from four to seven lines, as in Villon's "Prière à Nostre-Dame" and "La grosse Margot" (ccdccD). Molinet required it to begin with *Prince,* or some similar form of address to a patron or literary judge. This is not the case with most of Charles d'Orléans' envoys nor always with Villon's (*see,* for example, his "Ballade de bonne doctrine" and "La grosse Margot"). Among the most striking regular ballades ever written is, however, Villon's "Dames du temps jadis" of which the first stanza runs:

Dictes moy ou, n'en quel pays,	*a*
Est Flora, la belle Rommaine,	*b*
Archipiades, ne Thaïs,	*a*
Qui fust sa cousine germaine,	*b*
Echo parlant quant bruyt on maine	*b*
Dessus riviere ou sus estan,	*c*
Qui beaulté ot trop plus qu'humaine?	*b*
Mais ou sont les neiges d'antan?	*C*

and the envoy:

Prince, n'enquerez, de sepmaine,	*b*
Ou elles sont, ne de cest an,	*c*
Qu'a ce refrain ne vous remaine:	*b*
Mais ou sont les neiges d'antan?	*C*

The ballade had its origin in the Italian *canzone di ballo,* and developed toward its modern pattern through Provençal literature, to reach its most elaborate and highly polished form in the 14th and 15th centuries in France where, from the reign of Charles V. it flourished and became popular. Machaut and the *Livre des cent Ballades* occasionally offer heterometric stanzas (*i.e.,* with one shorter line), Eustache Deschamps and Georges Chastellain vary the number of lines up to 13 (with feminine alexandrine refrain); Charles d'Orléans favours the eight- or nine-line stanza (once with five-syllable lines). Jean Froissart, Alain Chartier, Christine de Pisan and Henri Baude were experts in the ballade, but the undoubted master of the genre was François Villon (*q.v.*). Clement Marot, Mme. Antoinette Deshoulières, Jean François Sarrazin, Vincent Voiture and Jean de La Fontaine used it with skill, but, attacked by Molière and Nicolas Boileau-Despréaux, it fell into disfavour. It was revived, some 200 years later, by Théodore de Banville, whose *Trente-six ballades joyeuses* (1873) found many imitators.

In no other language except English has this typically French form found favour. In the 15th and 16th centuries many ballades were written, with more or less close attention to the French rules, by English poets, in particular by Chaucer, by John Gower (whose surviving ballades, however, are all in French) and by John Lydgate. After the 16th century original ballades were no more written in English until the end of the 19th century, when they were reintroduced successfully by Andrew Lang, whose *Lays and Lyrics of Old France* (1872) was the first published work to revive the ballade in its pure form; by Austin Dobson, whose "The Prodigals" (1876) is an example of a correct English specimen; by Swinburne and Rosetti, both notable for their translations from Villon; and by Edmund Gosse and W. E. Henley. At the same time ballades were being written in the United States, where they were even more popular than in England, by Oscar F. Adams, Brander Matthews and Clinton Scollard, among others. In the 20th century G. K. Chesterton wrote successful ballades.

See G. Lote, *Histoire du vers français,* vol. ii, pp. 270–285 (1949).

(F. J. We.)

BALLAD OPERA, a type of opera peculiar to England, where it originated in the 18th century. The plots were usually in the nature of a burlesque or extravaganza while the music, mainly confined to songs or interludes interspersed in the spoken dialogue, was based on popular tunes, at first ballads or folksongs to which new words were adapted, and later often tunes borrowed from the works of well-known composers. The most famous and one of the earliest ballad operas was *The Beggar's Opera* (1728), a satire on contemporary politicians and Italian opera, on a text by John Gay, with music adapted by John Pepusch (*qq.v.*). It had many imitators, and music for ballad operas was adapted or composed by Thomas Arne, Charles Dibdin, William Shield, Samuel Arnold, both Linleys, William Jackson, James Hook and Stephen Storace, among others. The ballad opera also had an influence abroad, and by its affinities with the French vaudeville, led to the development of *opéra comique* and of the German Singspiel. In England it developed into the light opera of Gilbert and Sullivan and, indirectly, through musical comedy (*q.v.*), into the modern "musical." In the 20th century there have been notable revivals of early ballad operas, and also, closely connected with the revival of folk song, attempts, both in England and in the United States, to revive the form itself, the most notable being Vaughan Williams' *Hugh the Drover.*

See E. Walter White, *The Rise of English Opera* (1951). (Cs. Ch.)

BALLANCE, JOHN (1839–1893), New Zealand statesman, who, as prime minister (1891–93), initiated much progressive and enlightened legislation, was born at Glenavy, Antrim, Ire., on March 27, 1839. A farmer's son, he worked as an ironmonger in Birmingham, Eng., where he acquired political, economic and literary interests. He emigrated to New Zealand in 1865 and settled at Wanganui, where he founded the *Wanganui Herald.* He entered parliament in 1875 and supported the Liberal policy of leasing rather than selling crown lands. As colonial treasurer in Sir George Grey's cabinet (1877–79), he imposed a tax on unimproved land values. As minister of lands and native affairs in the Stout-Vogel government (1884–87), Ballance promoted village settlements, putting poor men on farms of 20–50 ac. at low rents with small advances for initial expenses, but with limited success.

When the Liberals came to power with a sound majority in 1891, the country was ripe for substantial changes and, in particular, for the breaking up of large estates and for the closer development of the land. Organized labour, defeated in the maritime strike of 1890, turned to parliament to win security. Ballance, who became prime minister, had able men in his government: Pember Reeves as minister of education, justice and labour; R. J. Seddon as minister of mines and public works; and John Mackenzie as minister of lands and immigration. Despite heavy opposition from the legislative council much was effected. The property tax penalizing improvement was replaced by Ballance's graduated income and land taxes which pressed on large estates. The government gained the right to repurchase private lands to develop them effectively. On crown land perpetual leasing at low rents was favoured, while purchasing the freehold, though not prohibited, was discouraged. Reeves began his series of acts that in five years gave what was then the most progressive labour code in the world, by removing abuses in factories and shops and by prohibiting payment of wages except in money; coal mines were also regulated. The legislative council was made more docile by reducing life membership to seven years, and Ballance was also responsible for the introduction of female suffrage, though this was not brought about in his lifetime.

Ballance combined liberal fervour with a sense of detail, chose and handled his colleagues well, was tactful, courteous and humane. He was still in office when he died on April 27, 1893.

(N. M. Ta.)

BALLANCHE, PIERRE SIMON (1776–1847), made a distinctive contribution as a religious and social philosopher to French thought and literature during the first half of the 19th century. He was born at Lyons on Aug. 4, 1776. His outlook was fundamentally Catholic, but he also owed much to the views of J. Böhme, J. G. von Herder, G. B. Vico, C. Bonnet and the Illuminists (*see* Illuminati) of Lyons. His *Du Sentiment considéré dans ses rapports avec la littérature et les arts* (1801) anticipates Chateaubriand's *Génie du Christianisme.* The problems of post-revolutionary France turned his thought to the origins and purpose of human society. *Essai sur les institutions sociales* (1818), like *Le Vieillard et le jeune homme* (1819, re-edited by R. Mauduit, 1929), reveals a mystical conception of the relation between tradition and progress, and reconciles the principle of Christian monarchy with liberal humanitarianism. Ballanche offered many of his quasi-prophetic works as "epics," usually amorphous compositions combining illuminism with speculations about comparative mythology. Such are the *Essais de palingénésie sociale* (1827–29), an ingenious interpretation of the Orpheus myth, and two incomplete works: *Formule générale de l'histoire de tous les peuples*

appliquée à l'histoire du peuple romain and *La Ville des expiations* (1832–35, re-edited by A. Rastoul, 1926). Ballanche's basic theme is the "rehabilitation" of fallen man through *"épreuve," "expiation"* and *"initiation." Antigone* (1814) and *L'Homme sans nom* (1820) had exemplified individual and collective expiations; "initiation" is mainly collective. He rejects Rousseau's doctrines. Society is the divinely appointed instrument whereby mankind is gradually released from "fatality" and educated for freedom—willing conformity to the designs of Providence. History is a succession of social rebirths or "palingeneses" by which closed societies open out until at last all classes achieve civic status. This is the work of great "initiators" from Orpheus to Jesus, in whose teaching all future initiations are implicit. *La Ville des expiations* applies this doctrine to criminal reform, and forecasts a theocratic organization of society. *La Vision d'Hébal* (1831) presents these views in apocalyptic guise. Ballanche's writings (partly collected, four volumes in 1830, six volumes in 1833) are diffuse and ill-organized, but their peculiar blend of poetry and prophecy appealed strongly to successive generations of romantic writers. Ballanche died in Paris on June 12, 1847.

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BALLANTYNE, ROBERT MICHAEL (1825–1894), Scottish author of stories which remain popular for their presentation of heroes whose self-reliance and moral uprightness lead to lively adventure, was born in Edinburgh on April 24, 1825. A clerk in the Hudson's Bay company (1841–48), he based his first book for boys, *The Young Fur-Traders* (1856), on his own experiences. In *Coral Island* (1857) he made a mistake through lack of firsthand knowledge and thereafter traveled widely, sharing the lives of lighthouse-keepers, lifeboatmen, tin miners and salvagemen to confirm his facts. Among the best known of over 80 books are *Martin Rattler* (1858); *Dog Crusoe* (1860); and *The Gorilla Hunters* (1862). He died in Rome on Feb. 8, 1894.

BALLARD, the name of a family of printers who from 1560 to 1750 virtually had a monopoly of music printing in France. The founder of the dynasty was Robert Ballard (d. 1588) who was brother-in-law to Adrian le Roy, the celebrated lutenist and composer. These two used movable type, cut in 1540 by Robert's father-in-law, Guillaume le Bé (or du Gué), and printed much secular and sacred vocal music and volumes of lute tablature. Their first patent was granted in 1552 as sole music printers to Henry II. Robert's widow and son Pierre (d. 1639) continued the business and further patents were obtained from Henry IV and Louis XIII. Robert's grandson Robert II ran the firm from 1640 to 1679, and it was taken over successively by Christophe (d. 1715), Jean Baptiste Christophe (d. 1750), Christophe Jean François (d. 1765) and Pierre Robert Christophe (d. 1812), who carried on management until 1788. Throughout the history of the family the women were often as active in the business as the men.

Ballard publications, both those with the early movable type and the later ones engraved on copper plates, were noted for their beauty and care of presentation. Their title pages were frequently superb examples of decorative engraving. The music published by the family represented practically all the French composers of the period. The extensive list includes lute tablatures by Adrian le Roy, organ music by Jean Titelouze, vocal works by Clément Jannequin, Claude Goudimel and Orlando di Lasso, Marin Mersenne's *Harmonie Universelle*, works by André Campra, François Couperin, Michel de Lalande, Michel de Montéclair, François Philidor, and Jean Philippe Rameau, and Lully's operas and ballets. (B. P.)

BALL BEARINGS: *see* BEARINGS.

BALLET. A form of theatrical performance in which classical dancing is employed, usually in conjunction with music, pantomime and painting (in costumes and scenery), to tell a story or to express a theme. The term is also used to denote the technique of the classic dance, as when a child studies ballet. The word ballet derives from the Italian *ballare* ("to dance"). Originally a court spectacle, in which performers as well as audiences were drawn exclusively from the nobility, ballet became popular with the general public as early as the 18th century, when itinerant troupes of dancers gave performances all over Europe, and even in America. Until the 20th century, however, ballet developed most luxuriantly in the sheltered atmosphere of the court theatre or state opera house. The extensive world tours of the great ballerina Anna Pavlova, between 1910 and 1930, the widespread activities of organizations such as the Ballet Russe de Monte Carlo, Ballet Theatre (now the American Ballet Theatre), the New York City Ballet, the Royal Ballet and, after 1950, the inestimable influence of dancing seen in motion pictures and on television, all contributed to a tremendous growth of interest in ballet. In 1955 a televised performance of Petr Ilich Tchaikovsky's ballet *The Sleeping Beauty*, danced by the Sadler's Wells (now the Royal) Ballet, was seen by an estimated 30,000,000 viewers.

DEVELOPMENT OF THE ART

Court Ballet.—Ballet, like opera, is directly descended from the court festivals of the Italian Renaissance. In the days of the Medici it was customary to honour distinguished guests with elaborate banquets lasting five or six hours. The entertainment at these feasts often consisted of a series of entrees, or interludes of music, poetry (sung or declaimed), pantomime and dancing, loosely linked together by a central theme. Costumes were lavish, and the scenery, built up in three dimensions in the centre of the banquet hall, was often magnificent. Leonardo da Vinci designed the settings for several of these festivals at the court of Milan. One such fete, given in Tortona, Italy, in 1489, has been called the first actual ballet performance. Bergonzio di Botta, a wealthy gentleman addicted to extravagant entertaining, arranged a banquet in honour of Gian Galeazzo Sforza, duke of Milan, and his bride, Isabella of Aragon. Between the courses, the story of Jason and the Golden Fleece was enacted in music and dance. The participants were members of the nobility, and the dances they executed were based upon the formal, elegant court dances of the period.

When Catherine de Medicis became queen of France, she introduced there the banquet entertainments of her native Italy. Rumour said that she hoped through these diverting spectacles to distract the attention of her son, Henry III, from affairs of state. At any rate she made ballet history when, on Oct. 15, 1581, she presented the *Ballet comique de la reine*, celebrating the marriage of the duc de Joyeuse and Marguerite of Lorraine. This is the first ballet of which there is a complete printed account. Its author and choreographer was Baldassarino de Belgiojoso (Balthazar de Beaujoyeulx), an Italian violinist whom Catherine had appointed official director of court festivals. The story concerned the legend of Circe and was enacted through music, poetry and allegorical dances by the queen, her ladies and the nobles of the court. The *Ballet comique* was a brilliant success, and Belgiojoso (or Beaujoyeulx, as he was known in France) published a description of it in a sumptuous volume that might be called the first ballet libretto. His definition of ballet as "a geometrical arrangement of many persons dancing together under a diverse harmony of instruments" would apply to many works danced in modern times. (*The Art of Ballet*, Mark E. Perugini, p. 57; Martin Secker & Warburg, Ltd., London.)

In England, the Italian custom of masquerading during balls had been introduced during the reign of Henry VIII. It grew in popularity and gradually evolved into the English masque, a form of spectacle very similar to French court ballet. Ben Jonson, author of delightful masques, owned a copy of the *Ballet comique da la reine*, which is now in the New York Public library. Court dances, during this period, were of two general types: the *basse danse*, of which the stately and dignified pavane was an example, and the lively *danse haute*, typified by the merry galliard, favourite dance of Queen Elizabeth I, with its quick running steps, jumps and capers. A remarkable book called *Orchésographie*, published in 1588 by a priest, Jehan Tabourot, using the pen name of Thoinot Arbeau, described these dances with such clarity that they can be reconstructed today. Later, French and Italian dancing

masters, such as Cesare Negri, who published treatises in 1602 and 1604, were to polish and elaborate upon the simple steps of these popular dances until they became the foundation of the classical ballet technique.

For another century, however, ballets continued to be performed by aristocratic amateurs. The dances remained simple, but a wide range of subject matter offered ample opportunity for resplendent display in costumes and décor. One early 17th-century ballet dealt with the regions of the upper air, and entrees represented hail, fog, lightning, clouds, a comet and a shooting star. Tobacco was the theme of a ballet given in Turin, Italy, in 1650. Its scenes represented the smoking and snuff-taking customs of various nations, as well as Indian cultivation of the plant. Other ballets ranged from *Curiosity* (in which Idleness ran about hunting for False Rumours) to the exotic *Ballet of the Seven Kings of China*. In 1632, for the first time, ballet performances were open to the general public on certain occasions, instead of only to invited court guests.

Ballet Under Louis XIV.——During the long reign of Louis XIV, ballet developed into a serious art form. Fond of dancing in his youth, Louis participated in many performances at court. His name of *le Roi Soleil* ("the Sun King") originated when he took the part of the sun in *Ballet de la nuit* in 1653, when he was 15. Louis gave up performing at 30 but throughout his lifetime remained an enlightened patron of ballet. Artists of genius were attracted to the French court, and such men as the dramatist Molière, the composer Jean Baptiste Lully, the poet Isaac de Benserade and the choreographer Charles Louis Beauchamp contributed to the development of the ballet. Their productions were conceived on a scale of unparalleled magnificence, but frequently they were hampered by a lack of trained performers. The form of Molière's comedy ballets, with the dance interludes spaced between spoken scenes, was actually dictated by the scarcity of skilled dancers. So few were available that Molière was obliged to allow time for them to change costumes and appear over and over again.

This shortage of dancers and the inability of the noble amateurs to keep pace with the increasing technical demands of professional dancing masters inspired Louis XIV to establish the Académie Royale de Danse in 1661. In the letters patent for its foundation, he declared that "Although the art of dancing has always been recognized as one of the most honorable, and the most necessary for the training of the body, . . . many ignorant people have tried to disfigure the dance and to spoil it . . . so that we see few among those of our Court and Suite who would be able to take part in our ballets, whatever scheme we drew up to attract them thereto. It being necessary, therefore, to provide for this, and wishing to establish the said art in its perfection, and to increase it as much as possible, we deemed it opportune to establish in our good town of Paris a Royal Academy of Dancing . . . ." (*The Art of Ballet*, Mark E. Perugini, p. 103; Martin Secker & Warburg, Ltd., London.)

The success of this academy, made up of the most experienced dancing masters of Paris, led Louis to found the Académie Royale de Musique in 1669 and to add a school of dancing, for the express purpose of training professional dancers, in 1672. These united organizations became the Académie Royale de Musique et de Danse, or Paris Opéra, which has remained for nearly three centuries a centre of ballet production.

Although court ladies frequently participated in royal *divertissements*, female roles on the public stage were played by young men until, in his ballet *Le Triomphe de l'amour*, in 1681, Lully introduced the first professional women dancers. A small ensemble was led by Mlle Lafontaine, the first *première danseuse*. The innovation was immensely successful; Lafontaine was called *la reine de la danse*. Elegance and dignity characterized the feminine dance of the time, for women's movements were hampered by their heavy costumes, similar to court dresses. Ballet was gracious and decorative but limited as a means of expression.

It was Pierre Beauchamp, first choreographer of the Paris Opéra, who defined the five positions of the feet, on which classical ballet technique is based. He also invented one of the earliest forms of dance notation. There have been many attempts to formulate a script in which dances could be accurately recorded, just as musical compositions are written down. Beauchamp's system, which was partially successful, has come down to us through the publications of his pupils Raoul Ager Feuillet, whose *Chorégraphie où l'art décrire la danse* dates from 1699, and Louis Pécourt, who succeeded Beauchamp as choreographer at the Paris Opéra.

In the last years of the Sun King's reign, ballet sought new dramatic expressiveness. At a fete given by the duchess of Maine in 1708, Jean Balon (Ballon) and Françoise Prévost mimed the last act of Pierre Corneille's *Les Horace*. The musical accompaniment dispensed with explanatory words, but the dancers' pantomime was so lucid that the audience was moved to tears.

At about the same time, in England, John Weaver was making similar experiments in dramatic dancing. Probably influenced by the pantomimes of John Rich, the famous Harlequin, Weaver produced narrative ballets (advertised as consisting of "dancing, action, and motion only") such as *The Cheats of Scapin, or, the Tavern Bilkers* (1702) and *The Loves of Mars and Venus* (1716).

The Rise of the Virtuoso.—With the professional dancer firmly established, ballet technique developed rapidly. Women were still hampered by cumbersome costumes, but men were not so restricted, and soon began to explore the possibilities of *pas d'élévation*, or jumping steps. Jean Balon, who appeared at the Opéra from 1691 to 1710, danced with such remarkable lightness that this quality in dancing is still called *ballon*. He achieved extraordinary brilliance in spite of the fact that dancers habitually wore heeled shoes, which limited the flexibility of the foot. The traditional ballet costume for men, since the days when Louis XIV had danced the heroic roles of Greek gods and Roman warriors, had been the costume *à la Romaine*, or *tonnelet*, a stiff, bell-shaped, wired skirt of brocade or similar material, resembling in shape if not in lightness the tutus worn by ballerinas in modern times. Male dancers, and sometimes women, too, wore leather masks, comic or tragic in appearance, which represented the character portrayed and concealed all facial expression.

Marie Camargo, who made her Paris debut in 1726, was one of the first important innovators in the technique of the classic dance. Lacking in beauty and grace, she achieved great brilliance and virtuosity. Taught by David Dumoulin, she excelled in *entrechats*, *jetés battus*, *cabrioles* and other jumping steps formerly executed only by men. To show her twinkling feet, she shortened her skirts to the middle of the calf. She also adopted the *caleçon de precaution*, or close-fitting drawers, previously considered an unnecessary refinement. (Camargo is also credited with the invention of the heelless slipper.) Her favourite vehicle, a plotless *divertissement* typical of the period, was *Les Caractères de la danse*, a series of solo dances in contrasting styles, including the minuet, courante, saraband and *gigue*.

Camargo's rival, Marie Sallé, was noted for her extraordinary grace and expressive gesture. Probably influenced by her early appearances in London with John Rich, she rebelled against the formal construction of the *divertissements* presented at the Paris Opéra. In 1734, in London, she created a ballet called *Pygmalion*, which told the familiar story of the sculptor whose masterpiece came to life. As the statue, Sallé discarded the usual ballet costume, with its stiff panniers, and appeared in a simple muslin robe, her hair flowing. She attempted to unify the music, costume and style of dancing, thus anticipating the reforms of Jean Georges Noverre by a quarter of a century.

At the Paris Opéra, dancers concentrated on perfecting their technique, and such virtuosos as the brothers François, Pierre and David Dumoulin, Jean Barthélemy Lany and Louis Dupré continued to expand the vocabulary of ballet steps. The Paris appearances of Italian acrobatic and comic dancers, such as Pietro Sodi, Nicolini Grimaldi (father of the famous clown "Joey") and the spectacular Barberina Campanini, stimulated French emulation. Gaetan Vestris, the so-called "god of the dance," developed the broad, high leap or *grand jeté*, still one of the most effective steps in classic ballet, and elaborated on the *pirouette*, or multiple turn on one foot, which was brought to Paris about 1770 by the German dancer Anne Heinel. Auguste Vestris, son of Gaetan, and his younger rival Louis Antoine Duport continued to experiment with

technique, until by 1800 men were able to execute incredibly high, sustained leaps and dazzling sequences of pirouettes.

Dramatic Ballet: The Ballet d'Action of Noverre and Angiolini.—Throughout ballet history, there has been an unending struggle between the exponents of the pure dance of formal, decorative beauty and virtuosity, and the advocates of dance as a means of dramatic expression. While technical advancement was making the classic ballet vocabulary a fluent language capable of expressing dramatic and emotional situations, theoreticians and choreographers were in bitter revolt against its use for purposes of mere acrobatic display. The most articulate and influential of the advocates of the *ballet d'action,* or drama in dance form, was Jean Georges Noverre, whose *Lettres sur la danse et sur les ballets,* published in 1760, is still considered the authoritative work on the subject. Nevertheless, the reforms advocated by Noverre were not so untried as he implied, for other choreographers had already achieved considerable success in this direction before he pointed the way.

The pantomimes of Rich and the early dramatic ballets of Weaver, as well as Sallé's *ballets d'action, Pygmalion* and *Bacchus and Ariadne,* were all staged in London. In Paris, in 1729, Sallé adapted the familiar solo work *Les Caractères de la danse* to duet form in order to give it a wider pantomimic range, and in it both she and her partner, Antoine Bandieri de Laval, discarded the traditional mask so that their expressions might be seen.

From about 1737 Jean Baptiste de Hesse, ballet master of the Théâtre Italien, Paris, staged a series of pantomimic ballets deriving from the commedia dell'arte. In 1753 he choreographed a tragedy in dance mime, *Acis et Galatée,* which seems to have been a genuine forerunner of the ballets of Noverre. Many of De Hesse's pupils, whom he trained as dance actors, later became stars of the Paris Opéra. Nevertheless his innovations seem to have had little influence on that stronghold of conservatism, and his name and works passed into oblivion.

In Vienna, about 1740, the choreographer Franz Hilverding was producing dramatic ballets such as *Britannicus,* based on Racine's tragedy, and *Alzire,* after Voltaire. For other themes he drew on Greek mythology, as in *Venus and Adonis* (1753), *Diane et Endymion* (1754) and *Ulisse et Circe* (1756).

Hilverding's pupil, Gasparo Angiolini, continued his work in Vienna and went still further in the development of the danced drama. In the preface to his ballet *Le Festin de Pierre, ou Don Juan* (1761), Angiolini stated: "If we can stir up every passion by a mute play, why should we be forbidden to attempt this? If the public does not wish to deprive itself of the greatest beauties of our art, it must accustom itself to be moved by our ballets and brought to tears . . . ."

Angiolini endeavoured to revive the ancient ballet pantomimes of the Romans, as he explained in the preface to his ballet *Semiramide* (1765). In both of these works, as well as in the original production of the opera *Orfeo ed Euridice,* he collaborated with the composer Christoph Gluck.

Although the work of his predecessors and contemporaries should not be minimized, it was Noverre who forcefully called attention to the decadent state of ballet in Paris and brought about extensive reforms. When he wrote his revolutionary *Lettres,* he was only 33 and ballet master of a provincial theatre in Lyons. Nevertheless he dared to challenge the potent authorities at the Paris Opéra. "A well-composed ballet . . . must be expressive in all its detail and speak to the soul through the eyes; . . ." he wrote, ". . . Steps, the ease and brilliancy of their combination, equilibrium, stability, speed, lightness, precision, the opposition of the arms and legs—these form what I term the mechanism of the dance. When all these movements are not directed by genius, and when feeling and expression do not contribute their powers sufficiently to affect and interest me, I admire the skill of the human machine, I render justice to the strength and ease of movement, but it leaves me unmoved . . . ." "Dancing," he continued, "is possessed of all the advantages of a beautiful language, yet it is not sufficient to know the alphabet alone. When a man of genius arranges the letters to form words, and the words to form sentences, it will cease to be dumb; it will speak with both strength and energy; and then ballets will share with the best plays the merit of affecting and moving, and of making the tears flow, and, in their less serious styles, of being able to amuse, captivate and please . . . ." (J. G. Noverre, *Letters on Dancing and Ballets,* trans. by C.W. Beaumont, pp. 16, 19–20, C.W. Beaumont, London, 1930.)

Noverre's theories shocked dancers who had spent all their lives mastering technical feats designed to entertain without stirring the emotions. His ideas were not welcomed at the Paris Opéra. In Stuttgart, Ger., London, Vienna and Milan, Italy, however, he carried out his theories in nearly 100 ballets, such as *Fêtes Chinoises* (about 1751), *Les Caprices de Galathée* (about 1758), *Psyché et l'Amour* (1762), *Adele de Ponthieu* (1773) and *Les Horaces* (1774). Drawn by curiosity, Gaetan Vestris went to Stuttgart to observe Noverre's work and was so impressed that he returned each summer to dance in Noverre's ballets. In 1770 Vestris arranged for the production at the Paris Opéra of an abbreviated version of Noverre's *Medée et Jason.* The leather mask, which Noverre had attacked in his book, was still used by male dancers in Paris. Now, in the role of Jason, Vestris discarded it, revealing an unsuspected talent for acting. A little later Maximilien Gardel followed his example, and the mask fell into disuse. A trace of its influence remains in the chalk-white make-up of Pierrot.

In 1776 Noverre was finally called to the Paris Opéra. There, in the ballerina Marie Madeleine Guimard, he found the ideal interpreter of his *ballets d'action.* Her mime was as convincing as her technique was skilful. Two of his own pupils, Jean Dauberval and Charles Le Picq, carried out his theories in the ballets they produced in Italy, England, France and Russia. At the Grand theatre, Bordeaux, France, in 1789, Dauberval staged *La Fille mal gardée,* which shares with Vincenzo Galeotti's *The Whims of Cupid and the Ballet Master* (in the repertoire of the Royal Danish Ballet) the distinction of being the oldest ballets still performed in the early 1960s.

Noverre's theories were followed and amplified by the Italian choreographer Salvatore Vigano, a pupil of Dauberval. Long active in Vienna, he staged Beethoven's only ballet, *Prometheus,* in 1801. Whereas Noverre had been content to carry forward the dramatic action in long mimed scenes that alternated with formal dances, Vigano sought to achieve a synthesis of dancing and pantomime. In 1811 he became choreographer at La Scala, Milan, where, during the next ten years, he produced such heroic works as *Mirra, La Vestale, I Titani* and *Otello.* Vigano assigned definite individual characteristics to each of his dancers and built up the roles of his ballets like those in a play. He was skilful in handling great masses of people and liked to work on a grandiose scale. The effectiveness of his method is attested by Stendhal, who wrote that the tragedian Edmund Kean in *Otello* and *Richard III* had not moved him as much as Vigano's ballets.

Le Picq, Dauberval, Vigano and a few later followers such as Gaetano Gioja and Louis Henry constructively developed the theories of Noverre. In Paris, however, Pierre Gardel and other Paris Opéra choreographers continued to stage conventional ballets, patterned after a routine formula, on subjects that had been popular a century earlier: gods and goddesses, nymphs and fauns, shepherds and shepherdesses. The advent of the romantic period was to bring new themes, new techniques and a new style of dancing.

The Romantic Ballet.—The spirit that infused the arts in the early years of the 19th century and that was expressed in the novels of Sir Walter Scott and Victor Hugo, in the music of Frédéric Chopin and Louis Hector Berlioz, and in the painting of Eugène Delacroix, found its perfect symbol in the dancing of Marie Taglioni. Fragile, delicate, lighter than air, she danced as though she were a disembodied spirit.

The innovations of Auguste Vestris and Duport, with their vigorous leaps and vertiginous pirouettes, had brought ballet technique to a high state of advancement by the time Taglioni began her training. Shortly after 1800—the exact date has never been established—women had begun to dance on the extreme tips, or points, of the toes. The possibilities of this new technical device had not yet been thoroughly explored, however, and it remained for

Taglioni to make such imaginative use of points that their introduction has often been erroneously credited to her. She used them so that she was able to achieve the actual illusion of flight. Trained chiefly by her father, Filippo Taglioni, Marie made her debut in Vienna in 1822. Ten years later, with the creation of her father's ballet *La Sylphide* at the Paris Opéra, March 12, 1832, she inaugurated a new era in the history of ballet.

"The old dancing did not appeal to the mind, but spoke only to the eyes," wrote Charles de Boigne, in his *Petits mémoires de l'Opéra*, ". . . the dance was merely a profession, the profession of jumping as high as possible, and pirouetting like a top . . . ." Operatic ballets were still based chiefly on Greek legends, interpreted according to rigid balletic convention. Taglioni discarded ancient subjects for more romantic themes.

"After *La Sylphide*," wrote Théophile Gautier, ". . . the Opéra was given over to gnomes, undines, salamanders, nixes, wilis, peris —to all that strange and mysterious folk who lend themselves so marvellously to the fantasies of the *maître de ballet* . . . . The Greek cothurnus was exchanged for satin shoes . . . ."

The diaphanous dress worn by Taglioni in *La Sylphide*, with its fitted bodice and airy, bell-like skirt, was the prototype of the tutu, or full, light skirt which, in various lengths, has remained the accepted uniform of the classical dancer for more than a century. Ballet costume had undergone sweeping reforms at the time of the French Revolution, when the panniers and hoop skirts abhorred by Noverre were finally discarded in favour of clinging tunics inspired by Greek robes. Taglioni, noted for the modesty and purity of her dancing, had adopted a long, full skirt of the Sylphide type for *Flore et Zéphire*, two years before the creation of her most famous role. This was the costume she always preferred. It is still used in Michel Fokine's *Les Sylphides* (inspired by the earlier ballet) and, in adapted form, in modern works like George Balanchine's *Bourrée fantasque*.

As the Sylphide, a forest sprite loved by a Scottish youth who abandons his fiancée for her, Taglioni created a whole new style of dancing marked by floating leaps, miraculously balanced poses (such as the *arabesque*) and a delicate, restrained use of the points. She followed her success in *La Sylphide* by other works similar in theme and likewise created by her father, *La Fille du Danube* (1836) and *L'Ombre* (1839).

In the meantime, a rival had appeared in the shape of Fanny Elssler, a Viennese dancer who epitomized the earthly aspects of romanticism and was at her best in the fiery Spanish *Cachucha* and the spirited Polish *Cracovienne*. Elssler conquered Paris in 1836, when she was 26, with the creation of the role of Florinda in *Le Diable boiteux*. This she followed with *La Gypsy* (1839) and *La Tarentule* (1839), both of which displayed to full advantage her warmth and vitality in *pas de caractère*, or theatricalized folk dances. In 1840 Elssler came to the United States, where for two years she danced with a success unprecedented in American theatrical history. Her popularity attained fantastic proportions, and she returned to Europe with a fortune estimated at $500,000. Elssler outstayed her leave of absence from the Paris Opéra by a year and a half, and on her return found its doors closed to her. She went to London and Italy, where during the next decade she found ample outlet for her varied gifts in the dramatic ballets of Jules Perrot.

The spectacular interest added to women's dancing by their recent conquest of a new plane, in dancing on the points of the toes, combined with the rare phenomenon of two contemporary but contrasted ballerinas of genius, Taglioni, daughter of the air, and Elssler, child of the earth, detracted from the importance of the male dancer and nearly caused the disappearance, in France at least, of male virtuosity in ballet. Perrot turned his attention to choreography and achieved renown for his excellent *ballets d'action*, in which all the rich resources of the ethnic dance were brilliantly adapted for the theatre. His finest works included *Ondine* (1843), *Esmeralda* (1844) and *Catarina* (1846), all created in London, which he made an important ballet centre.

While Elssler was touring America, Taglioni was in Russia, and the post of leading ballerina at the Paris Opéra fell to a young Italian dancer, Carlotta Grisi, who combined the ethereal lightness of Taglioni with the appealing warmth of Elssler. For Grisi, Gautier wrote the ballet *Giselle*, produced at the Paris Opéra June 28, 1841. Combining as it does the two principal facets of the romantic ballet, through the colourful peasant scenes of the first act and the unearthly, haunting atmosphere of the second, *Giselle* has not only survived but has increased in popularity until it has become an indispensable feature of the repertoire of almost every ballet company. Its original choreography was by Jean Coralli, but the role of Giselle, still considered the touchstone of the ballerina's art, is said to have been staged by Grisi's husband, Perrot.

Rich in great executants, the romantic period also produced Fanny Cerrito, a vivacious, undisciplined, captivating little Neapolitan, and Lucile Grahn, a Danish ballerina whose style resembled that of Taglioni. In 1845 Benjamin Lumley, an astute London theatre manager, united Taglioni, Grisi, Cerrito and Grahn in one fabulous *Pas de quatre*. Expertly staged by Perrot, this *divertissement* marked the pinnacle of the romantic ballet. Its success led to the presentation, in 1846, of *Le Jugement de Paris*, in which Taglioni, Grahn and Cerrito were supported by Perrot and Arthur Saint-Léon, a young man whose extraordinary abilities as both dancer and violinist had succeeded in overcoming the current prejudice against male dancers. Saint-Léon, like Perrot, turned to choreography, creating numerous works for Cerrito, who became his wife. His last ballet was *Coppélia*, produced at the Paris Opéra on May 25, 1870, a few months before his death.

In both Paris and London, after 1850, the leading ballerinas, including Amalia Ferraris and Carolina Rosati, concentrated on strength and virtuosity rather than on the poetic qualities that had made Taglioni's dancing appeal to the imagination and touch the heart. Choreographers exploited the physical prowess of their stars and were content to depend upon spectacular scenic effect and impressive masses of ensemble dancers rather than to cultivate the art itself, either in its dramatic aspects or as pure beauty of movement. A hint of the forgotten artistry of Taglioni was glimpsed during the brief career of Emma Livry, who made her debut in 1858. When *La Sylphide* was revived for her, Taglioni emerged from retirement to coach her in the role and to create for her, in 1860, the only choreographic work of Taglioni's career, *Le Papillon*. Just three years later Livry died, aged 21, from the effect of burns received when her ballet skirt caught fire from an open gas jet during a stage rehearsal. Her tragic death heralded the general decline of western European ballet.

The Italian School.—The technique of the classic ballet, very much as it is practised today, was codified by the Italian dancer Carlo Blasis in his *Traité élémentaire, théorique et pratique de l'art de la danse*, published in Milan in 1820. An experienced dancer and a prolific writer, Blasis issued several versions of this treatise, as well as books on such allied subjects as music, history, drama and pantomime. His indomitable energy found its principal expression, however, in his work as head of the ballet school at La Scala, Milan, a post he assumed in 1837.

The advice to young dancers that Blasis propounded in his *Code of Terpsichore* (1830) is applicable today. "Dancing," he wrote, ". . . cannot be acquired and retained without the utmost study and assiduity. Remain not, therefore, twenty-four hours without practicing . . . Particularly attend to the carriage of your body and arms. Let their motions be easy, graceful, and always in accordance with those of the legs . . . Take especial care to acquire perpendicularity and an exact equilibrium. In your performance be correct, and very precise; in your steps, brilliant and light; in every attitude, natural and elegant. A good dancer ought always to serve for a model to a sculptor or painter . . . Let your countenance be animated and expressive . . . Be vigorous, but avoid stiffness; seek to acquire a facility of spring . . . Rapidity is very pleasing in a dancer; lightness still more so . . . ."

The teaching methods of Blasis and his wife, Annunciata Ramaccini, were strict and demanding. During his long directorship of the Scala school, it became the principal source of supply for solo dancers for the entire theatrical world. Established stars, like Cerrito and Grisi, came to Milan to study with him. He developed Ferraris, Sophia Fuoco, Flora Fabbri and Marietta

Baderna, who later danced in the opera houses of Paris, London and St. Petersburg. His pupil Giovanni Lepri was the teacher of Enrico Cecchetti, one of the greatest dance pedagogues of the 20th century who became in turn director of the Scala academy and who in his turn taught Pavlova, Vaslav Nijinsky, Cia Fornaroli, and Ninette de Valois, director of England's Royal Ballet. The traditions of Blasis have been handed down directly and without interruption. These traditions include a number of Blasis' own discoveries and innovations. A statue of Mercury by Giovanni da Bologna inspired the *attitude*, which he invented. He probably discovered the snapping movement of the head that makes it possible for dancers to turn indefinitely, without dizziness. He enlarged the scope of dancing on the points. The invention of the reinforced or blocked toe-shoe, unknown to Taglioni and Elssler, who danced in soft satin slippers, enabled dancers to execute multiple pirouettes on the point instead of the demi-point, as before. It was Pierina Legnani, a graduate of the Scala academy, who first executed 32 *fouettés*, the whipping turns on one toe featured in the third act of *Swan Lake*.

Late in the 19th century there emerged from La Scala such ballerinas as Maria Bonfanti, Giuseppina Morlacchi and Malvina Cavalazzi, all celebrated in the U.S., Caterina Beretta and Rita Sangalli, stars of the Paris Opéra, and Virginia Zucchi and Carlotta Brianza, who won their greatest fame in Russia. The dazzling technique of these brilliant soloists, combined with a prevailing laxity in the training of ensemble dancers, led choreographers to concentrate on the presentation of the prima ballerina, to the detriment of ballet as a whole. This led to the degeneration and ultimate stagnation of the ballet, which by 1900 had reached a low level in most of Europe and the U.S. The exception was Russia, where the genius of Marius Petipa had fused the French and Italian schools into the form indelibly labeled Russian ballet.

Ballet in Russia Before 1900.—Ballet was firmly established in Russia by the time of Catherine the Great. Angiolini produced some of his finest works in St. Petersburg, as did Noverre's pupil Le Picq. In 1801 the French-Swedish dancer Charles Louis Didelot was appointed choreographer, principal dancer and director of the ballet school. Before his retirement in 1829, he had produced dozens of ballets, reorganized the school, imported guest artists (including Duport) and developed such native Russian dancers as Marie Danilova and Avdotia Istomina, who won the admiration of the poet Aleksandr Pushkin. From 1837 to 1842 Taglioni danced in Russia, where her father staged some of his most typical ballets, including *La Sylphide, L'Ombre* and *La Fille du Danube*. Elssler, Grisi, Cerrito and Grahn also appeared in St. Petersburg. The inspiration provided by such distinguished visitors helped produce the Russian ballerinas Elena Andreyanova, who later danced in Paris and Milan, and Nadezhda Bogdanova, whose successful appearances at the Paris Opéra were interrupted by the Crimean War.

The major force in the development of Russian ballet was a Frenchman, Petipa, who reached St. Petersburg in 1847 after a brief, adventurous career that had already included appearances in France, Spain and the United States. His brother Lucien was *premier danseur* of the Paris Opéra, while his father, Jean Petipa, had been ballet master in Brussels before going to Russia to teach in the Imperial Academy of Dancing. Marius Petipa served as leading dancer until 1858, when he was allowed to produce his first ballet, *Un Mariage sous la régence*, at the Imperial theatre. *La Fille du Pharaon*, a magnificent three-act spectacle that he staged in 1862, established him as an important choreographer. Although Perrot and Saint-Léon, who were frequent visitors to Russia, left their mark on its ballet, Petipa molded it into its distinctive national form. Appointed choreographer in 1862, he was the virtual dictator of the Russian ballet until his death in 1910.

Christian Johannsen, a Swedish pupil of August Bournonville, who in turn had studied with Auguste Vestris, was the principal teacher at the Imperial school. He developed the Russian method of teaching, with its varied exercises and its emphasis on versatility, softness and purity of line. He formed a long line of accomplished ballerinas, including Eugenia Sokolova, Ekaterina Vazem, Varvara Nikitina and Johannsen's daughter Anna, later one of the teachers of Tamara Karsavina.

Late in the century Petipa, always an admirer of virtuosity, began importing Italian stars to enhance his ballets with their glittering technique. Zucchi, Legnani and Cecchetti dazzled the Russian dancers with their brilliant tours de force. It was not long, however, before Mathilde Kchessinska and Olga Preobrajenska were emulating their most effective steps. Cecchetti remained to teach in Russia and helped to form Pavlova, Nijinsky and the other artists who burst upon the western world with such splendour during the first Paris season of the Diaghilev ballet in 1909. Petipa collaborated extensively with the composer Tchaikovsky. Although Mozart and Beethoven had written ballet music, throughout most of the 19th century it had been written to order by light, facile composers like Adolphe Adam, Cesare Pugni, Léon (Aloisius Ludwig) Minkus and Léo Delibes. Tchaikovsky's splendid scores for *The Sleeping Beauty, Swan Lake* and *The Nutcracker* remain outstanding examples of ballet composition, although Aleksandr Glazunov composed three fine ballet scores, and in the 20th century Sergei Prokofiev attempted similar things in his *Romeo and Juliet, Cinderella* and *The Stone Flower*.

Petipa and his assistant, Lev Ivanov, shared in the choreography for *Swan Lake*, still unsurpassed in the classic style. Ivanov staged *The Nutcracker*, following Petipa's preliminary notes. *The Sleeping Beauty*, probably Petipa's masterpiece, was revived in its entirety by Diaghilev, and is well known in England and America through performances given by the Royal Ballet and on television.

Petipa combined the smoothly flowing elegance of the French school with the virtuosity of the Italians. He perfected the elaborate, full-evening ballet in which set dances, emphasizing the spectacular art of the prima ballerina, alternated with static mimed scenes in which the story unfolded through stylized gestures. In the early years of the 20th century the young choreographer Michel Fokine led a revolt against this rigid balletic formula, inaugurating the great contemporary renaissance of ballet.

The Diaghilev Ballet.—Sergei Diaghilev first stimulated western interest in Russian art by presenting, in Paris, an exhibition of paintings and a series of concerts of Russian music. These attracted such wide attention that in 1909 he organized a troupe of dancers, artists on vacation from the Maryinsky theatre, and presented a season of ballet at the Théâtre du Châtelet.

As choreographer of the enterprise, Diaghilev chose Fokine, a 29-year-old dancer who had already demonstrated his reluctance to follow blindly the choreographic traditions of his predecessors. As early as 1904, he had declared his belief that ballets should no longer be broken up into separate dances but should flow without interruption (as in Wagnerian opera), the whole story or theme being expressed through dance movement, which should not be exclusively classical but should vary in style according to the theme expressed. This was, of course, simply a return to the forgotten principles of Noverre. The officials of the imperial theatres showed little sympathy for Fokine's revolutionary ideas, but he was able to put them into practice in his *Acis et Galathée*, staged for a pupils' performance; *The Vine*, given for charity; and the miniature masterpiece immortalized by Pavlova, *The Dying Swan. Chopiniana*, which we know as *Les Sylphides*, was created for a charity performance in 1908.

For his first Paris season (1909), Diaghilev chose Fokine's ballets *Les Sylphides, Le Pavillon d'Armide* and *Cléopâtre*, all of which had already been given in Russia. Fokine also put together a *divertissement* called *Le Festin*, which included dances by Petipa and other choreographers, and staged a new work of major importance, the magnificently barbaric *Prince Igor*. This ballet represented glorious departure from the pretty and innocuous trifles to which Parisian audiences were accustomed and was a triumph for Fokine and Diaghilev. The original Diaghilev company included Pavlova and Mikhail Mordkin (both of whom departed after the first season), Karsavina, Nijinsky, Adolph Bolm, Vera Fokina, Alexandra Fedorova, Bronislava Nijinska and other dancers who were to spread the fame of Russian ballet around the world.

The early Diaghilev seasons coincided with the richest period of

Fokine's creative activity. In rapid succession he choreographed *Scheherazade, The Firebird, Petrouchka* and *Le Spectre de la rose,* each work showing a new facet of his genius. Diaghilev meanwhile had discovered the composer Igor Stravinsky and commissioned his first ballet scores. He had secured the collaboration of painters like Alexandre Benois and Leon Bakst, whose contribution to the initial impact of the Russian ballet upon the world of art can scarcely be overestimated.

The dancing of Nijinsky came as a revelation to audiences in western Europe, who had long forgotten what male dancing could be. At the Paris Opéra, the unpleasant custom of *travesti* prevailed, and girls frequently played men's roles. Nijinsky, the supreme male dancer of modern times, had a phenomenal *elevation,* made more spectacular by his seeming ability to remain suspended in air. His strange, exotic personality transformed him into the creature of another world when he entered the magic circle of the stage. Scarcely less impressive was Karsavina, a superb actress-dancer and the ideal interpreter of Fokine's ballets. Diaghilev encouraged Nijinsky to attempt choreography. He staged *L'Aprés-midi d'un faune* (1912), *Jeux* (1913) and Stravinsky's *Le Sacre du printemps* (1913). All three of these works were marked by radical departures from accepted choreographic practice, utilizing angular, stylized movement far ahead of its time. Each of Nijinsky's ballets precipitated a scandal, and the furor attending the première of *Sacre du printemps* attained monumental proportions. Nijinsky created only one other ballet, *Till Eulenspiegel* (given in New York in 1916), before his tragic insanity cut short a phenomenal career.

In 1914 Diaghilev discovered the young Leonide Massine, whom he groomed to replace Nijinsky, presenting him first in Richard Strauss' *The Legend of Joseph.* Massine's first ballet, *The Midnight Sun* (1915), proved him a gifted choreographer. For Diaghilev he created such works as *The Three-Cornered Hat, La Boutique fantasque* and *Pulcinella,* collaborating with the painters André Derain and Pablo Picasso.

By this time Diaghilev had broken his ties with Russia. His company toured constantly in Europe, South America and the United States, where it appeared in 1916–17. At first, Diaghilev worked only with Russians: Stravinsky, Bakst, Benois and Fokine. Later his company became international in many respects. He commissioned scores from Erik Satie, Georges Auric, Francis Poulenc, Manuel de Falla and Darius Milhaud. Décors were designed by Maurice Utrillo, Georges Braque, Giorgio de Chirico and André Bauchant. Russian dancers, including Lydia Lopokova (Lopoukhova), Felia Dubrovska, Vera Nemtchinova, Olga Spessivtzeva (Spessiva), Alexandra Danilova, Pierre Vladimiroff, Anatole Vilzak and Serge Lifar, were joined by Poles such as Leon Woicikowski and Stanislas Idzikowski, and eventually by the English dancers Lydia Sokolova (Hilda Munnings), Anton Dolin and the 14-year-old Alicia Markova (Alice Marks).

In 1921 Diaghilev revived *The Sleeping Beauty* in London, but as usual the impresario was ahead of his time. Petipa classics became generally popular only a quarter of a century later.

Diaghilev's last choreographer was George Balanchine, an artist of marked originality as well as an ardent disciple of Petipa. Trained in the U.S.S.R., he left it in 1924 and joined Diaghilev. For Diaghilev he created about ten ballets, including *Apollo, The Prodigal Son, La Chatte* and *Le Bal.* After Diaghilev's death in 1929, Balanchine was to exert a tremendous personal influence on the whole course of contemporary classic ballet.

Pavlova.—Anna Pavlova, trained in the Russian Imperial school in St. Petersburg, was already one of the finest dancers of the Maryinsky theatre when, in 1907, she made the first of her foreign tours, to Stockholm, Copenhagen, Prague and Berlin. In 1909 she danced in Paris with the Diaghilev company, leaving it to accept a contract at the Metropolitan Opera with her partner, Mordkin, in Jan. 1910. Although from 1910 to 1913 she returned to Russia intermittently for limited engagements, from this period she devoted herself more and more intensively to the tours that absorbed the remainder of her life. First with a single partner, later with her own company, Pavlova danced tirelessly and unremittently, on stages large and small, good and bad, in villages and capitals all over the world, which she circled more than once. A superb artist, completely and selflessly dedicated to the dance, she brought ballet to people who had never suspected its existence. Through her personal genius and her courageous example she inspired a whole generation of dancers, from Australia to Finland. Her service to ballet and her influence on the artists who followed were inestimable.

Ballet in America, 1735–1932.—Since colonial days, American audiences have shown warm and discriminating appreciation of ballet as an entertainment and as an art, but neither official nor private enterprise has ever given it a permanent home in the United States. Consequently it has never been consistently cultivated; its progress has been sporadic, and it has gone through long periods of eclipse as well as cycles of healthy evolution.

Ballet was probably introduced to the colonies by Henry Holt, a dancer from London, who in 1735 presented *The Adventures of Harlequin and Scaramouch, with the Burgo'master Trick'd,* in Charleston, S.C. Harlequinades and pantomimes were often seen on colonial stages, and the hornpipe ranked high in popularity. However, ballets were not given in America with any frequency until after the French Revolution, which uprooted artists in great numbers. As early as 1791 Stephen Sicard, a pupil of Maximilien Gardel, presented his Philadelphia pupils in a timely work called *The Congress' Return.* Alexander Placide and his wife produced a "dancing ballot" (*sic*) called *The Bird Catcher* in New York in 1792. Later the Placides moved on to Charleston, where in association with the choreographer Jean Baptiste Francisqui they gave such well-known works as Noverre's *Les Caprices de Galathée* and Gardel's *La Chercheuse d'esprit.* Their ballet company included Jean Baptiste Val and his wife, and the youthful prodigy Louis Duport. In 1794 Anna Gardie made her American debut in *La Forêt noire.* Until she was tragically murdered by her husband, four years later, Mme Gardie brightened the American stage with her vivid mimic artistry. James Byrne, noted English dance mime who revolutionized the traditional presentation of Harlequin, spent several years in the United States (1796–1800). His most ambitious productions were the "grand serious pantomimes" *The Death of Captain Cook* and *Oscar and Malvina.* Mrs. Byrne's debut was marred by the hisses of an audience that disapproved her scanty costume; she was obliged to add a pair of pantalettes.

The ballet traditions introduced by French refugees had all but died out when, in 1821, New York's Park theatre engaged a new ballet master, Claude Labassé, who had danced under Pietro Angiolini's direction in Milan. In 1827 Mme Francisque Hutin made a sensational debut. She excelled in multiple *pirouettes* and in dancing on points, then fairly new even in Europe.

Charles and Marietta Ronzi Vestris, relatives of the great *dieu de la danse,* toured in America in 1828–29. During the following quarter of a century the United States enjoyed a steady stream of dancers from Europe and even developed a few native artists of considerable distinction. Mary Ann Lee and Augusta Maywood, both trained in Philadelphia, Pa., by a former Paris Opéra dancer, Philip Hazard, made their debuts together in 1837. Maywood soon went to Paris, appeared with astonishing success at the Paris Opéra and enjoyed a flourishing career in Portugal, Austria and Italy, attaining the rank of prima ballerina at La Scala, Milan. Mary Ann Lee also studied in Paris but soon returned to America, where she was the first to dance *Giselle* (in Boston, Mass., Jan. 1, 1846).

Jean and Marius Petipa danced briefly in New York in 1839, as did Paul Taglioni, brother of the great Marie, and his wife Amelie. The Taglionis presented *La Sylphide,* already well known in the United States through productions by Mme Celeste (Celeste Keppler) and other touring ballerinas, who led their itinerant troupes as far west as the Mississippi river.

The romantic ballet in America reached its peak with the visit of Fanny Elssler, 1840–42. The great Austrian dancer created a furor comparable only to that which greeted the singer Jenny Lind a decade later. When Elssler danced in Washington, D.C., congress was obliged to recess because it could not obtain a quorum. In Baltimore, Md., young admirers unhitched the horses from her carriage and pulled her from the theatre to her hotel, then sere-

naded her until early morning. In such ballets as *La Tarentule, La Sylphide, Nathalie* and *La Gypsy,* her mature artistry captivated intellectuals like Ralph Waldo Emerson, Margaret Fuller and Fanny Appleton Longfellow. Her *Cachucha* and *La Cracovienne* swept the country and were imitated by everyone from aspiring American ballerinas to children in dancing school. Elssler encouraged American dancers, engaging Julia Turnbull, Henrietta Vallée and George Washington Smith for her company. Her partner, James Sylvain (born Sullivan), had several American pupils but did not remain in the country long enough to establish a permanent school.

Ballet continued to enjoy enormous popularity for a decade after Elssler's departure. Hermine Blangy, from the Paris Opéra, was able to dance *Giselle* ten times in a fortnight in Mobile, Ala. In New York, in 1848, the Monplaisir Ballet gave *Esmeralda* every night for more than a month. This troupe, which featured the great comic dancer Leon Espinosa, traveled as far as California. Even the colourful Lola Montez, more noted for her influence on King Louis I of Bavaria than for her dance talent, profited from the vogue for ballet in the United States. In 1866 *The Black Crook,* called the first musical comedy, featured an elaborate dance sequence, but by this time ballet had lost much of its poetic beauty. A handful of distinguished dancers, including Bonfanti, Sangalli and Morlacchi (who earned the admiration of Brander Matthews and Philip Hale), maintained high standards of individual artistry in the face of a general vulgarization of the ballet.

With the opening of the Metropolitan Opera house in 1883, one might have expected the steady encouragement of American dancers and choreographers. Such was not the case. The Metropolitan imported its dancers until 1909, when Malvina Cavalazzi, who had been its first ballerina, returned to open the company's first ballet school. Its first American-born choreographer, Zachary Solov, was not engaged until 1951.

During its brief existence, 1885–1887, the American Opera company made a genuine effort to present fine ballet and even tried to establish a school. It introduced Delibes' *Coppélia* and *Sylvia,* and starred first-rate dancers like Maria Giuri.

It was the depressing sterility of the ballet, around 1900, that caused creative artists like Isadora Duncan, Loie Fuller and Ruth St. Denis to turn to other forms of dance expression. A glimpse of hope for the traditional art came with the debut of the Danish dancer Adeline Genée. In a musical comedy, *The Soul Kiss* (1908), and later as guest artist at the Metropolitan, Genée, with her precise technique and delicate charm, did much to reawaken American interest in ballet. Cia Fornaroli, the Metropolitan's ballerina from 1910 to 1913, also rose far above the prevalent level of mediocrity.

The Russian renaissance of the dance was announced in the United States by the debut of Pavlova and Mordkin in *Coppélia* at the Metropolitan Opera early in 1910. Their sensational success was followed by the appearance of several more or less Russian ballet companies and, in 1916, by the arrival of the full Diaghilev Ballet. American artists and critics were profoundly impressed by Fokine's masterpieces in their original settings by Bakst and Benois, but the general public was not yet ready to give wholehearted support. Not even the belated appearance of Nijinsky, delayed by wartime internment in Hungary, was able to save the tour from financial collapse. In 1918 Adolph Bolm staged Fokine's version of the opera-ballet *Le Coq d'or* for the Metropolitan, with Rosina Galli as the queen of Shemakha. In 1919 he staged and danced *Petrouchka.* Two American works, Henry Gilbert's *The Dance in the Place Congo* (1917) and John Alden Carpenter's *Skyscrapers* (1926), completed the list of independent ballets given at the Metropolitan until Balanchine's appointment as choreographer in 1935.

Pavlova, meanwhile, toured the length and breadth of the country, bringing her inspiring art to thousands who had never seen ballet and awakening the desire to be ballerinas in hundreds of little girls. Her last appearance in the United States was in 1925.

During the 1920s there were sporadic attempts at ballet production by the Neighborhood Playhouse and the League of Composers in New York, while in Chicago, Ill., Bolm's company flourished briefly, and Ruth Page began her first attempt at choreography on an American theme with the production of *Oak Street Beach* in 1929. St. Denis, Ted Shawn and the Denishawn company toured regularly, doing much to cultivate audience interest and to develop an understanding and appreciation of dance, but their repertoire did not include classic ballet.

Although great artists in other fields of dance, such as the Spaniards Vicente Escudero and La Argentina (Antonia Mercé) and the Indian Uday Shan-Kar, made frequent U.S. appearances, very little ballet was seen in the United States between the departure of Pavlova in 1925 and the arrival of Col. W. de Basil's Ballet Russe de Monte Carlo in 1933.

Ballet in England.—The British Isles have produced good dancers since Shakespeare's day, when William Kempe earned notoriety by dancing a jig from London to Norwich. An Irishman named Simon Slingsby held his own as a soloist in Noverre's London company of 1781. The Byrnes and the Degvilles competed successfully with imported stars in the London of 1800. England might have claimed one of the great ballerinas of the romantic period if the promising young Clara Webster had not been burned to death in 1844.

During the last years of the 19th century, when ballet was on the decline elsewhere, it was solidly established on an entertainment level in two of London's most popular theatres, the Alhambra and the Empire. Cavalazzi, Legnani and Cecchetti all danced at the Alhambra. Katti Lanner, daughter of the famed composer of waltzes, was ballet mistress at the Empire, where she established a school for training English dancers. Espinosa also taught in London, and after his death in 1903 his school was continued by his son Edouard. Prima ballerina of the Empire theatre, 1897–1907, was the exquisite Adeline Genée, noted for meticulous technique and sparkling style. The Empire featured elaborate, rather tasteless productions such as *The Milliner Duchess* and *The Bugle Call,* but it also gave the Delibes classics, *Coppélia* and *Sylvia.* Genée was succeeded by Lydia Kyasht, of the Russian Imperial ballet, and then by Phyllis Bedells, the first English girl in nearly a century to attain recognition as a classic ballerina.

Pavlova exerted a profound influence on ballet in Great Britain, dancing frequently in London from 1908 until her last public appearance, at Golder's Green Hippodrome, Dec. 1930. The Diaghilev Ballet danced annually in London. Both Pavlova and Diaghilev engaged British dancers, some of them (including Markova and Patrick Healey-Kay, who became Anton Dolin) trained by the exiled Russian dancer Seraphima Astafieva.

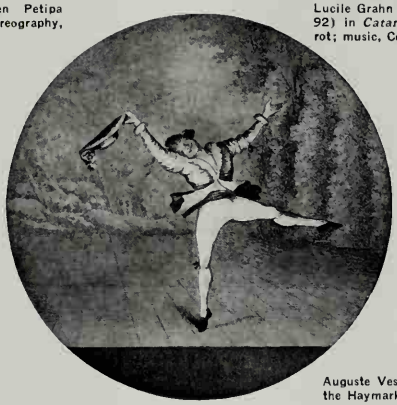
During the 1930s the De Basil Ballet Russe de Monte Carlo, with Massine, Danilova, Irina Baronova, Tamara Toumanova and David Lichine, made annual visits to London. The Royal Danish Ballet made a deep impression on its first visit to England, in 1953, while the Covent Garden Opera house season of the Bolshoi Theatre Ballet of Moscow with its almost legendary ballerina, Galina Ulanova, in 1956, was sensational. Nevertheless two women, the Irish-born Ninette de Valois (Edris Stannus) and the Polish Marie Rambert (Miriam Rambach), were chiefly responsible for the high status attained by British ballet in the 20th century.

Rambert was a student of Émile Jaques-Dalcroze when Diaghilev invited her to teach eurythmics to his company. Her lessons influenced Nijinsky's choreography for *L'Aprés-midi d'un faune* and *Sacre du printemps.* Rambert, in turn, learned the value of classic ballet technique. She studied under Cecchetti, following his methods when she opened her own school in London in 1920. She had a decided flair for discovering choreographic talent. She encouraged Frederick Ashton in the creation of his first ballet, *A Tragedy of Fashion,* in 1926. Among her other protégés were Antony Tudor, Walter Gore, Norman Morrice, Frank Staff and Andrée Howard. In 1930 she founded the Ballet Club, devoted to developing English choreographers and dancers. Later known as the Ballet Rambert, this enterprising and progressive company was still active after more than 30 years. Dancers who worked intensively under Rambert include Agnes de Mille, Maude Lloyd, Peggy van Praagh, Celia Franca (director of the National Ballet of Canada), Sally Gilmour, Hugh Laing, Harold Turner and John Gilpin. Tudor's first works, *Cross Gartered* (1931), *Lysistrata*

Carlotta Grisi (1819–99) and Lucien Petipa (1815–1900) in *La Péri* (1843). Choreography, Jean Coralli; music, Johann Burgmüller

Lucile Grahn (1819–1907) and Jules Perrot (1810–92) in *Catarina* (1846). Choreography, Jules Perrot; music, Cesare Pugni

Marie Taglioni (1804–84), most famous dancer of the Romantic period and among the first to dance *sur les pointes*



Auguste Vestris (1760–1842) dancing at the Haymarket, London

BALLET IN THE 18TH and 19TH CENTURIES

Marie Camargo (1710–70), one of the foremost dancers of her time and instituter of costuming innovations credited with increasing the technical possibilities of the dance

Fanny Elssler (1810–84) in the costume of *La Cachucha*, a Spanish dance she made popular in the mid-19th century

BY COURTESY OF (TOP LEFT) HARVARD THEATRE COLLECTION, (TOP RIGHT) LILLIAN MOORE, (OTHERS) ANN BARZEL

BALLET

Anna Pavlova (1881–1931), foremost ballerina of the early 20th century

Scene from the Diaghilev Ballet Russe production (1929) of *Le Bal*. Choreography, George Balanchine; music, Vittorio Rieti

STYLE-SETTING DANCERS AND PRODUCTIONS

Leonide Massine and Mia Slavenska in *Gaîté Parisiènne*. Choreography, Leonide Massine; music, Jacques Offenbach. A production of Massine's Ballet Russe de Monte Carlo

Vaslav Nijinsky (1890–1950) as Albrecht in *Giselle*. Choreography, Jules Perrot and Jean Coralli; music, Adolphe Adam

Scene from the Royal Danish Ballet production of *La Sylphide* with Margrethe Schanne and Erik Bruhn. Choreography, August Bournonville; music, Herman Lovenskjold

BY COURTESY OF (TOP LEFT) ANN GARZEL; (BOTTOM LEFT) NEW YORK PUBLIC LIBRARY DANCE COLLECTION, ROGER PRYOR DODGE COLLECTION, (TOP RIGHT) ANN GARZEL; PHOTOGRAPHS, (CENTRE RIGHT) BARON STUDIOS, (BOTTOM RIGHT) J. MYDTSKOV

Nora Kaye and Hugh Laing in *Pillar of Fire*. Choreography, Antony Tudor, who also wrote the book; music, Arnold Schönberg. An American Ballet Theatre production

Scene from *Fancy Free* with (left to right) Ruth Ann Koesun, Basil Thompson, John Kriza, Christine Mayer, Scott Douglas and Audrey Deckmann. Choreography, Jerome Robbins; music, Leonard Bernstein. An American Ballet Theatre production

Melissa Hayden and John Kriza in *Interplay*. Choreography, Jerome Robbins; music, Morton Gould. An American Ballet Theatre production

Diane Richards and Royes Fernandez in *Lilac Garden*. Choreography, Antony Tudor; music, Ernest Chausson. An American Ballet Theatre production

CONTEMPORARY BALLET

Solveig Ostergaard and Niels Kehlet in *Flower Festival in Genzano*. Choreography, August Bournonville; music, E. Helsted and Holger Paulli. A Royal Danish Ballet production

BY COURTESY OF (TOP LEFT, TOP RIGHT, CENTRE RIGHT) AMERICAN BALLET THEATRE; PHOTOGRAPHS, (CENTRE LEFT) ALFREDO VALENTE, (CENTRE RIGHT) JACK MITCHELL, (BOTTOM) ANTHONY CRICKMAY

BALLET

Scene from *Giselle* with Galina Ulanova and the Bolshoi Ballet

Scene from *Don Quixote* with Maya Plisetskaya and the Bolshoi Ballet. Choreography, Alexander Gorsky; music, Leon Minkus

CONTEMPORARY BALLET

Scene from *Persephone* with Svetlana Beriosova and Donald MacLeary. Choreography, Frederick Ashton; music, Igor Stravinsky. A Royal Ballet production

Scene from *Petrouchka* with (left to right) Keith Rosson, Nadia Nerina and Rudolf Nureyev. Choreography, Michel Fokine; music, Igor Stravinsky. A Royal Ballet production

Scene from *La Ventana* with Mette Mollerup, Jorn Madsen and Ruth Andersen. Choreography, August Bournonville; music, H. C. Lumbye. A Royal Danish Ballet production

PHOTOGRAPHS, (TOP LEFT) ROGER WOOD, (BOTTOM RIGHT) VON HAVEN, (OTHERS) ZOË DOMINIC

Marguerite and Armand with Margot Fonteyn and Rudolf Nureyev. Choreography, Frederick Ashton; music, Franz Liszt. A Royal Ballet production

Scene from *Rodeo* with Catherine Horn, John Kriza, Kelly Brown and Jenny Workman. Choreography, Agnes de Mille; music, Aaron Copland. An American Ballet Theatre production

Scene from *Etudes* with Eske Holm, Toni Lander and Flemming Flindt. Choreography, Harald Lander; music, Karl Czerny. A Royal Danish Ballet production

CONTEMPORARY BALLET

Scene from *Napoli*. Choreography, August Bournonville; music, E. Helsted, Niels Gade and Holger Paulli. A Royal Danish Ballet production

Scene from *Daphnis and Chloë* with Margot Fonteyn and Alexander Grant. Choreography, Michel Fokine; music, Maurice Ravel. A Royal Ballet production

PHOTOGRAPHS, (TOP LEFT) ANTHONY CRICKMAY, (TOP RIGHT) BARON—PIX FROM PUBLIX, (CENTRE, BOTTOM LEFT) VON HAVEN, (BOTTOM RIGHT) BARON STUDIOS

BALLET

The Nutcracker with Melissa Hayden and Jacques d'Amboise. Choreography, George Balanchine; music, Petr Tchaikovsky. A New York City Ballet production

Scene from *Symphonic Variations* with Margot Fonteyn. Choreography, Frederick Ashton; music, César Franck. A Royal Ballet production

The Sleeping Beauty with Margot Fonteyn and Michael Somes. Choreography, Marius Petipa; music, Petr Tchaikovsky. A television production of the Sadler's Wells Ballet

A Midsummer Night's Dream with Allegra Kent and Jacques d'Amboise. Choreography, George Balanchine; music, Felix Mendelssohn-Bartholdy. A New York City Ballet production

Scene from *Gounod Symphony* with Maria Tallchief and André Prokovsky. Choreography, George Balanchine; music, Charles Gounod. A New York City Ballet production

CONTEMPORARY BALLET

PHOTOGRAPHS, (TOP RIGHT, CENTRE) ROGEN WOOD, (OTHERS) FRED FEHL, NEW YORK

(1932), *Dark Elegies* (1937), and the work that many consider his masterpiece, *Lilac Garden* (1936), were created for the Ballet Club under Rambert's supervision.

A short-lived but important influence on British ballet was the Camargo society, first projected in 1929 by Philip J. S. Richardson, editor of *The Dancing Times,* and the critic Arnold Haskell. Devoted to the advancement of ballet through professional productions of classic and modern works for subscription audiences, it commissioned ballets by Ashton, De Valois and Tudor, and presented Spessivtzeva in *Giselle* and *Swan Lake* before its dissolution in 1933.

By this time the Vic-Wells Ballet, later to become England's Royal Ballet, was firmly established. De Valois, its director and guiding spirit, had danced in pantomime, Italian opera and in the Diaghilev Ballet before establishing a school in London in 1926. She also had valuable experience in play production for the Abbey theatre, Dublin, and the Festival theatre, Cambridge. That same year Lilian Baylis, director of the Old Vic theatre, engaged her to stage incidental dances for operas and plays. When Miss Baylis reopened Sadler's Wells theatre in 1931, the Vic-Wells Ballet was officially organized with six dancers. Soon Markova, Dolin, Lopokova and Idzikowski made guest appearances. The company was gradually enlarged, and in 1933 Markova became its ballerina. *Giselle, The Nutcracker* and *Swan Lake* were produced for her. In the years that followed, De Valois' ballets *Job, The Rake's Progress* and *Checkmate* were added to the repertoire. Through such works as *Façade, Les Patineurs* and *A Wedding Bouquet,* Ashton was recognized as a major choreographer. Robert Helpmann, who joined the company in 1933, soon became its principal male dancer, pre-eminent in dramatic roles. When Markova left the Vic-Wells in 1935, many of her roles were inherited by 16-year-old Margot Fonteyn, who later matured into one of the great ballerinas of the century. Noted for her musicality, sensitivity and perfection of line, Fonteyn is unsurpassed in *The Sleeping Beauty* and incomparable in the many roles Ashton has created for her. During World War II the Vic-Wells Ballet made frequent excursions to the continent to entertain troops. Helpmann choreographed several dramatic ballets, such as *Hamlet, Adam Zero* and *Miracle in the Gorbals.* Beryl Grey and Moira Shearer, gifted ballerinas, emerged from the ensemble. Violetta (Prokhorova) Elvin, newly arrived from Moscow, joined the company.

In 1946 the Sadler's Wells Ballet, as it was then known, was invited to reopen Covent Garden Opera house. *The Sleeping Beauty* was revived for the occasion, and in that same year Massine revived *The Three-Cornered Hat* and *La Boutique fantasque,* especially for the company, dancing in these ballets himself. In 1948 he revived *Mamzelle Angot* and in 1951 he produced a new ballet, *Donald of the Burthens,* based on Scottish rhythms and dances. Ashton choreographed Prokofiev's *Cinderella* (1948), Delibes' *Sylvia* (1952), Hans Werner Henze's *Ondine* (1958) and a new version of one of the oldest ballets extant, Dauberval's creation of 1789, *La Fille mal gardée* (1960).

In 1949 Sadler's Wells Ballet made its first triumphant American tour, increasing its prestige at home. An organization of gigantic proportions, it had its own school, providing general education in addition to ballet training, as well as a sister company, Sadler's Wells Theatre Ballet, founded in 1946 and functioning as a separate entity. In 1957 Sadler's Wells received a royal charter and was renamed the Royal Ballet. Its two companies began a gradual amalgamation that was completed in 1959, with control placed under the Royal Opera house, Covent Garden. From that year its peerless ballerina, Fonteyn, appeared as guest artist, while its accomplished dancers included Svetlana Beriosova, Nadia Nerina, Lynn Seymour, Michael Somes, David Blair and Alexander Grant.

Technical standards were maintained in England through a number of schools, individual teachers of ballet and examining bodies such as the Royal Academy of Dancing and the Cecchetti society.

In 1949 Markova and Dolin formed a small group and went on tour. By the following year their performances had become so popular that a company was founded on a permanent basis under the title of Festival Ballet. Julian Braunsweg became the administrator, with Dolin as artistic director. The first London season of this company lasted for three months, from Oct. 1950 to Jan. 1951. In addition to the famous founder-leaders, John Gilpin, Natalie Krassovska and several other highly accomplished dancers have appeared with the company, both as guests and on its permanent strength, Gilpin having become assistant artistic director under Dolin. In 1951 Festival Ballet became the first English company to be invited to Monte Carlo, where they made a great impression, with David Lichine and Tatiana Riabouchinska as guest artists. Subsequently the company made extensive tours throughout Europe and North and South America. In its repertory are *Swan Lake, The Nutcracker,* various Fokine ballets (*Les Sylphides, Petrouchka, Scheherezade* and *Prince Igor*) and a number of works produced especially for the company by Lichine, Harald Lander, Michael Charnley and Jack Carter.

Another company that did a great deal to promote interest in ballet during and after World War II, especially in provincial England, was the International Ballet founded by Mona Inglesby in 1941. Miss Inglesby was the company's prima ballerina, and at the outset the repertory included several one-act ballets. Later Miss Inglesby, with the assistance of the distinguished Russian *régisseur* Nicolai Sergueeff, arranged *Swan Lake, The Sleeping Beauty, Coppélia* and *Giselle.* International Ballet was the first company in Great Britain to appear for special seasons in super cinemas and in arenas such as those employed for ice hockey; and for a time this group enjoyed tremendous success. In 1953, however, through increasing costs, chiefly those of travel and orchestral salaries, the company, which had been substantially subsidized by Miss Inglesby's father, was compelled to disband.

France After 1920.—The somnolence of the Paris Opéra Ballet, stagnant since the death of Saint-Léon in 1870, was interrupted in 1924 by the revival of *Giselle* for the great Russian ballerina Spessivtzeva and finally dispelled in 1930 with the appointment of Serge Lifar, Diaghilev's last *premier danseur,* as ballet master.

Lifar cleared the Opéra Ballet of deadwood, raised its technical standards and greatly enlarged its repertoire. His ballets included *Promethée, Icare* (danced to a percussion accompaniment of his own devising), *Joan de Zarissa, Le Chevalier et la damoiselle,* and dozens of others. Except for an interlude following World War II, he continued as director of the Opéra Ballet until 1958, when he was replaced by George Skibine. Yvette Chauviré, noted for her feminine elegance, and Nina Vyroubova, trained by Russian teachers outside the Opéra, and the American ballerina Marjorie Tallchief achieved distinction among its stars. Harald Lander choreographed several successful works. In 1960 Gene Kelly became the first American to produce a ballet for the Opéra when he staged *Pas des dieux* to music by George Gershwin. Many gifted dancers educated at the Opéra, such as Janine Charrat, Renée Jeanmaire, Colette Marchand, Jean Babilée and Roland Petit, revolted against its rigid hierarchy and left to form their own companies or to dance in revues and films. Petit, an imaginative young man with a flair for the theatrical, formed Les Ballets des Champs Élysées in 1945. Later he headed Les Ballets de Paris, which toured the United States in 1949 and 1950.

The Marquis de Cuevas' Grand Ballet de Monte Carlo made its headquarters in Paris and Monte Carlo after its foundation in 1947. With two American dancers, Rosella Hightower and Marjorie Tallchief, as its principal ballerinas, it presented an extensive repertoire of classic and modern ballets.

Ballet in Denmark.—After the Royal Danish Ballet held its first festival in 1951, attention was increasingly focused on this company, which has enjoyed an uninterrupted existence since the mid-18th century. Its early masters, Antonio Sacco and Vincenzo Galeotti, were strongly influenced by Noverre and Angiolini. They established dramatic ballet on the Danish stage before the close of the 18th century. The principal architect of the Danish ballet was August Bournonville, born in Copenhagen in 1805. He studied under Auguste Vestris, danced at the Paris Opéra and returned to Copenhagen in 1829 to guide its ballet for nearly half a century. The Danish style, with its emphasis on masculine virtuosity and expressive mime, is actually the pre-romantic style of Vestris and Duport, which Bournonville brought from Paris and meticulously preserved. The Bournonville ballets *La Sylphide,*

Napoli and *Konservatoriet*, with Galeotti's *The Whims of Cupid and the Ballet Master* (the oldest ballet still performed in its original choreography, dating from 1786), still maintained a key position in the Danish repertoire early in the sixth decade of the 20th century. Lander, who served the company as dancer and principal choreographer between 1925 and 1951, broadened its scope and gave it a more international character. Alexandre Volinine produced *Giselle*, and Massine staged his *Le Beau Danube*.

After Lander's departure, the noted Russian teacher Vera Volkova was appointed artistic adviser of the Royal Danish Ballet and head of its school. Her influence was observed in the superimposition of the Russian style, with its emphasis on elegance and length of line, on the strongly Danish technical foundation of the dancers.

Several Balanchine ballets were added to the repertoire. In 1955 Ashton produced Prokofiev's *Romeo and Juliet*, and in 1957 Peggy van Praagh and Ninette de Valois staged the Petipa version of *The Sleeping Beauty*. Birgit Cullberg's *The Moon Reindeer* was a stirring ballet on a Scandinavian theme. The company visited London in 1953 and the United States in 1956 and 1960. Preeminent among the classic dancers of the time were Erik Bruhn (who appeared as *premier danseur* of the American Ballet Theatre between engagements in his native Copenhagen), Henning Kronstam and Flemming Flindt.

Soviet Union.—Ballet in the U.S.S.R. has followed the traditions established by Marius Petipa in the 19th century. Many Petipa classics remain in the repertoire, although they are sometimes restaged. Ballet technique was developed to an extraordinarily high level of proficiency, sometimes approaching the acrobatic, through the work of such fine teachers as Vasili Tikhomirov (1876–1956) in Moscow and Agrippina Vaganova (1879–1951) in Leningrad. Vaganova's textbook, *Fundamentals of the Classic Dance* (1934), was translated into many languages. Ekaterina Geltzer, a contemporary of Pavlova, continued to dance in the 1930s, when Vaganova's pupil Marina Semenova attained her greatest fame. Vakhtang Chabukiani and Constantin Sergeev combined prodigious technique with forceful dramatic conviction.

Three- or four-act ballets remained the rule rather than the exception. In the active repertoire during the early 1960s were the Tchaikovsky ballets *Swan Lake* and *The Sleeping Beauty*, Petipa's versions of *Giselle* and *Don Quixote*, and the more recent works *Red Sails, Shurale, Laurencia, The Bronze Horseman* and *The Fountain of Bakhchisarai*. Prokofiev's *Romeo and Juliet*, choreographed by Leonid Lavrovsky, enjoyed particular favour.

Soviet choreography in general tended to conventionality, although much imagination was shown in devising unusual lifts, and in the careful delineation of each ballet's story. Principal centres of ballet production were the Bolshoi theatre, Moscow, and the Kirov theatre, Leningrad, although ballet companies functioned even in remote sections of the Soviet Union. Chief glory of the Soviet ballet in the early 1960s was its extraordinary ballerina, Galina Ulanova, a lyrical dancer with a phenomenal ability to sustain a role. Forty-seven years old at the time of her London debut in 1956 and nearing 50 when she first appeared in the United States, she won critical acclaim that recognized not the slightest diminution of her technical or interpretive resources. Her contemporaries Olga Lepeshinskaya and Natalia Dudinskaya remained popular favourites, while among her younger colleagues, Maya Plisetskaya, Raissa Struchkova, Yuri Zhdanov and Nikolai Fadeyechev earned high praise. Character dancing was developed to an extraordinary degree by Vladimir Levashev and Georgi Farmanyantz.

Tremendous excitement attended the American debut of the Bolshoi Ballet in 1959. The company's lavish productions and magnificent dancers aroused intense enthusiasm, although there was some controversy over the chorcographic merits of individual ballets. Especially memorable were Ulanova's characterizations of Giselle and Juliet.

Beginning in 1958 foreign ballet companies and guest stars were invited to the U.S.S.R. for the first time in many years. The Paris Opéra Ballet, with Marjorie Tallchief, was one of the earliest visitors. In 1960 the American Ballet Theatre, headed by Marjorie's sister, Maria Tallchief, and Erik Bruhn, became the first U.S. dance company to appear in the Soviet Union.

Ballet in America After 1932.—After the death of Diaghilev, a number of his associates formed the Ballet Russe de Monte Carlo with Col. Wassily de Basil as its head. Balanchine and Massine were the principal choreographers, with Danilova, Baronova, Toumanova, Riabouchinska and Lichine as leading dancers. The company made its U.S. debut late in 1933. Although it returned to Europe each year before the war, its activities soon centred in the United States. In addition to many works originally produced by Diaghilev, the repertoire included new ballets by Balanchine (*Cotillon, La Concurrence*) and Massine (*Jeux d'enfants, Scuola di Ballo*). During the 1930s Massine's controversial experiments in the use of symphonic music produced several important productions. *Les Présages* used Tchaikovsky's Fifth Symphony, *Choreartium*, Brahms' Fourth, and *Seventh Symphony*, Beethoven's score. Discord within the company caused a split in its ranks in 1938. De Basil led a group called the Original Ballet Russe, which spent most of the war years in South America and had little influence in the United States. Massine reorganized the Ballet Russe de Monte Carlo and brought it back to the United States with new ballets (*Gaité Parisienne, St. Francis*, a revival of *Giselle*) and a galaxy of dancers new to this country, including Markova, Mia Slavenska, Frederic Franklin and Igor Youskevitch.

During the war years the Ballet Russe became, in everything but name, a U.S. company. As European dancers dropped out they were replaced by Americans (Maria Tallchief, Mary Ellen Moylan, Leon Danielian) until its personnel was almost entirely American born. The company presented American ballets, De Mille's *Rodeo* and Ruth Page's *Frankie and Johnny*. After Massine's departure Balanchine was for a time the principal choreographer, creating *Night Shadow* and *Le Bourgeois gentilhomme*. After he left in 1946, no firm hand guided the artistic policies of the Ballet Russe, and its productions became haphazard although it frequently offered excellent dancing. Danilova and Franklin, its stars for more than a decade, earned a tremendous personal following, and their indefatigable efforts to take good ballet to remote corners of America rivaled those of Pavlova herself.

Ballet Theatre, established in 1940, united some of the most distinguished dance artists of England and America: Tudor, De Mille, Dolin, Laing, Bolm and Fokine, who prepared *Les Sylphides* for the opening performance. The dancers, almost exclusively American, demonstrated conclusively that permanent schools with good teachers had produced technicians able to compete with the best of the Europeans. From the ranks of Ballet Theatre came Nora Kaye, acknowledged the finest dramatic dancer of her time, Alicia Alonso, versatile classicist, Melissa Hayden, Diana Adams, Janet Reed, Rosella Hightower, Jerome Robbins, Michael Kidd, John Kriza and a score of others who helped raise the standards of American ballet. Ballet Theatre's first program included Tudor's wonderful *Lilac Garden*, which disclosed unexplored possibilities in the expressive power of the classic vocabulary. Tudor, a follower of Fokine's dictum that each new theme demands its own style of movement, proved his versatility in such contrasted works as the hilarious comedy *Gala Performance*, the tragic *Dark Elegies*, the bitter satire *The Judgment of Paris*, and the poetic *Romeo and Juliet*. One of the major contributions of Ballet Theatre was the production of Tudor's memorable *Pillar of Fire*, which first revealed Kaye's capacities as a dance actress. Ballet Theatre also encouraged American choreographers and composers, and the use of American themes, producing Jerome Robbins' *Fancy Free*, score by Leonard Bernstein; Kidd's *On Stage*, music by Norman dello Joio; and De Mille's *Fall River Legend*, composed by Morton Gould. In 1958 Cullberg's *Miss Julie* revealed the impressive dramatic ability of classic dancer Erik Bruhn.

After 1946 Ballet Theatre toured extensively in Europe and South America, admirably furthering cultural exchange. Its first visit to the U.S.S.R. in 1960 was the subject of considerable controversy. Inactive during most of 1959, the company reassembled for a brief, unsatisfactory New York season before beginning a European tour. By the time it reached the Soviet Union, however, the company had regained much of its former brilliance and prestige. Its performances there were well received, and, although

profound differences in taste in choreography were discernible between Soviet audiences and those in the west, individual artists won enthusiastic acclaim. Particularly successful were Bruhn (recognized as one of the world's great dancers), Maria Tallchief, Lupe Serrano (especially in William Dollar's *The Duel*), Scott Douglas and Royes Fernandez.

The youngest of the great American companies, the New York City Ballet, is in a sense the oldest. At the invitation of Lincoln Kirstein, Balanchine came to the United States in 1933 to found the School of American Ballet. The first company to grow out of the school was the American Ballet, which made its debut in Hartford, Conn., in 1934, had a brief New York season early in 1935 and became the official ballet of the Metropolitan Opera that autumn. The repertoire, entirely by Balanchine, included *Serenade,* which has since become a classic, and one work on an American theme, the college satire *Alma Mater.* Dancers included William Dollar, Gisella Caccialanza, Annabelle Lyon, Harold and Lew Christensen and Eugene Loring. Balanchine's progressive classicism did not mix with the Metropolitan's old-fashioned operatic traditions, and the American Ballet disbanded after three years, but not before it had presented three works by Stravinsky, *Apollo, The Card Party* and *Le Baiser de la fée.*

Meanwhile, several of the dancers had banded together under Kirstein's leadership to form the Ballet Caravan, which rapidly became the incubator for a generation of American choreographers: Loring, who created *Yankee Clipper* and *Billy the Kid;* Lew Christensen, with *Filling Station* and *Pocahontas;* and Dollar, with *Promenade* and *Airs and Variations.* Here, and especially in the work of Loring, the influence of the modern dance on American ballet choreography first became strongly apparent. The reaction against stilted ballet convention, which had motivated dance revolutionaries like Duncan, Graham and Doris Humphrey, had borne fruit in a whole new vocabulary of movement that ballet choreographers began to absorb, adapt and incorporate into their own works.

Although the American Ballet was reactivated for a good-will tour of South America in 1941, it was not until 1946 that Kirstein and Balanchine again joined forces in the creation of a company. This was the Ballet society, a subscription organization dedicated to the production of works for the lyric theatre, including both ballet and opera. Attracting dancers of the calibre of Maria Tallchief, Tanaquil LeClercq, Nicolas Magallanes, Todd Bolender and Francisco Moncion, the Ballet society during its two years of existence produced nine new works by Balanchine and ballets by six young Americans: Bolender, Dollar, John Taras, Lew Christensen, Merce Cunningham and Fred Danieli. In 1948 the New York City Center of Music and Drama invited the young company to join it with the title of the New York City Ballet. It thus achieved the unique advantage of a permanent home theatre, something no American ballet company had previously enjoyed. In its first decade of existence, the New York City Ballet gave nearly 75 ballets, most of them original works by Balanchine or his associate artistic director, Robbins.

Working for his own company, Balanchine reached the full flowering of his genius. He has been largely responsible for the American classic style (splendidly exemplified in his *Symphony in C*), based on the pure classic technique as transmitted through the Russians, but incorporating certain American qualities of clean, cool, buoyant athleticism. The unusual gifts of Robbins, most versatile of choreographers, provided the New York City Ballet with a wealth of works ranging from the exhilarating *Pied Piper* to the thoughtful *Age of Anxiety.* Works by Tudor, Dollar, Bolender and Christensen added depth and variety to the repertoire, which was enriched in 1957 by Moncion's touching *Pastorale,* and by a stimulating excursion into the realm of lyric theatre, John Butler's staging of Gian-Carlo Menotti's "madrigal fable," *The Unicorn, the Gorgon and the Manticore.* Balanchine explored new paths in his provocative and fascinating *Agon* (1957) and pursued them still further in the equally unorthodox *Episodes,* in which he collaborated with Martha Graham, using music by Anton Webern (1959).

In 1960 the stars of the New York City Ballet included Melissa Hayden, Patricia Wilde, French ballerina Violette Verdy, Jacques d'Amboise and three highly promising young dancers, Allegra Kent, Edward Villella and Jonathan Watts. Maria Tallchief had withdrawn to join the American Ballet Theatre. The career of gifted Tanaquil LeClercq was tragically interrupted by polio in 1956.

Ballet activity in the United States was not confined to the major companies. In the 1930s Catherine and Dorothie Littlefield built the Philadelphia Ballet into an admirable ensemble, the first American company to visit Europe (in 1937). Ruth Page, Bentley Stone and Walter Camryn, in Chicago, made valuable experiments with American thematic material. The San Francisco Ballet, developed by Willam Christensen and directed after 1952 by his brother Lew, consistently produced fresh and original works, in addition to staging classics like *The Nutcracker, Swan Lake* and *Coppélia.* It undertook government-sponsored tours of South America, the orient and the near east with notable success.

After Balanchine staged the dances for *On Your Toes* in 1938, ballet played an important part in the Broadway theatre. The greatest impetus was derived from the impact of De Mille's stunning dances for *Oklahoma!* in 1943. Robbins, Kidd and Loring, as well as the modern dancers Hanya Holm, Helen Tamiris and John Butler, contributed memorable dance scenes for the musical comedy stage.

In the early 1960s a tendency toward the establishment of regional ballet companies was increasingly evident. As teaching standards were gradually raised all over the country, professional and semiprofessional groups were established in such widely scattered centres as Atlanta, Ga.; Detroit, Mich.; Houston, Tex.; Miami, Fla.; New Orleans, La.; Seattle, Wash.; and the University of Utah, Salt Lake City. A young company of solid accomplishment and exceptional promise was the Washington Ballet, directed by Frederic Franklin and Mary Day, in the U.S. capital.

Trends.—After 1950 there was an impressive increase of interest in ballet all over the world. Greater facility of travel enabled artists like Markova, Danilova, Fonteyn, Kaye, Alonso, Tudor and Dolin to visit far corners of the world. The favourable influence of ballet films such as *The Red Shoes, Invitation to the Dance* and *Romeo and Juliet* should not be underestimated. Neither should the dissemination of knowledge about ballet through increased publication of books and magazines on the subject, and through constructive criticism by dance specialists such as John Martin of the *New York Times,* Walter Terry of the *New York Herald Tribune,* Cyril W. Beaumont of the London *Times* and Alexander Bland of the London *Observer.*

In the early 1960s there were ballet companies in Australia, South Africa, Iran, South America, Japan and the Philippines. Turkey organized its own ballet, with the help of Ninette de Valois. Poul Gnatt of the Royal Danish Ballet headed a company in New Zealand. Alicia Alonso headed the state-sponsored Ballet de Cuba; Canada had its Royal Winnipeg Ballet, founded in 1940, and the younger National Ballet of Canada. Countries where ballet had long been established but which had not felt the full effect of the 20th-century renaissance (Austria, Germany, Sweden) turned to other lands where it was in a healthier state (notably, to England) for help in its rehabilitation.

The United States, after centuries of dependence on the resources of the old world, began to play a prominent part in the international exchange of art and artists. Its dancers and choreographers, recognizing no barriers of language, were not the least of its cultural ambassadors. *See* also DANCE; PANTOMIME; CHOREOGRAPHY.

BALLET TECHNIQUES AND TERMS

Classical ballet technique is acquired through an arduous system of physical training, evolved over three centuries of experimentation, and designed to enable the human body to move with the greatest possible agility, control, speed, lightness and grace. It is based upon the turned-out position of the legs, which greatly increases the range of movement through added mobility in the hip joint, and also imparts a more pleasing line to the extended leg, as in the classic *arabesque.* Modern advances in choreography have caused ballet masters to demand ever-higher standards of proficiency and versatility in their executants. Ensemble dancers of the early 1960s could easily execute steps (such as the *fouetté en tournant*) considered difficult by the star

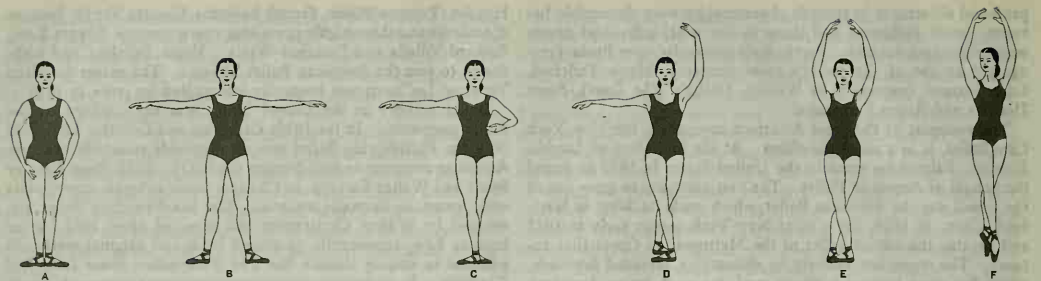


FIG. 1.—THE FIVE BASIC POSITIONS OF THE FEET. THESE MAY BE EXECUTED WITH THE FEET FLAT (A–E) OR ON POINT (F, IN THE FIFTH POSITION). POSITIONS OF THE ARMS, WHILE FOLLOWING GENERALLY ACCEPTED RULES, HAVE NEVER BEEN DEFINITIVELY NUMBERED OR STANDARDIZED, AND VARIOUS ARM POSITIONS ARE USED WITH EACH OF THE POSITIONS OF THE FEET

performers of the 1890s.

The ideal age for commencing the serious study of ballet is eight or nine, although the child should not dance on point (toe-dancing) until two or three years later, when the bones of the foot are more fully developed. Boys often start dance training later than girls. Daily classes are needed to acquire real proficiency. Once a dancer has acquired facility, virtuosity and polish, daily practice is required to maintain it.

The vocabulary of the ballet is extensive, and its steps can be varied in an infinite number of ways. Only a few fundamentals can be described here.

All ballet steps are based on the five fundamental positions of the feet, codified by Beauchamp about 1680 (*see* fig. 1[A–E]):

First position.—The heels are together, toes turned out until feet are in a straight line.

Second position.—The feet are in a parallel line, separated by a distance of about 12 in., and both turned outward, with the weight equally divided between them. In second position *en l'air* ("in the air"), the weight is supported by one foot while the other is raised at the side. (Fig. 3[A] shows the raised leg in second position *en l'air,* at the conclusion of the whipping movement of a *jouetté en tournant.*)

Third position.—The heel of one foot rests against the instep of the other. Both are firmly turned out and the weight is divided between them. Used extensively in 18th-century social dances such as the minuet and gavotte, this position has almost disappeared from theatrical usage.

Fourth position.—One foot rests about 12 in. in advance of the other, both are turned out and the weight is divided between them. Like the second position, fourth has its equivalent *en l'air.* The weight is supported on one leg while the other is raised in front of the body.

Fifth position.—The feet are turned out and pressed closely together, the heel of the right foot against the toe of the left, and vice versa.

Ballet training includes basic exercises performed each day, with a wooden rail or *barre* for support. These movements are designed to give strength and flexibility to the entire body while helping the dancer acquire perfect posture or "placement," with the weight lightly balanced over the centre of gravity and the legs turned out from the hip sockets. The movements include:

Plié.—A bend of the knees.

Battement.—An extension of the leg. In a *battement tendu* one leg is extended (in front, side or back) until the point of the stretched foot barely touches the ground. In a *grand battement* the working leg is raised to hip level or higher.

Rond de jambe.—A circular movement of the leg, accomplished either with the toe on the floor or with the working leg raised.

Développé.—A smooth gradual unfolding of the leg, toward the front, side or back.

Classroom exercises are seldom seen on the stage, although ballet choreography derives from them. In almost every classic ballet, however, the spectator will be able to discern certain positions of the body and typical steps.

Arabesque.—One of the most beautiful of ballet positions. The weight of the body is supported on one leg, while the other is extended in back, with the knee straight. The *arabesque* may be varied in many ways, by changing the position of the arms, the angle of the body and the height of the leg in the air. (*See* figs. 2[A], 2[B] and 2[C].)

Attitude.—A classic position similar to the *arabesque,* except that the knee of the raised leg is bent. In an *attitude en avant,* the raised leg is in front of the body, with knee bent. In an *attitude allongée,* the raised leg is elongated, or nearly straight. Like the *arabesque,* the *attitude* is capable of infinite variation. (*See* fig. 2[D–E].)

The most spectacular steps of the ballet are the *pas d'élévation,* or jumping and leaping steps, and the various *tours* ("turns"). *Pas d'élévation* include:

Cabriole.—A jump in which the dancer beats the calves of the legs together in the air, with a scissorslike movement. When the beat takes place the legs are extended at an angle to the body, at the front, side or back.

Entrechat.—A jump, beginning and ending in the fifth position. While the body is in the air the feet are rapidly crossed. Every trained classic dancer can execute the *entrechat-quatre* and *entrechat-six,* which consist of four and six crossings respectively. Nijinsky, Eglevsky, Bruhn and a few other dancers have accomplished the *entrechat-dix* (ten crossings).

Jeté.—A jump in which the weight is transferred from one foot to the other. In a *jeté battu* the legs are crossed in the air before the descent. One of the most effective forms is the *grand jeté,* a broad leap with one leg stretched forward and the other back, like a "split" in the air (*see* fig. 3[C]). In a *grand jeté en tournant* (sometimes abbreviated to *tour jeté*), the body turns in the air as the transfer of weight is made.

A dancer who excels in jumping steps and attains considerable height from the floor in his leaps is said to have good *elevation;* if he has lightness and elasticity, rebounding without effort, he has good *ballon.* The ballerina usually executes turns on the point (the extreme tip of the toe); the male dancer often leaves the ground entirely, to revolve in the air. Of the many varieties of ballet turns, those frequently seen include:

FIG. 2.—VARIOUS TYPES OF ARABESQUE AND ATTITUDE (A) FIRST ARABESQUE, ON POINT; (B) ARABESQUE PENCHÉ, ON POINT; (C) THIRD ARABESQUE (CECCHETTI SYSTEM), ON POINT; (D) ATTITUDE CROISÉE, ON POINT; (E) ATTITUDE ALLONGÉE, ON POINT

A B C

DRAWN ESPECIALLY FOR "ENCYCLOPÆDIA BRITANNICA" BY ARLINE K. THOMSON

FIG. 3.—(A AND B) TWO POSITIONS USED IN THE FOUETTÉ EN TOURNANT, (A) THE WHIP, OR ACTUAL FOUETTÉ, CONCLUDING IN SECOND POSITION EN L'AIR; (B) THE TURN. THE BODY REVOLVES IN THIS POSITION IN ANY SIMPLE PIROUETTE ON POINT; (C) GRAND JETÉ, A SPECTACULAR BROAD LEAP OFTEN USED BY MALE DANCERS

Chaîné, or *deboulé.*—A series of turns, executed either in a line or in a circle, in which the feet remain close to the floor and the weight is transferred rapidly and almost imperceptibly from one to the other as the body revolves.

Fouetté en tournant.—One of the most brilliant steps in ballet. The dancer turns on one foot (usually, on point) while at each revolution the working leg whips sharply to second position *en l'air* and then in to the supporting leg (*see* figs. 3[A] and 3[B]). In a *rond de jambe fouetté en tournant,* the working leg whips front to fourth position *en l'air* and then to second before being pulled in for the turn.

Pirouette.—A turn in place, on one foot. A good dancer can execute four or five continuous revolutions; a virtuoso, as many as a dozen. In a *pirouette sur le coup de pied,* the raised foot rests on the supporting ankle; in a *pirouette à la seconde,* it is extended in the second position. Pirouettes can also be executed in *arabesque,* in *attitude,* etc.

Tour en l'air.—A complete single, double or triple turn in the air, usually beginning from and ending in the fifth position. It is almost always executed by male dancers. The more brilliant display steps are linked by softer, less spectacular movements, which require great style and control for their proper execution.

Chassé.—A slide, in which the weight is transferred from two feet to one, or from one to another.

Glissade.—A sliding step, beginning and ending in fifth position.

Bourrée, or *bourrée couru.*—A rapid run, like a trill on the points of the toes, with the feet in fifth position (*see* fig. 1[F]). The feet move so quickly that the transfer of weight is almost imperceptible, and the ballerina seems to skim across the stage. There are many other *pas de bourrée,* or variations on this step.

See also Index references under "Ballet" in the Index volume.

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(LN. ME.)

BALLETT, a type of vocal composition that enjoyed a brief vogue in England at the end of the 16th century. Both the word and the music it designates were directly imitated from the five-part *balletti* of G. G. Gastoldi (Venice, 1591). These pieces were distinguished by homophonic texture, strongly marked dancelike rhythms and refrains in which the voices sing such syllables as "fa la la" in imitation of instruments. Thomas Morley published his *First Booke of Balletts to Five Voyces* (1595) in both English and Italian editions, which suggests that Italian pieces of this kind had already achieved popularity in England; a further edition of the same collection, with German words, was printed at Nürnberg in 1609. Morley himself, the most Italianate composer of his generation, did not return to the genre, but Thomas Weelkes published a collection of *Balletts and Madrigals,* again for five voices, in 1598. Though it would have been possible to dance to these balletts they should really be regarded as a form of idealized dance music; *i.e.,* dance music translated from the ballroom into the sphere of the madrigal. Both Morley's and Weelkes's collections were reprinted in *The English Madrigal School,* ed. by E. H. Fellowes, vol. iv and x (1913–24).

(J. J. N.)

BALL GAMES: *see* BASEBALL; BASKETBALL; etc. *See* also SPORTS (ARTICLES ON).

BALLIA, a town in the Varanasi (Benares) division of Uttar Pradesh, India, the headquarters of Ballia district, is near the confluence of the Lesser Sarju river with the Ganges, 75 mi. N.E. of Varanasi city. Pop. (1961) 38,216. Ballia is an ancient settlement, but because of changes in the course of the Ganges there were withdrawals of settlement northward in 1873–77 and around 1894; and the civil lines, or administrative quarter, across the railway from Ballia proper, were occupied only in 1900. Ballia proper is a rectangular area, with the Chauk, an open space around a masonry well, as its central market square. The town contains two colleges of Gorakhpur university. It is a junction on the North Eastern railway, with metre-gauge lines running to Varanasi, Mau and Monghyr. It is mainly an administrative and business centre, with some oil-crushing, flour-milling and cottage industry. River fish are exported to Calcutta. An annual cattle fair is held in October–November.

BALLIA DISTRICT, the easternmost section of Uttar Pradesh, is a wedge of alluvial plain in the angle of the Ganges-Gogra confluence. Pop. (1961) 1,335,863. Area 1,183 sq.mi. It is highly fertile but subject to frequent flooding. Three-quarters of the population depends on agriculture, though there are some hand-loom and other cottage industries. The main crops are rice, barley, gram, millets, pulses, oilseeds and sugar cane. (R. L. St.)

BALLINA (BÉAL ÁTHA AN FHEADHA), an urban district in County Mayo, Republic of Ireland, on the river Moy. Pop. (1961) 6,028. In the suburb of Ardnaree is the Roman Catholic cathedral (diocese of Killala), with an east window of Munich glass, and adjoining it are the ruins of an Augustinian abbey (1427). It was the first town to be captured by the French invaders after they landed at Killala bay in 1798. The salmon fishery is notable.

BALLIOL, the name of a family that played an important part in the history of Scotland and came originally to England from Bailleul (Somme) in Normandy. GUY DE BALLIOL already possessed Bywell on the river Tyne, Marwood on the river Tees and perhaps Stokesley in Yorkshire, during the reign of William II (1087–1100). Guy's nephew and successor, BERNARD (d. *c.* 1167), built Barnard castle and was the first of his family to receive lands in Scotland. He fought against David I of Scotland at Northallerton in 1138, and with King Stephen was captured by Matilda at Lincoln in 1141. His son BERNARD (d. *c.* 1190) was present at the capture of King William of Scotland at Alnwick in 1174. Bernard and his son and successor EUSTACE (d. *c.* 1210) occur frequently in English records. HUGH (d. 1228), who succeeded his father Eustace, supported King John against the baronial party in England in 1215–16.

Hugh's son and successor JOHN (d. 1268) married in 1233 Dervorguilla, daughter of Alan, the last "Celtic" lord of Galloway, and also a co-heiress of David, earl of Huntingdon, younger brother of King William of Scotland. John was from 1251 to 1255 a guardian of the young Scottish king Alexander III. His loyalty to Henry III of England in the Barons' War led to the loss of his lands in 1263 and to his capture at the battle of Lewes in 1264; but by 1265 he had recovered lands and liberty. John was the founder of Balliol college, Oxford. He had quarreled with the bishop of Durham in *c.* 1255 and apparently in penance for this he was supporting several scholars at the university by 1266. After his death in 1268, his wife completed his endowment of scholars, giving their house a charter in 1282. John was succeeded in turn by his three sons, HUGH (d. 1271), ALEXANDER (d. 1278) and JOHN DE BALLIOL (*q.v.*; d. 1314).

EDWARD (d. 1364), John's son, inherited only the family lands in France and his father's claim to Scotland. He was kept in England from 1296 to 1315, after which he lived mainly in France. With the connivance of Edward III of England he attacked Scotland in Aug. 1332. He defeated Donald, earl of Mar, regent for the young David II, took Perth and was crowned at Scone in September. He acknowledged Edward III as suzerain over Scotland in November, promising him £2,000 worth of land, but was defeated in Dec. 1332 by a Scottish coalition. Edward III then came openly to Balliol's aid and, after winning the battle of Halidon Hill near Berwick in July 1333, received from him Lothian and the counties of Berwick, Selkirk, Peebles and Dumfries in fulfillment of the £2,000 agreement. Balliol's hold on parts of Scotland was precarious and by 1339 he lost Perth. He resigned his kingdom, title and personal lands to Edward III in 1356, and died in Jan. 1364 a childless pensioner of the English king. SIR ALEXANDER DE BALLIOL (d. *c.* 1310), chamberlain of Scotland from *c.* 1287 to *c.* 1296, belonged to a cadet branch of the family which held the lordship of Cavers (Roxburghshire) until 1368. (A. A. M. D.)

BALLIOL, JOHN DE (*c.* 1250–1314), king of Scotland from 1292 to 1296, was the youngest son of John de Balliol of Barnard castle, Durham, and his wife Dervorguilla, daughter and heiress of Alan, lord of Galloway. His brothers dying childless, he inherited the Balliol lands in England and France in 1278 and succeeded to Galloway in 1290. In that year, when the heiress to the kingdom of Scotland, Margaret, "the maid of Norway," died, Balliol became one of 13 competitors for the crown. He at once designated himself "heir of the kingdom of Scotland," clearly anticipating the vindication of his claim, which was derived from his mother, daughter of Margaret, eldest daughter of David, earl of Huntingdon, brother to kings Malcolm IV and William. His chief rival was Robert de Bruce (grandfather of King Robert I) whose claim was as son of Earl David's second daughter.

The English king Edward I met the Scottish baronage at Norham in Northumberland and insisted that as adjudicator between the claimants he should be recognized as overlord of Scotland. His court of 104 persons discussed the rival titles for more than a year, but Balliol's simple claim by primogeniture ultimately prevailed. Edward I confirmed the decision on Nov. 17, 1292, and Balliol was enthroned at Scone on Nov. 30, doing homage to Edward at Newcastle on Dec. 26. Edward had agreed that appeals should not lie from Scotland to his court but he summoned King John in March 1293 for failure to do justice to Macduff, son of the earl of Fife. John did not attend until Oct. 1293, when he refused to answer without his barons' advice and was judged contumacious. When in June 1294 Edward demanded military aid from Scotland for his projected war in Gascony, the Scottish reaction was in effect to transfer King John's power to an elected council; and at Paris on Oct. 23, 1295, Scottish commissioners concluded a treaty of mutual aid with the French. When Edward I sent an army to Gascony in Jan. 1296, the Scots raided northern England. Edward reacted quickly; he took Berwick on March 30. Castle after castle fell to the English king, and at Kincardine (Mearns) on July 2, at Stracathro (July 7), at Brechin (July 10) and at Montrose, John resigned his kingdom to Edward. He was stripped of his arms and knightly dignity in a ceremony which later earned him the nickname "Toom (empty) Tabard." John was a prisoner in the Tower until July 1299 when papal intervention secured his release. Thereafter, he lived in Normandy, where he died in 1314.

Probably the Wallace rising of 1297 was in his favour, but the movement of 1297–1300 does not seem to have committed itself to the name of the king (if any) for whom it fought. After 1300 the party under John de Soulis openly supported King John; but they abandoned the struggle in 1304 and the independence of Scotland was later won by the Bruces who never recognized the validity of John's acts. *See* also SCOTLAND: *History.* (A. A. M. D.)

BALLISTA: *see* ENGINES OF WAR.

BALLISTIC GALVANOMETER, a galvanometer with a small damping factor and therefore a long period of oscillation. *See* INSTRUMENTS, ELECTRICAL MEASURING.

BALLISTIC MISSILES: *see* ROCKETS AND GUIDED MISSILES.

BALLISTICS. Ballistics is that branch of applied physics concerned with missile weapons and their propulsion, motion and effect at the target. Included among missile weapons are small-arms bullets, artillery projectiles, aircraft bombs, rockets, guided missiles and ballistic missiles.

The subject is conveniently divided into three branches: interior (or internal) ballistics, which treats of the propulsion of the missile; exterior (or external) ballistics, which treats of the motion of the missile along its trajectory through the circumambient medium, which may be air, water or space; and terminal ballistics,

which treats of the effects that the missile produces at the target through blast, heat, nuclear radiation, etc. Information related to ballistics can be found in the articles AMMUNITION, ARTILLERY; GUNS, SPORTING AND TARGET; SPACE EXPLORATION; ROCKETS AND GUIDED MISSILES; and SMALL ARMS, MILITARY.

INTERIOR BALLISTICS

Interior ballistics is usually considered to exclude the treatment of propulsion engines employing atmospheric oxygen to burn their fuel, even though such "air-breathing" engines may well be capable of the high performance required for weapon propulsion. With this exclusion, the propulsion engines of interest to interior ballistics are the gun and the rocket. These have in common the employment of a propellant as a source of energy for a heat engine, which usually operates by controlled and directed expansion of hot gases.

Propellants.—A propellant is a substance, or a mixture of substances, which upon suitable ignition releases a large amount of chemical energy at a high, though controllable, rate. The effect of the energy liberation is to convert the propellant substance into a high-temperature gas. Propellants may be gaseous, liquid or solid, or combinations of these three, although gaseous propellants have been little used because of the difficulty of storing and transporting them. Combinations have also been little used. Propellants of practical interest are either liquid or solid. (*See* also PROPELLANTS.)

Liquid propellants may be monopropellants, consisting of a single substance stable under conditions of storage but decomposing exothermically at increased temperature and pressure (for example, hydrogen peroxide or hydrazine), or bipropellants, consisting of two substances stored separately and mixed only in the combustion chamber. Most successful liquid propellants have been bipropellants, the two liquids usually being distinguished by the terms fuel and oxidizer. A very large number of combinations have been used or suggested, the fuels including liquid hydrogen, hydrocarbons, alcohols, ammonia, hydrazine and aniline, and the oxidizers including liquid oxygen, nitric acid, hydrogen peroxide and fluorine. Liquid propellants may also contain a catalyst to promote the desired chemical reaction or inert material to increase the propellant mass. The German V-2 missile, as an example, employed a three-to-one mixture of ethyl alcohol and water, burned with liquid oxygen.

Solid propellants are always monopropellants, and are of two principal types. Composite propellants consist of a physical mixture of fuel and oxidizer. Black powder, made from charcoal, sulfur and potassium nitrate, belongs to this class and was the only propellant in use from the invention of gunpowder until the 19th century. More advanced composite propellants consist characteristically of a finely ground crystalline oxidizer, usually an inorganic nitrate or perchlorate, mixed intimately with a synthetic plastic or rubber which not only serves as fuel but also gives the propellant the required mechanical strength. The other class of solid propellant, like the liquid monopropellant, relies on the existence of chemical compounds capable of burning without the addition of any other material. Such compounds are explosives, and their formulation into propellants must be such as to permit control of their burning rate, with no danger of detonation, which would liberate energy too rapidly for its successful control. While many explosives are capable of use in propellants, the only ones of any practical importance are nitrocellulose and mixtures of nitrocellulose and nitroglycerin, colloided to control burning rate. Those with a nitrocellulose base, called single-base propellants, were the first "smokeless powders" to be developed and are widely used as gun propellants. Double-base propellants have a nitrocellulose-nitroglycerin base and are used in rockets as well as guns, since their process of manufacture permits the fabrication of larger grains than are feasible with single-base compositions. Solid propellants also include small amounts of additives for such purposes as retarding chemical processes of deterioration during storage, improving physical strength or ease of processing, influencing burning rate or decreasing hygroscopicity.

Control of the rate of burning of liquid propellants is achieved by means of auxiliary machinery which governs the rate of admission of material to the combustion chamber. This method is obviously not suitable for solid propellants, the whole charge of which is contained in the combustion chamber at the start of burning. Their burning is controlled by the geometrical design of the propellant grain, with consideration of the characteristics of the weapon in which it is to be used. Upon ignition of a solid propellant charge, burning takes place on all the exposed surfaces, at a rate which does not vary from point to point. Thus all surfaces recede at the same rate, and it is possible to derive a purely geometrical relation between the amount of propellant burned at any time and the corresponding value of some thickness parameter characteristic of the grain, such as the unburned diameter of a cylindrical grain. The rate at which the thickness parameter decreases (the rate of burning) increases with increasing pressure, and is also affected by the temperature of the grain before burning, as well as by the composition of the propellant. The rate of burning is frequently taken to be proportional to a power of the pressure, as low as 0.1 or as high as 1.0 for different propellants. If a more precise relationship is required, data derived directly from experiment are used. It is clear from the foregoing that a considerable degree of control of burning may be produced by proper shaping of the grain, including the provision of perforations, and much ingenuity has been expended on the design of grains for various purposes. In rocket grain design, it is common practice to attain further control of burning by the use of inhibitors, which are pieces of inert material cemented or otherwise applied to part of the surface. The inhibited surface takes no part in the burning. A grain design is termed regressive if its surface decreases during burning (as for a long solid cylinder), neutral if it remains relatively constant (as for a hollow tube) or progressive if it increases (as for a hollow tube whose outside surface is inhibited).

The relationship between the mass of propellant burned and the thickness parameter and the relationship between rate of burning and pressure are two of the systems of equations which it is the task of the interior ballistician to solve. Other quantities of interest determined by the propellant are the energy liberated by combustion, the equation of state of the propellant gases and their specific heats, all of which are calculable from thermochemical data (*see* THERMODYNAMICS).

It is easy to prepare a list of the desirable characteristics of a propellant. A large energy release gives high performance (although it also entails a high temperature of the combustion gases, and so creates problems in the design of parts of the engine that must withstand them). A low molecular weight of the combustion products improves efficiency. Uniformity of performance of the propellant, its stability and inertness to its environment during manufacture, storage and handling, its freedom from toxicity, its ease and low cost of manufacture are all obviously to be desired. Absence of smoke or flame in the exhaust is a frequent military requirement. No propellant combines all these features to a high degree.

Interior Ballistics of Rockets.—A rocket engine, or motor, consists essentially of a chamber in which combustion takes place and the high-temperature, high-pressure gases are confined, and as outlet to the chamber one or more De Laval nozzles. The De Laval nozzle, a device of basic importance in the operation of turbines and ram jets as well as rockets, is characterized by an internal cross-sectional area which decreases smoothly from the entry to a minimum at a position called the throat, and then increases smoothly to the exit. Corners or abrupt changes in cross section must be avoided, particularly in the diverging portion; otherwise the gas flow through the nozzle will be disturbed to the detriment of efficiency.

The gas evolved from the burning of propellant in the chamber moves, relatively slowly, toward the afterend of the chamber and enters the nozzle. In the converging portion the gas gains velocity at the expense of its thermal energy. If the throat of the nozzle is not overly large, the gas flow velocity reaches the local velocity of sound at that point. It now enters the diverging portion of the nozzle, and since its flow has become sonic, expansion of the

cross section produces further increase in velocity, so that at the nozzle exit the flow is supersonic by a considerable margin. In this fashion the rocket motor produces a jet of high-velocity gas whose reaction on the motor produces the thrust or force that drives the rocket forward. In accordance with Newton's third law of motion, the thrust is equal to the mass rate of discharge of the gas multiplied by its exit velocity, plus a small term depending on the difference between exit pressure and atmospheric pressure.

A simplified calculation of the performance of a rocket motor may be made by assuming a steady-state, one-dimensional flow of the gas, with no friction or heat loss to the walls. The laws of fluid dynamics, essentially the laws of conservation of mass, momentum and energy, and knowledge of the thermodynamic properties of the gas then permit calculation of the details of the flow for an assigned chamber pressure. It is found that the thrust of the motor is proportional to the product of the throat area and the chamber pressure, with a factor of proportionality between one and two, depending on the thermodynamic properties of the propellant and on the expansion ratio. This is true provided that the nozzle throat has not been made so large that the flow does not become supersonic, and that the expansion ratio has not been chosen to be so high or so low that efficiency is lost, neither of which conditions is very restrictive in practice. For the fixed chamber pressure assumed and the rate of mass flow determined, the laws of burning permit the calculation of the required flow rate of liquid propellant or the geometry of the grain of solid propellant, as indicated in the discussion of propellants above.

Minor effects which must be taken into account in a more precise treatment of the rocket motor include nonaxiality of the flow, heat transfer to the walls and nonuniformity of burning of the propellant. Actual rocket design uses a combination of calculation from theory and empirical determination from test.

Experimental methods in rocket interior ballistics rely heavily on the static test, in which the rocket motor is operated while held in a fixed stand. Under these circumstances measuring instruments may be used freely, without the concern for weight and space limitations and the difficulties of recording the data that a flight test entails. Thrust of the motor is measured by allowing a slight forward motion against a force-sensing element, which may operate on mechanical, hydraulic or pneumatic principles. Pressures are measured by Bourdon gauges or manometers if response to rapid fluctuations is not desired; if it is, piezoelectric, capacitance or other types of pressure gauges with good high-frequency response are used. Temperatures of metal parts and other components are usually measured by thermocouples. Temperature measurements in the propellant gas are very difficult to make, since the gas not only is very hot but also may be moving very rapidly; radiation methods have been used with some success. Measurements of other quantities, such as time, stress or vibration, are performed in much the same manner as in other fields of experiment.

Both liquid- and solid-propellant rockets are widely used, and a comparison of the merits of the two types is in order. A greater variety of substances can meet the requirements for a liquid propellant, and higher available energies and lower temperature sensitivities are therefore available. Production of liquid propellants is often simpler, since no fabrication of the substance is required. The thrust of a liquid-propellant rocket is much easier to vary or turn on and off during flight. A liquid-propellant rocket may have a weight advantage, since its propellant can be contained in tanks of relatively light construction and the combustion chamber, with its heavy walls to withstand the gas pressure, need not be very large; the chamber must be large enough to contain the whole propellant mass if a solid is used. This advantage tends to be offset by the weight of the machinery required to produce and control the flow of liquid fuel and oxidizer, the complicated nature of which is a disadvantage in itself. The net effect is that liquid propellants offer a weight advantage only for large thrust or long duration of thrust; that is, for large rockets. Solid-propellant rockets, in addition to being simpler in construction, require less maintenance, are more reliable and stand rough handling better. They are especially preferable where the handling of quantities of inflammable and toxic liquids in close quarters would otherwise be involved, as on shipboard.

Interior Ballistics of Guns.—From the viewpoint of interior ballistics, a gun consists of a chamber in which the propellant is ignited and a bore down which the projectile travels. The bore is almost always rifled. Characteristics of importance include the chamber volume, the length of the bore or distance the projectile travels in the barrel and the mass and diameter of the projectile. Of somewhat lesser importance are the shape of the chamber, the weight of the gun, the rifling design, the design of the rotating or driving band of the projectile and the strength of the barrel at each point along it, which provides an upper bound for the pressure which can be applied after the projectile passes that point.

When the propellant charge is ignited, the pressure in the chamber begins to rise rapidly and soon reaches a value high enough to move the projectile ("shot-start" pressure). The principal resistance to motion of the projectile at this stage is the force required to deform the rotating band to fit the rifling of the barrel. As the projectile moves, the propellant gas expands into the space behind it, the rate of pressure rise is reduced and the temperature of the gas begins to decrease. With increasing projectile velocity, the expansion becomes rapid enough to cause the pressure to begin to drop. When the burning of the charge is complete, and the evolution of propellant gas ceases, which usually occurs when the projectile is from one-third to two-thirds of the way down the barrel, the pressure drop becomes more rapid. When the projectile leaves the bore with its full velocity, a few hundredths of a second after ignition, the remaining pressure vents the propellant gas to the atmosphere.

Since a gun, as compared with a rocket, must burn its propellant in a very short time, and a large surface area is therefore required, a gun charge characteristically consists of a large number of identical solid grains. (Liquid propellants are not used in guns to any important extent.) Each of the grains is considered as burning simultaneously with the others and in accordance with the laws of burning described above.

In addition to the laws of burning, a complete system of interior ballistic equations for the gun includes three other major members. The equation of state of the propellant gas relates the pressure, volume and temperature of the gas. The law of conservation of energy is formulated to express the balance between the thermal energy of the gas and the kinetic energy of the projectile and the gas. Newton's second law of motion gives the acceleration of the projectile in terms of the pressure on its base. Numerous small effects must also be taken into account, such as those arising from resistance to projectile motion, heat loss to the walls and pressure gradient in the barrel. The resulting system of differential equations is too complex for direct solution, and before the rise of the modern large-scale computing machine much effort was devoted to approximate solutions which were either analytic or capable of being summarized in relatively brief tables. After World War II it became possible to produce quickly a numerical solution for any set of parameters, and interest in analytical solutions tended to diminish.

The quantities of major interest in the ballistic solution are pressure and projectile velocity, and these are also the quantities most frequently measured in experimental firings. The crusher gauge is an inexpensive and reliable instrument for routine measurement of pressure. A piston exposed to the gas compresses a copper cylinder longitudinally, and the permanent deformation is a measure of the peak pressure attained. The gauge is best calibrated by direct comparison with a piezoelectric or strain pressure gauge. The latter gauges are also used directly, mounted in the gun wall or in the chamber, when a more accurate measurement of peak pressure or a measurement of the pressure as a function of time throughout the firing is desired. Velocity of the projectile as it leaves the gun is determined most accurately by radar devices. A widely used method employs a pair of photoelectric devices, placed a known distance apart and producing an electrical pulse when the projectile passes each device. The time

between the two pulses is measured accurately by an electric counter. Coils are frequently substituted for the photoelectric devices, in which case the projectile is magnetized before firing. The ballistic pendulum, the oldest device for measuring projectile velocity, is still in use and is capable of very good accuracy. The projectile is caught by a massive pendulum whose subsequent swing measures the momentum and hence the striking velocity of the projectile. Position of the projectile in the barrel may be determined by a short-duration burst of X-rays or by probes which the projectile shorts in passing.

Recoil of the gun is measured by photography or by a mechanical indicator. Temperatures in the wall of the gun may be found by drilling the wall and inserting thermocouples. A useful auxiliary piece of apparatus is the explosion vessel or closed bomb, a strong container in which a charge of propellant may be ignited and burned at constant volume, with means for measuring pressure as a function of time. The maximum pressure obtained is related to the energy liberated, and the course of pressure with time gives information on the rate of burning.

Small arms are a special case for interior ballistics because of the different bore resistance resulting from the soft metal sheath and the large relative magnitude of the heat loss to the walls. Recoilless guns, in which recoil is counteracted by venting a portion of the gas through a nozzle to the rear, and smooth-bore muzzle-loading mortars also require special formulations of theory, but also present no grave difficulties.

EXTERIOR BALLISTICS

The problem of exterior ballistics may be stated very succinctly: to predict the entire trajectory of a missile. As long as the only case of practical interest was that of a gun firing at a surface target, the position of the point of fall of the projectile as governed by the aim of the gun was the desired end product, and the other details of the trajectory, including the time of flight of the projectile, were of secondary interest. The introduction of the airplane into warfare quickly gave rise to the new problems of aircraft gunnery, antiaircraft gunnery and bombing. Here either the weapon platform or the target or both are in relatively rapid motion, and any point on a trajectory may represent the position of the target. Accordingly, more precise prediction of the details of the trajectory became a requirement. During World War II the great improvement in the determination of target position brought about by radar made it necessary to provide more accurate ballistic information, and rocket problems became important. After the war still different problems were generated by the advent of guided and ballistic missiles.

The end result of an exterior ballistic calculation is usually a firing table, summarizing the trajectory information essential to the user of the weapon in determining how to release the missile so as to hit the target. In the simplest case, that of surface-to-surface gunfire, the primary information contained in the table is a listing of the angles of elevation corresponding to various ranges. The principal information in bombing tables, for another example, is range and time of flight for various altitudes of the bomber above the target. In many cases the firing table is built into a machine called a director, which accepts observations of target position and computes the release conditions. A radar, a director and a power-aimed gun can thus form a fully automatic system for antiaircraft fire.

The time-honoured method of observing the results of firing and correcting the aim of succeeding rounds is of only limited application. At best, against a fixed target which cannot return fire, the spotting rounds are expended to produce no effect on the target. Under most conditions of modern warfare the opportunity to fire is evanescent and the conditions are continually changing. Observation of bomb impact error is of no value in releasing the next bomb, since the aircraft cannot again assume the same position with respect to the target. An accurate firing table is thus of the first importance.

It would seem at first glance that the construction of a firing table would be a simple matter of observing weapon trajectories under controlled conditions and tabulating the results. The attainment of an acceptable degree of accuracy, however, requires that a number of minor variables be taken into account, including wind, temperature and density of the atmosphere, temperature of the weapon propellant and others. A set of simple empirical observations for one weapon would therefore require firing under so many conditions as to be prohibitively costly in time and effort. Furthermore, each weapon would then be a separate case, and it would not be possible to bring to bear on a new problem the accumulated experience gained from old ones. The only practicable alternative is to assign to theory the role which it usually plays in the physical sciences, that of furnishing a unifying framework for the results of experiments and permitting accurate prediction of the results of experiments not actually carried out. In exterior ballistics as in any other field, of course, experiment is the court of last resort, and it is still necessary to obtain information on a limited number of trajectories to permit simplification of the theory to a manageable degree of complexity. The principles involved in the formulation of a mathematical theory of exterior ballistics, and the methods used in applying it, are the subject of this discussion.

The Equations of Motion of a Missile.—Clearly a missile in flight is a mechanical system, and accordingly is governed by the dynamical equations for the motion of a rigid body (*see* MECHANICS). Since these equations state that the product of mass by acceleration, for the missile as a whole, is equal to the resultant of the applied forces, and that the time rate of change of angular momentum is equal to the resultant of the moments of the applied forces, they form a set of six second-order differential equations; once the force resultants are set down in concrete terms of missile position and velocity (and perhaps time), the problem is definite and is susceptible of solution by the methods to be indicated below. A solution consists of finding the three coordinates of the missile's centre of mass and three angles defining its orientation in space at any desired time.

Although this set of equations, with the most accurate available account of the complete force system, is soluble, it is formidably complex, and the solution a lengthy process not to be undertaken unless absolutely necessary. It is at this point that the skill of the exterior ballistician is exercised in the choice of a mathematical model of the motion. The mathematical model is a simplification of the general differential equations, whose solution predicts the motion of the particular missile under consideration to the degree of accuracy required for practical purposes. The ballistician examines the general equations term by term, primarily the expressions for the forces, dropping some entirely as insignificant and approximating others by simpler and more tractable forms. He is guided in this by consideration of the dispersion of the missile, the errors in its fire control, the errors to be expected in field determination of environmental conditions affecting the trajectory and other circumstances limiting the useful accuracy of the solution to be obtained.

The Forces Acting on a Missile.—The most obvious and universal force to be taken into account is that of gravity. This is usually considered as a constant force acting along the vertical, although for long-range trajectories it may be necessary to allow for its variation with distance from the centre of the earth or for its variation in different parts of the globe. If the frame of reference is fixed in the earth, centrifugal force and Coriolis force are present. These result from the rotation of the earth; the former is usually combined with gravity, and the latter has a small effect noticeable only for long-range trajectories. If the missile is rocket powered, the propulsive force, or thrust, is important while the rocket is burning. The thrust is usually taken to be directed axially with a magnitude derived from static firings and given as a function of time; in some cases it is necessary to consider lateral forces arising from thrust asymmetries. (Since the motion of a projectile before it leaves the gun is calculated by the methods of interior ballistics, propulsive forces are not considered in gun exterior ballistics.) Guidance forces occur for guided missiles, or for the propulsion phase of ballistic missiles. They may arise from the action of control surfaces in the air stream around the missile, or from lateral thrust produced by deflection

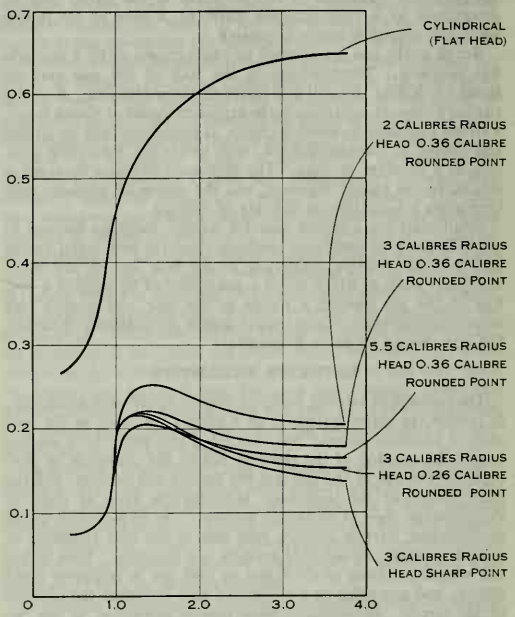
of the rocket jet by means of vanes or by rotation of the rocket motor within the missile.

The most complex contribution to the force system comes from the aerodynamic forces, produced by the resistance of the atmosphere to the missile motion. In order to arrive at suitable expressions for them, it is necessary to consider some of the characteristics common to all missiles. The usual shape of a missile is an elongated cylinder with a more or less pointed nose. Even when this shape is varied, the missile is still elongated and has rotational symmetry about its longitudinal axis. The reasons for this shape lie partly in design considerations not of concern here and partly in the reduction of the effects of air resistance that it entails, but if this reduction is to be realized, with its advantages of increased range and decreased dispersion, the missile must be made to travel nose on. If this is accomplished, the missile is said to be stabilized. Stabilization is brought about in one of three ways. Bombs, most mortar shells and most rockets are fin stabilized, having fixed guiding surfaces attached to them, much like the feathers on an arrow. Most projectiles and some rockets are spin stabilized; the projectile spins about its axis because the gun bore is rifled, and the rocket because its several small nozzles are inclined slightly to its axis. If the spin is properly chosen, the missile is stabilized in much the same way as an ordinary top. The third method of stabilization is by rocket thrust control, mentioned as a guidance force above. Perfect stabilization is never achieved. If the angle between the missile axis and its direction of motion, called the angle of yaw, is always small, the stability is good; if the yaw remains large for any length of time (for example, after an accidental disturbance to the trajectory), stability is poor. The simplest approximation to the aerodynamic force system, which is adequate for some purposes, can be obtained on the assumption that the yaw is zero. Since the missile is rotationally symmetrical with its spin (if any) around its axis, the symmetry implies that the only aerodynamic force acts along the missile axis. This force is called the drag, and experiment shows that it depends on the shape of the missile, on its maximum diameter d, on its velocity through the air v, on the density of the air ρ, and on the local velocity of sound a. This being the case, it may be shown by dimensional analysis ($q.v.$) that the drag must be of the form

$$\text{drag} = \rho v^2 d^2 K_D$$

where K_D is a dimensionless quantity called the drag coefficient and is dependent on the missile shape and on the Mach number, which is the ratio v/a. The manner of this dependence is illustrated in the figure. The various drag coefficients shown there for different nose shapes are based on the Krupp experiments of 1912. One particular drag coefficient, known as the Gâvre function, dominated ballistic practice for many years. It resembles rather closely the curve in the figure for a two-calibres radius head. (This expression means that the nose of the missile is of ogival shape, with the radius of the ogive twice the diameter of the missile.) The Gâvre function was formulated in 1898 by the French, and was based on a study of previous firings in many countries. Since nearly all of these firings had been done with projectiles approximating the shape just mentioned, the Gâvre function was strictly applicable to this shape, but ballisticians used it for a long period for projectiles of all shapes.

If the assumption of zero yaw is not made, the drag remains the principal aerodynamic force, but by no means the only one. A closer approximation to the general aerodynamic force and moment system, which is sufficiently accurate for most purposes, is obtained by assuming that the yaw is small and that the component of the missile angular velocity perpendicular to its axis is small. The forces and moments are then written as a power series in the small cross-velocity and cross-spin components and powers higher than the first are neglected. Arguments from symmetry then lead to the conclusion that ten aerodynamic coefficients (including K_D) suffice to describe the force system; these coefficients are also dependent on Mach number and shape, and are determinable from experiment. As a further refinement the important coefficients are sometimes taken to be functions of the yaw angle. In another refinement, the departure from cylindrical symmetry of a finned missile due to the fins is taken into account, with the small changes in the coefficients which this implies. As stated before, it is the responsibility of the ballistician to examine the force system for each type of problem and decide which terms must be included in the mathematical model for the best compromise between simplicity and accuracy for that problem.



FROM DRYSDALE, "MECHANICAL PROPERTIES OF FLUIDS" (BLACKIE & SON)

THE DRAG COEFFICIENT FOR 10-CM. PROJECTILES

Showing how it varies with velocity. The effect of small changes in the shape of head can be seen in the curves. Note the effect at high velocity

The Computation of Trajectories.—The methods used to solve the equations of motion derived as indicated above will be illustrated by the zero-yaw mathematical model with additional simplifying assumptions. It will be assumed that the only forces acting in an earth-fixed co-ordinate system are those of gravity and drag, and that the gravitational field is constant. It will also be assumed that atmospheric conditions are standard; that is, that there is no wind, that the surface temperature of the atmosphere is 59° F. and that the surface density a standard value, and that the temperature and density change with height in accordance with standard laws designed to reflect average conditions. (Temperature and density will of course vary with weather, and the effects of the departure from the standard atmosphere as well as the effects of wind will be considered later.) Under these circumstances, the motion of the missile is confined to a plane, and the two co-ordinates of its centre of mass describe its position at any time. If the x-axis is horizontal and the y-axis vertically upward, the equations of motion are:

$$\frac{d^2x}{dt^2} = \frac{\rho v K_D}{C}\frac{dx}{dt} \qquad \frac{d^2y}{dt^2} = \frac{\rho v K_D}{C}\frac{dy}{dt} - g$$

The ballistic coefficient C is equal to m/id^2, where i is a dimensionless constant called the form factor customarily introduced into the zero-yaw drag force to permit a certain degree of correction for the neglected aerodynamic effects without increasing the difficulty of the solution. The density of the standard atmosphere decreases approximately exponentially, and the temperature linearly, with increasing y. (Temperature changes alter the

velocity of sound, and hence K_D.)

The computation of a standard trajectory for the mathematical model assumed consists of finding a solution of the equations above. Prior to 1914 the usual purpose was to reduce the equations to a form soluble in terms of elementary functions, or at worst quadratures. No such method of general applicability was found, although the Siacci method is still in use for very flat trajectories, such as forward fire from aircraft guns. From 1917 the principal method of solution of the equations has been some form of numerical integration. In essence, the time interval during which the trajectory is described is divided into a large number of small steps. The values of x, y, dx/dt and dy/dt being known at the beginning of the first step (initial position and velocity of the missile), the equations permit exact calculation of d^2x/dt^2 and d^2y/dt^2 at the beginning of the first step. Over a small enough step, the second derivatives can be treated as constants, and simple integrations give the values of the first derivatives and the co-ordinates at the end of the first step. The computation is then repeated for the second step, and so on. The accuracy of the results obtained is clearly greater the smaller the step, but once an acceptable accuracy has been attained, further decrease of the size of step increases the labour of the computation without significant improvement in the results. It should be remarked that the use of numerical integration is by no means peculiar to ballistics. It is, as a matter of fact, the only method available for the accurate solution of most differential equations, and hence of a very large class of scientific and engineering problems. Its use in ballistics is essentially an outgrowth of the development of numerical methods in astronomy. In view of the importance of numerical integration, much attention has been given to refinements and the development of efficient techniques for special problems, as well as to methods for the prediction of the error of approximation.

Once the problem has been formulated, the actual work of performing a numerical integration is simple, involving only the operations of arithmetic. It can therefore be done by relatively unskilled labour, and until the period after World War II the standard procedure was to engage a large staff of computers who did the arithmetical operations, perhaps with the aid of small desk calculators. Because of the large number of repetitive steps required for each trajectory, and the large number of trajectories required for each weapon, this was an extremely expensive procedure, and the solution of problems involving a mathematical model much more realistic (and hence more complex) than the simple example above was economically impossible. Simple and repetitious operations are those which can best be mechanized, and it is not surprising that the development of the large-scale electronic calculator revolutionized exterior ballistics, nor that a great part of the support for its development came from military sources interested in better firing tables. Following the pioneer days of 1947, increasingly rapid and powerful calculators, such as the ENIAC, EDVAC and ORDVAC at the army's Ballistic Research laboratories at Aberdeen, Md., and the Mark II, Mark III and NORC at the naval proving ground, Dahlgren, Va., were applied to the problems of exterior ballistics. These calculators also furnished opportunities for corresponding advances in computation in other fields. Thus no great difficulty is offered by mathematical models of the most complex aerodynamic force systems measurable, and trajectories are computed in vast numbers.

Differential Corrections.—A collection of standard trajectories, even though based on the most precise mathematical model, would form an utterly inadequate firing table. The standard atmosphere used in their computation makes no allowance for variations of temperature and density with the weather. Wind, which acts by changing the missile velocity with respect to the air, has been ignored. The muzzle velocity of a projectile decreases as the gun barrel wears, and propellant temperature changes affect both projectiles and rockets. Corrections for these and other minor variables are required, in such form that the user can apply them in the field. The older way of calculating these differential corrections was to calculate the perturbation of a standard trajectory when a standard disturbance was applied; for example, for a 10% change in air density. The newer method, more suited to machine calculation, is to calculate another complete trajectory for the disturbed condition. In either case, the estimate obtained of the effect of the standard disturbance is tabulated in the firing table, and the user allows for an effect proportional to the disturbance he observes.

Experimental Measurements.—The determination of the aerodynamic coefficients needed for the most accurate calculations is not an easy matter. The expense of determining them from actual firings of the missiles would be prohibitive, even if it were physically possible to obtain all the data required. Measurements of the aerodynamic forces and moments can be made on a scale model in an aerodynamic wind tunnel or similar models can be fired down an aeroballistic range. This consists of a series of stations past which the model travels in free flight. As it passes each station it triggers a brief flash of light, and photographic records are made showing its position and orientation at the time of the flash, which is also recorded. From precise data on the successive positions, orientations and times, the aerodynamic coefficients may be determined. Some ranges include provision for pressurization, to permit enhancement of the aerodynamic effects, or for firing the missile model through gases in which sound travels less rapidly than in air, to permit a greater variation of Mach number than would otherwise be possible. An older method of obtaining the drag coefficient alone is by means of a resistance firing. This consists essentially of measuring the times at which the missile in free flight passes three successive points in space. Distance traveled is plotted against time, and the curvature of the arc through the three plotted points is a measure of the deceleration and hence of the force on the missile. The principal difficulty with this method is that it is not easy to launch a missile with no initial yaw. A better technique is to employ a radar device to measure the velocity continuously as the missile describes a substantial portion of its trajectory.

In addition to the determination of aerodynamic coefficients, some actual firing of the full-scale missile is required. Scale-model tests cannot quite duplicate full-scale phenomena, both because the aerodynamic coefficients depend to some extent on scale and because a fully accurate scale model is impossible. (Even a small change of the machine finish on the nose of a missile can affect its trajectory to an observable extent.) The basic physical data collected during the full-scale range firing of a projectile or a rocket include measurements of missile weight, centre of mass and moments of inertia, and its initial velocity and initial direction of motion. In addition, the air density and temperature are determined by sounding techniques, as are the direction and speed of the wind, for the whole range of altitudes covered by the trajectory. Measurements of the position of the missile as it describes its trajectory are obtained by radar methods or by triangulation from photographic or theodolite observations, and these measurements are accurately timed. The position of the termination of the trajectory, whether by impact on the surface or by air burst, and the corresponding time of flight are determined with special care. A better sample of the conditions of use of the missile is acquired by conducting the firings on several days, using different lots of ammunition, and in the case of projectiles using both new and old guns. In range bombing, or bomb calibration, bombs are dropped from a number of altitudes and at different aircraft speeds. A series of position and time measurements for aircraft and bomb, bomb yaw and meteorological data are recorded. The position measurements are usually made by photographic instrumentation. Much the same methods are used for aircraft-dropped mines.

Construction of Tables.—For a projectile, two trajectories are computed for each round, from the mathematical model chosen, using the actual conditions under which that round was fired: muzzle velocity, meteorological conditions and so on. These are called weather trajectories, and the two computed differ only in the value of the form factor used. The best form factor is determined by comparison of the weather trajectories with the range firing data for the round. Marked variation of the form factor from round to round is generally a sign that the assumed

drag function is a poor one. When the best value of the form factor for all the firings has been found, standard trajectories and differential corrections may be computed and the firing table composed. The procedure is similar for rockets, although the thrust must be included as another force, and special attention must be given to the burning period, during which a small yaw may produce a considerable effect because the thrust acts along the rocket axis and not along the trajectory. For this reason, a more complex mathematical model is usually employed for the period of burning than after burning.

For a bomb, a rather simple model is used, and two form factors are determined, one giving best fit with the observed range and another best fit with the observed time of flight. The table entries of range and time of flight are computed with the two separate form factors. The form factors are different because the mathematical model is not fully adequate; it ignores the disturbance of the bomb's motion by the air flow about the aircraft at release. As aircraft speeds continue to increase, it may be necessary to develop a more sophisticated model.

Other Problems.—Problems of the stability of rockets and bombs may be attacked by the methods which have been outlined. The basic difficulty with both types is that substantial yaw may be induced early in the trajectory while the missile is still moving relatively slowly. This occurs when a rocket is fired into a cross wind and when a bomb is released from a high-speed aircraft. Once the yaw exists, there is a complex interaction of the effects of the various aerodynamic forces which may produce instability and bad flight. The circumstances under which this will occur have been investigated using advanced mathematical models, with good results. There are also approximate theories available which aid in understanding these phenomena. A similar but more difficult problem is that of projectiles fired from supersonic aircraft in any direction except ahead. The difficulty is due to the large disturbances induced in the projectile path by the supersonic air flow across it.

The role of exterior ballistics in the field of guided missiles may be considered as secondary. There is little interest in launching them precisely toward the target, since their flight is controlled throughout the trajectory. There are thus no firing tables for guided missiles, and exterior ballistic computations are made only for proposed designs, to determine their stability in flight and response to control forces.

Ballistic missiles are in a different category. A ballistic missile is guided from launching until the end of burning, at which point guidance and propulsion both cease. The missile then completes its trajectory in free flight. At the end of burning, therefore, it must be aimed for the target, as a projectile at the gun muzzle must be. The entries in the firing table are the data which must be set into the missile guidance system before launching, so that during the burning period it can steer the missile to the desired aiming conditions. The mathematical model for the trajectory calculations during burning includes the given thrust of the motor and a simulation of the modes of action of the control and guidance systems. During free flight these are inactive, and a simpler model is adequate. Over the major portion of its free flight, a long-range ballistic missile is at such a high altitude that aerodynamic forces are of little consequence; when the missile begins to descend toward its target, they become predominant. The problem of expense of firing is most serious; it is impossible to fire enough rounds to determine empirically all the quantities of interest, and ballistic computation plays an important part in providing answers to the design questions which must be resolved during development, as well as providing firing tables for the completed missile. Satellite trajectory calculations, from launching to orbit, are very similar to those for ballistic missiles.

The theory of the exterior ballistics of a missile traveling through water is not as highly developed as the theory for air travel. The density of the medium, and hence its resistance, is so much greater that what would be small, easily approximated effects in air must be considered in all their complexity. Experiment with scale models or full-scale missiles still dominates this field, although the theory is making substantial progress along much the same lines developed in air ballistics.

TERMINAL BALLISTICS

Terminal ballistics takes up where exterior ballistics leaves off—when the missile reaches the target or otherwise ends its flight. The portion of the missile active in producing target damage is referred to under the general name of warhead, although this usage is somewhat anomalous, since essentially the whole bomb or the whole projectile is the warhead, while rockets, guided missiles and ballistic missiles have warheads which are separate, identifiable components. Warheads produce their effects on the target by one or more of several means, which will be discussed briefly.

Blast is produced by the detonation of a charge of high explosive carried in the warhead. It produces its effects by means of a shock wave, whose propagation is calculable by fluid dynamics and whose properties are determinable by means of pressure measurements. Calculation of the effects produced is more difficult, particularly if the target is a complicated structure or is in motion. Detonation of the explosive also converts the metal case in which it is carried into high-velocity fragments, which are also capable of producing damage. Their numbers, directions of flight, velocities and masses are the parameters of interest, and description, prediction and control of these properties have been undertaken. Penetration, by the warhead or its fragments, may produce the desired damage directly, as in the perforation of a boiler or an aircraft fuel cell. Penetration of an armoured structure may also be a necessary preliminary to the infliction of other damage, as in the case of an explosive-loaded warhead fuzed to detonate after it enters the protected space behind the armour. Much study has been given to the penetration of earth, wood, concrete, rock, steel and flesh. The results depend upon a variety of factors, including the warhead (or fragment) mass, cross section, velocity and angle of impact and the strength of the target material. Observation of the process of penetration is very difficult because of the short times and large forces involved, and theoretical treatments have generally been semiempirical. The study of penetration damage to human or animal bodies is sometimes called wound ballistics. Incendiary mixtures (*q.v.*) are sometimes used to inflict damage by fire. Nuclear warheads produce not only blast but also intense thermal radiation and nuclear radiation, both immediate and lingering.

See Index references under "Ballistics" in the Index volume.

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(RL. H. L.)

BALLOON, a bag or envelope of impermeable material which, when inflated with a gas lighter than air, rises from the ground. The complex of envelope with equipment, load, etc., is also called a balloon or an aerostat. Balloons have been important in sport, war and scientific research.

Legends of all time show that man desires to get his feet off the ground and soar into the unknown regions of the sky, but the methods described in the legends always copied nature and used heavier-than-air devices. (*See* AERODYNAMICS.) Neither in the vegetable nor animal kingdom does nature make use of lighter-than-air devices; *i.e.*, aerostatics. Balloons, therefore, did not result, as did airplanes, from man's ability to adapt nature's methods to his own use. Balloons resulted from man's creative genius.

Invention and Early History.—The Montgolfier brothers, Jacques Etienne and Joseph, French paper manufacturers, on June 15, 1783, at Annonay near Lyons, filled a bag 33 ft. in diameter with smoke from a straw fire and saw it rise to a height of 1,000 ft. Soon it was realized that not the gas resulting from the straw combustion but the heat made the balloon go up. Air expands when heated so that a given volume weighs less than the

same volume of cold air.

The impression created by the Montgolfiers' experiment was tremendous, and in August of the same year J. A. C. Charles, a French professor of physics, released a hydrogen-filled balloon from Paris. It had long been known that hydrogen was lighter than air, but only the year before, in 1782, had Tiberius Cavallo made soap bubbles with hydrogen and seen them rise to the ceiling of the room, an easy and still fascinating experiment. In Great Britain a number of miniature hot-air and hydrogen balloons were sent up in 1783 and 1784, and in Aug. 1784 abortive attempts were made to fly in hot-air balloons by James Tytler (editor of the second edition of the *Encyclopædia Britannica*) at Edinburgh, and by Moret and Keegan at London. The first aerial voyage in Britain was made by the Tuscan Vincenzo Lunardi on Sept. 15, 1784, when he flew in a hydrogen balloon from London (Moorfields) to Standon in Hertfordshire.

A very interesting and quite fundamental law of physics states that the weight per cubic foot of any gas is strictly proportional to its molecular weight; *i.e.*, the sum of the weights of all the atoms forming the molecules of that gas. The average molecular weight of air is 29, and 1 cu.ft. of air at standard conditions (32° F. and 29.92 in. mercury) weighs 0.0807 lb. Any gas that is appreciably lighter than this can be used to inflate a balloon. The lightest of all known gases is hydrogen, the molecular weight being 2; the weight of 1 cu.ft. of hydrogen is only 0.0055 lb., and the lifting force of 1 cu.ft. is equal to the weight of 1 cu.ft. of air minus 0.0055 lb., that is 0.0752 lb. It is certain that there is no "missing link" among the light elements, and that no lighter gas will ever be discovered. Even if a weightless gas should ever be found, the difference between its lifting force and that of hydrogen would be so small that such a weightless gas would not have any great advantage from a lifting point of view.

Next to hydrogen, helium, with a molecular weight of 4, is the lightest gas and has the advantage over hydrogen of being noncombustible. Mixed with air, it does not explode. Formerly a very rare and expensive gas, helium was isolated in the 20th century from some American natural gases. The United States armed forces rarely use anything but helium for inflating balloons.

The density of methane (molecular weight 16), the main constituent of natural gas, is too great to make it attractive. Ammonia, molecular weight 17, has the advantage of being easily compressed and transported in relatively thin cylinders, but pure ammonia is very dangerous to men. It can, however, be transformed chemically into a much lighter gas mixture of 75% hydrogen and 25% nitrogen.

The first experimental flights with animals as well as the first manned flights, however, were made with the Montgolfiers' hot-air balloons. Jean Pilâtre de Rozier (1756–85) went up several times in a captive balloon and proved it was possible to keep the fire burning while the balloon was aloft. On Nov. 21, 1783, Pilâtre de Rozier and the marquis d'Arlandes made the first manned free-balloon flight over Paris for 5½ mi. in about 25 minutes.

On Dec. 1, 1783, Charles, accompanied by one of the Robert brothers who had manufactured the balloon, ascended in a hydrogen-filled, rubberized silk balloon to 2,000 ft. and flew 27 mi. Most of the features of the classic free balloon (fig. 1) were introduced at this time. The only important later additions were: (1) the rip panel invented by the U.S. aeronaut John Wise (1808–79); and (2) the drag, or guide (trail), rope invented by the Englishman Charles Green (1785–1870). The rip panel is an elongated section of the balloon that is only lightly fixed in place and can be quickly pulled or ripped open at the moment of landing. It adds greatly to the safety of ballooning by making quick deflation possible and preventing the balloon from dragging along the ground, throwing the passengers against trees, houses or other obstacles. The drag rope, a heavy manila rope attached to the load ring, reduces vertical and horizontal speeds before landing, gives the aerostat a "front" and "back" and automatically replaces ballast release when flying very low over flat country.

Balloon Flight.—The control of a balloon is neither difficult nor complicated but requires intelligence and the ability to meet changing conditions. Before launching, the balloon is "weighed-off" by the release, or addition, of ballast until it just barely stays on the ground. Then a certain amount of ballast is jettisoned, depending on conditions, and the aerostat is air-borne. The chief of the ground crew shouts, reminding the pilot to open the neck (or appendix), the opening at the bottom of the balloon. If the appendix is not opened, the expanding gas of a fully inflated balloon will burst the bag during ascent.

Once the balloon is air-borne, it becomes a part of the air. The balloon goes where the wind blows. There is no bumping, no noise. The sounds of the ground fade away. One loses the sense of earthliness and gains a feeling of being part of infinite space, almost a part of eternity. Man, however, is man—and the time comes when one must return to earth. This too is a simple procedure. A line, or cord, leads from the basket up through the balloon to a valve, one to three feet in diameter. The pilot pulls this valve line, gas escapes and the balloon starts down. Once started, the balloon often descends with increasing speed, and the pilot must drop ballast discreetly to slow the descent. Instruments on board show the altitude and the rate of ascent or descent. A balloon that rises too rapidly usually "overshoots" its position of equilibrium, and it takes skilful maneuvering, valving and ballasting by the pilot

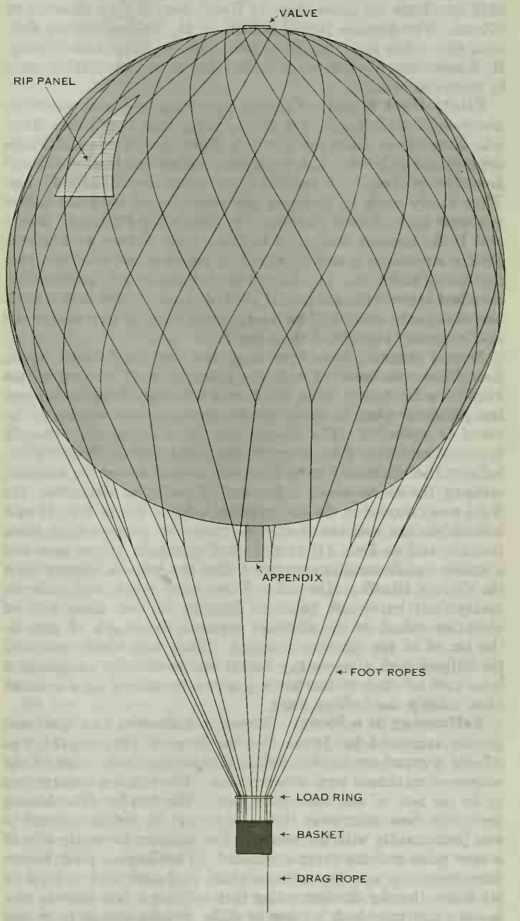

FIG. 1.—CLASSIC FREE BALLOON

to make the balloon level off. At different altitudes the winds blow in different directions, so that it is often possible for a smart pilot with knowledge of weather conditions to choose his direction of travel. Races have often been run to see who, starting from a given place, could land nearest to a specified point. Pilots frequently landed squarely on a bed sheet marking the desired spot.

Other 19th-Century Flights.—In 1821, at the coronation of George IV, Charles Green made the first ascent with a balloon inflated with coal gas. Coal gas is much heavier than hydrogen and the fire hazard is greater, but its cheapness and its former easy availability offered great advantages. Green also, on Nov. 7, 1836, accompanied by Robert Hollond, M.P., and Monck Mason, flew in the "Vauxhall" balloon, later called the "Great Nassau" balloon, from London to Weilburg in the duchy of Nassau, Ger., a distance of 480 mi., in 18 hr., a brief time compared to the time such a trip would have taken by sailboat and horse-drawn coach.

The Alps were first crossed from Marseilles to Turin in Sept. 1849 by François Arban. Count Henri de la Vaulx flew over the Mediterranean in 1901 from Toulon to Algeria. One of the amazing early long-distance balloon flights was that of Wise, who in 1859 flew from St. Louis, Mo., to Henderson, N.Y., a distance of 800 mi. The distance record is held by H. Berliner who in Feb. 1914 flew 1,890 mi. from Bitterfeld, Ger., to Kirgishan (Urals). H. Kaulen had already made a duration record by staying aloft 87 hr. in Dec. 1913.

Flight Over Water.—Crossing important bodies of water has always been a challenge. On Jan. 7, 1785, Jean Pierre Blanchard, who later was to make the first U.S. flight, Jan. 9, 1793, at Philadelphia, and J. Jeffries, U.S. physician, crossed the English channel from Dover, Eng., to a forest 12 mi. inland from Calais, France. They barely made it, throwing out every bit of available ballast and even part of their clothing. In June 1785 Pilâtre de Rozier and P. A. Romain attempted to cross from France to England. Pilâtre introduced a new idea that he hoped would help him control his altitude: the use of a hot-air cylinder, 10 ft. in diameter, attached beneath the gas bag of 37 ft. diameter. The device functioned for only about half an hour. Then the hydrogen caught fire and both men plunged to their death.

Several attempts have been made to cross the Atlantic ocean. John Wise was involved with the preparation of one expedition from New York city, using the *New York Daily Graphic* balloon, but withdrew when he found his recommendations repeatedly ignored or overruled. The voyage was never completed. Shortly before World War I an attempt was made with a 500,000-cu.ft. balloon, the "Suchard," to fly from east to west across the Atlantic, utilizing the trade winds. Because of technical difficulties the flight was canceled at the last moment. After World War II new balloon designs and new materials made the project seem more feasible, and on Dec. 12, 1958, four Englishmen (three men and a woman) made another attempt to cross the Atlantic, leaving from the Canary Islands. The take-off was very rough, and unfortunately their barograph failed to function so that there was no objective record of the altitudes reached, the length of time in the air or of the distance traveled. They had wisely provided the balloon with a seaworthy basket and eventually completed a large part of their transatlantic journey by sailing on the ocean after cutting the balloon loose.

Ballooning as a Sport.—Interest in ballooning as a sport was greatly increased by James Gordon Bennett (1841–1918) who offered a grandiose trophy and a substantial money prize to the winner of an annual long-distance race. The winning country was to be the host of the succeeding race. The trophy, after having been won three successive times (1922–24) by Belgium, came to rest permanently with the winner. The Belgians promptly offered a new prize and the races continued. The Belgian pilot Ernest Demuyter also won the races in 1920, 1936 and 1937, a total of six times, thereby demonstrating that winning a free-balloon race is not a matter of luck but one of skill. Poland won in 1938, and the races were not revived after World War II.

Reasons for the decrease of interest in ballooning as a sport lie in the widespread increase of electric-power lines, making landing operations dangerous, and in the great increase of airplanes. The horrifying catastrophe of the "Hindenburg" (*see* AIRSHIP: *Germany*) produced a terrific fear, not wholly justified, of hydrogen. Helium is not only extremely expensive but not easily accessible to civilians. Coal gas is manufactured less and less.

Balloons in War.—The possibility of using balloons in war was envisioned from the beginning. Benjamin Franklin, in Paris at the time of the first ascents of the Montgolfier balloons, prophetically wrote: "This Method of filling the Balloon with hot Air is cheap and expeditious, and it is supposed, may be sufficient for certain purposes, such as elevating an Engineer to take a View of an Enemy's Army, Works, Etc. conveying Intelligence into, or out of a besieged Town, giving Signals to distant Places, or the like."

Military observation balloons (captive balloons; *i.e.*, balloons fastened to the ground by long cables) were actually used as early as 1794, and again during the American Civil War (1861–65) by both the Federal and Confederate armies. A city was first

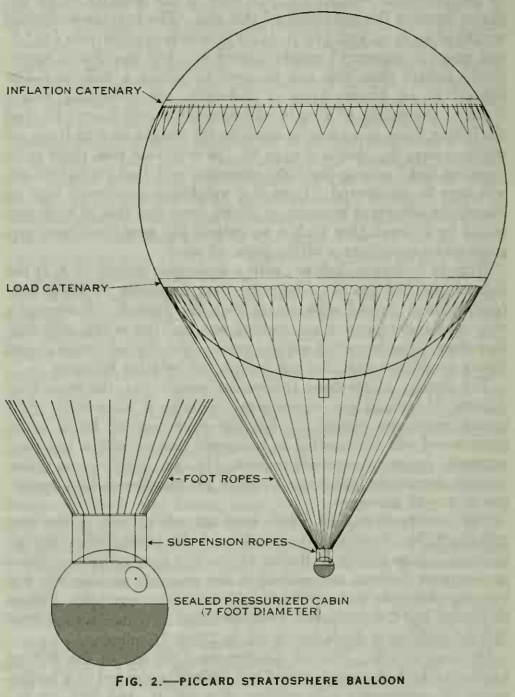

FIG. 2.—PICCARD STRATOSPHERE BALLOON

bombed from the air in 1849 when the Austrians used pilotless hot-air balloons to bomb Venice. In the War of 1870–71, during the siege of Paris, balloons had strategic importance. They not only took out tons of mail but also carrier pigeons, which in turn brought news back into Paris. Furthermore the balloons flew out the members of the French government into unoccupied parts of France.

The captive balloon used as an observation platform was the most common type of military balloon. The spherical captive balloon, however, is a very unsatisfactory instrument for such use. Even a wind of 20 m.p.h. is too much for a captive spherical balloon. The aerostat bounces violently about. The envelope of the balloon has been known to come between the observer in the basket and the ground under observation. During the latter decade of the 19th century the spherical balloon was modified to make better captive balloons by elongation, addition of fins, etc., resulting in an aerostat that combined the properties of the kite and

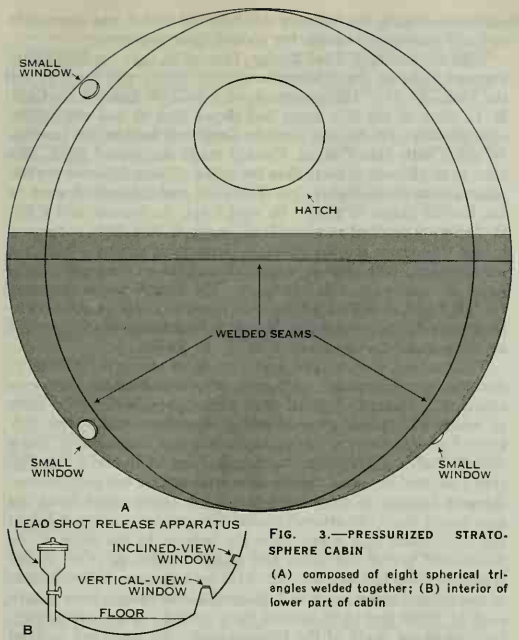

FIG. 3.—PRESSURIZED STRATOSPHERE CABIN

(A) composed of eight spherical triangles welded together; (B) interior of lower part of cabin

the balloon. Gradually a better streamlined body was developed largely by the Germans so that it could withstand winds of 50 m.p.h. The Caquot balloons designed by the French in 1916 became the best captive balloons used in World War I for the observation of troops and the detection of submarines. It is claimed that they could stand a gale of 70 m.p.h. and rise to 6,000 ft. The invention of the airplane eventually eliminated the value of observation balloons. In World War II, however, captive balloons effectively raised steel-cable barrages over many cities and over ships at sea—forcing attacking planes to altitudes where precision bombing became difficult and strafing impossible.

Free unmanned balloons were also used in World War II by the Japanese to bomb the United States. Security measures and the co-operation of the press and radio prevented the enemy from learning how many of their balloons, nearly 1,000, actually reached some part of the North American continent. Believing that only a few had landed in America, the Japanese abandoned the weapon as ineffectual.

Scientific Use of Balloons.—The most important modern aspect of the free balloon lies in its contribution to meteorology and other sciences, notably the study of cosmic rays. The first aerial photographs were taken from balloons. The free-balloon pilot Captain Spelterini (real name Eduard Schweizer, 1852–1931) was the first to see and photograph the pyramids from above (1890).

Salomon August Andrée (1854–97) attempted to fly over the north pole in 1897 and actually came to within 500 mi. of it, but the information he uncovered on this tragic voyage was not found until 1930 when a Norwegian surveying party found the bodies of Andrée and his two companions 200 mi. from Spitsbergen, their starting point. The detailed boardbook, the diaries and letters found with the bodies were still largely decipherable. The photographs, even after 33 years, were developed and gave extraordinarily good prints.

Balloons opened the atmosphere to investigation, and scientists immediately made use of them for measurement of temperature, winds, humidity and so on. Long before men could climb Mt. Everest, its altitude was not only reached but surpassed by manned free balloons. Men strove for greater and greater heights. The use of oxygen became indispensable, but at high altitudes even with oxygen many balloonists died from suffocation.

Superficial consideration seems to show that men breathing pure oxygen could stay alive at a pressure of $\frac{1}{10}$ atm. (about 50,000 ft.). Mountaineers, without additional oxygen, in fact do go beyond an altitude where the pressure is $\frac{1}{2}$ atm. (approximately 17,000 ft.). Since air is by volume $\frac{1}{5}$ oxygen, it would appear reasonable to assume that, breathing pure oxygen, man would not be worse off at $\frac{1}{10}$ atm. than he would be when breathing air at $\frac{1}{2}$ atm. This hypothesis neglects, however, the fact that man emits carbon dioxide and water vapour at constant partial pressure, so that the little gas he would still get into his lungs at 50,000 ft. would be largely carbon dioxide and water vapour. In addition to oxygen deficiency at high altitudes there is the danger of "bends" (caisson disease), very small nitrogen bubbles developing in body tissue under decreasing pressure. In order to avoid "bends" one must breathe oxygen for some time before a high-altitude ascent as well as during the ascent—and one must ascend slowly. In a pressurized cabin these precautions are not necessary, but the pressurized cabin did not exist until after 1930.

Investigation of the upper atmosphere by unmanned balloons also eliminates this danger. The first small pilot balloon, a small unmanned balloon, came into use in 1893. The pilot balloon is usually made of latex and carries no load. It is sealed and rises at approximately constant speeds till it bursts. It is watched from below for observation of wind speeds and direction at different altitudes.

The pilot balloon was the forerunner of the sounding balloon, an unmanned balloon which carries scientific equipment and recording devices. Such balloons (both closed latex and open-neck plastic balloons) are in constant use for meteorological and cosmic-ray study and classified government projects.

The French meteorologist Leon Teisserenc de Bort (1855–1913) actually discovered the stratosphere by means of sounding balloons. He found that in the temperate zones, at and above an altitude of about 35,000 ft., the air temperature is nearly constant (−70° F.). From this discovery he concluded, a little too hastily, that above this altitude no vertical winds existed, and clouds had no reason to be formed. Eric Regener, (1881–1955), Robert Millikan (1868–1953) and others made intensive studies of cosmic rays during the 1920s and early 1930s by means of sounding balloons that had to be recovered after flight. Later radio balloons were used, but for years manned flights gave more reliable results. Manned flight, however, was restricted to low altitude.

Piccard Balloons.—Auguste Piccard, a Swiss scientist and professor of physics in Belgium, was also a balloon pilot and had used the free balloon in 1926 to perform the Michelson-Morley experiment (*q.v.*) on light speed in different directions. When he became interested in cosmic ray study, he decided to modify the balloon (*see* fig. 2 and 3) and construct a pressurized cabin, so that he could ascend safely to the stratosphere with an effective physics laboratory. Sponsored by the Belgian Fonds National de la Recherche Scientifique (F.N.R.S.), he had little difficulty arranging for the manufacture of the balloon, which differed from the classical balloon chiefly by elimination of the net. The net was replaced by two catenary belts: the upper one for handling during inflation and the lower one for carrying the load during flight.

He had difficulty arranging for the construction of the cabin (gondola) and was repeatedly told it could not be done. Finally he asked a manufacturer to build him a spherical beer barrel with windows, so that he could look *into* the sphere to check on its contents, and a large hatch, so that a man could get inside to clean it. This the engineer said could be done.

The first cabins for the stratosphere balloons were built either of soft aluminum or magnesium by welding two "polar plates" and one centre belt together to form a sphere. In addition to several 4-in. windows looking out, both up and down, at a 45° angle, there was one window on top looking up, so that the pilot could check on the balloon, and one window looking down for purposes of terrestrial navigation. There were two hatches. This design has one drawback. A weld that terminates in a "dead end" creates, beyond the extremity of the weld, undue stresses in any sphere,

be it a balloon or a pressurized cabin. A fatal accident in Belgium and the destruction of a balloon during inflation in the Black hills of South Dakota drew attention to this basic fact. Jean Piccard, twin brother of A. Piccard, in designing the cabin for project Helios (*see* below) therefore designed a cabin using eight spherical triangles (fig. 3[A]) producing a spherical octahedron, so that no weld terminated in a "dead end," but each formed a portion of a "great circle" around the sphere. This cabin has been used three times by the U.S. armed forces for project Strato Lab (*see* Table II). Each time certain modifications have been made (fig. 3), the number of windows increasing from one 9-in. window to four. The number of hatches increased from one to two, and these are larger than the original hatch in order to allow the men to slide through them wearing pressure suits, parachutes and equipment.

The hatches of the early cabins each had double hatch covers, one inside and one outside, held together by a heavy screw. J. Piccard made a radical break in design by utilizing the inside pressure, and only the inside pressure, of the cabin to hold the single hatch cover in place, thus ensuring easy opening of the hatch when the balloon redescended to the air pressure at which the hatch had originally been closed or, during flight, after equalization of the inside and outside pressures.

Air regeneration in a pressurized cabin is a problem that must be solved. In a 7-ft. cabin occupied by two people the oxygen content, 21% by volume at the start, goes down about 1% of the total air volume per hour. After four to five hours fresh oxygen must be added. Carbon dioxide (0.03% at the start) goes up 1% of the total air volume per hour. After about one hour absorption of the excess should be started, using sodium or potassium hydroxide, which can be put into gauze bags hanging from the walls of the cabin. Even before the end of the first hour it is important to absorb "anthropotoxines," by-products of human metabolism, which very soon reduce human efficiency and easily produce nausea and other bad effects. While the above-named hydroxides absorb some of the anthropotoxines, activated charcoal is added for others. Water is best absorbed by magnesium perchlorate or by silica gel. The temperature of the cabin at altitudes between 35,000 and 85,000 ft. can be held within very agreeable limits (60°–70° F.) by the method described by A. Piccard. The last gondola designed by him and used by Comdr. T. G. W. Settle, U.S. navy, and by Jean and Jeannette Piccard (*see* Table I) was painted with a heat-reflecting white paint on its upper portion and black on its lower portion up to 4 in. above its equator. Later cabins, designed to go to 100,000 ft., have been kept unpainted in order to reflect a maximum of solar radiation.

Stratosphere Flights.—When everything was ready for A. Piccard's first stratosphere flight, starting from Augsburg, Bavaria, the German authorities tried to prevent the flight because the aerostat was not "conventional." It is difficult to realize that as late as 1933 the Piccard stratosphere gondola was the only pressurized aircraft cabin in existence, and that, even after A. Piccard's successful flights, the industry still believed that it was impossible to build pressurized cabins for high-altitude airplanes.

With his assistant, Paul Kipfer, Piccard in 1931 made the first manned flight to the stratosphere (51,775 ft.) and lived to tell the tale. In 1927 the barograph of a balloon manned by Capt. H. C. Gray of the U.S. army had shown that he had reached an altitude of 42,470 ft., but Captain Gray was dead at the landing. In 1932, with Max Cosyns, Piccard made the second flight, this time to an altitude of more than ten miles. There followed several other stratosphere flights (*see* Table I), and the record went to the United States in 1933. In 1935 Capt. A. Stevens and Capt. O. Anderson reached an altitude of 72,377 ft. in a flight sponsored by the U.S. army and the National Geographic society. This was a record both with respect to altitude and the amount and importance of cosmic-ray data obtained. The cosmic-ray instruments for this flight, as well as for the 1934 flight of J. and Jeannette Piccard, were built by the Bartol Research foundation of the Franklin institute under the direction of W. F. G. Swann.

The manned stratosphere flights made in the 1930s (Table I) were, in every instance, made with pressurized cabins that were copies of A. Piccard's original cabin with slight modifications, some of which were good, some of which were disastrous. The U.S. army-National Geographic society cabin was considerably larger than Piccard's, contributing to the efficiency of the crew. J. Piccard's method for rapid release of outside ballast not only assured the safe landing of his balloon through a heavy cloud layer but also saved the U.S. army-National Geographic society flight at the start when high winds blew the balloon to the edge of the Stratobowl before the cabin had wholly cleared it. One of the Russian cabins had hatch covers held by numerous bolts (instead of one central screw or, as in J. Piccard's later design, none at all), each of which had to be opened by a wrench. This arrangement resulted in the death of the Russian crew, who could not bail out in an emergency. The balloons themselves were made successively larger but were still constructed according to Piccard's design, and one used the same general inflation technique. Stratosphere balloons, manned or unmanned, are only partially inflated before start. The material was rubberized cotton but was thinner than standard balloon fabric.

Later Design and Material Developments.—The ultimate seemed to have been reached. It seemed impossible to build larger balloons of light enough material. It was time for another break with convention. In 1935 Thomas H. Johnson, then assistant director of the Bartol Research foundation, suggested to J. Piccard the possibility of making sounding balloons from a new material, a plastic film called cellophane. Johnson and others had customarily used sealed latex balloons singly or, for heavier loads, in small clusters. Johnson wanted a single balloon capable of carrying radio-equipped cosmic-ray instruments to high altitudes. Piccard immediately went to work designing the new balloons and built the first on the floor of the attic of the Bartol Research

TABLE I.—*Early High-Altitude, Manned Free-Balloon Flights 1931-36*

Date	Crew	Launching site	Landing site	Balloon volume	Altitude	Remarks
May 27, 1931	A. Piccard P. Kipfer (engineer)	Augsburg, Ger.	Ober Gurgl glacier, Aus.	500,000 cu.ft.	51,775 ft.*	First use of pressurized cabin for manned flight. Altitude record. Duration 16 hr. Valve rope broke, but crew and scientific equipment landed safely
Aug. 18, 1932	A. Piccard M. Cosyns	Zürich, Switz.	Volta Mantuana, Garda, Italy	500,000 cu.ft.	53,153 ft.*	New altitude record. Fully controlled flight with scientific equipment functioning well. First daytime landing from the stratosphere
Sept. 30, 1933	G. Profkoviet F. N. Birnbaum K. D. Godunow	Moscow, U.S.S.R.	Near Moscow, U.S.S.R.	860,000 cu.ft.	60,680 ft.	Claimed altitude not verified by Fédération Aéronautique Internationale but accepted through courtesy. No information about scientific work
Nov. 20, 1933	T. G. W. Settle, U.S. navy Maj. C. Fordney, U.S. marines	Akron, O.	Blayside, N.J.	600,000 cu.ft.	61,221 ft.*	New altitude record. Valve rope escaped from cabin during flight. Much equipment, even doors, jettisoned. Safe landing at southern tip of New Jersey
Aug. 18, 1934	M. Cosyns N. Van der Elst	Haur Havenne, Belg.	Morska Sobota, Yugo.	500,000 cu.ft.	50,840 ft.	Balloon traveled approximately 1,000 mi., a distance record for stratosphere flights
Oct. 23, 1934	Jeannette Piccard Jean Piccard	Dearboro, Mich.	Cadiz, O.	600,000 cu.ft.	57,579 ft.*	Take off and landing through thick cloud layer. Fully controlled flight. Heavy load of scientific equipment gave good cosmic-ray data
June 26, 1935	Warigo Christofil Priluchi	U.S.S.R.	U.S.S.R.	883,000 cu.ft.	52,800 ft.	During uncontrolled descent the crew parachuted to safety
Nov. 11, 1935	Capt. A. Stevens Capt. O. Anderson, U.S. army	Rapid City, S.D.	White Lake, S.D.	3,700,000 cu.ft.	72,377 ft.*	New altitude record. Heavy load of scientific equipment gave rich cosmic-ray data and photographs. Fully controlled flight

*Altitude verified by the Fédération Aéronautique Internationale (F.A.I.).

TABLE II.—*Notable Plastic Balloon Ascents*

Flight and balloon capacity	Date	Crew	Launching site	Landing site	Altitude	Load carried	Duration	Cabin	Remarks
Bartol Research foundation (cellophane), 2,578 cu.ft.	Spring-summer 1936	None	Swarthmore, Pa.	About 30 mi. distant	About 58,000 ft.	4 kg.	?	None	First plastic balloon. Appendix apparently failed to open. Balloon tore at top altitude
University of Minnesota (cellophane), 2,578 cu.ft.	June 24, 1936	None	Minneapolis, Minn.	Arkansas, distance 600 mi.	About 50,000 ft.	7 lb. plus ballast	10 hr.	None	First plastic balloon to level off and carry scientific instruments over constant level course for considerable period
1—G.M.I.,* 144 cu.ft.	July 11, 1947	None	St. Cloud, Minn.	North of Anoka, Minn.	28,000 ft.	4 lb.	About 3 hr.	None	First plastic balloon released after lifting of security regulations
36 and 37 Naval Research laboratory 27,000 cu.ft.	Feb. 14-20, 1956 Feb. 18-23, 1956	None None	Oppama, Jap.	Precise locations not known	About 30,000 ft.	Radiosonde weight not given	128 hr. 98 hr.	None None	Flight 36 traveled 15,400 mi. Flight 37 traveled 12,400 mi. and was picked up in Strait of Gibraltar by a Dutch vessel at 36°58′ N., 00°16′ W. about one week after termination
University of Minn. 314-G.T.S.,* 1,000,000 cu.ft.	Sept. 7, 1956	None	Anoka, Minn.	Georgetown, Ky.	144,000 ft.	22 lb. plus 43-lb. ballast	About 3 days	None	Altitude record. Mylar Tetroon designed by W. F. Huch and R. B. Thorness, University of Minnesota
1856—G.M.I.,* 125,000 cu.ft.	Aug. 10, 1956	M. D. Ross Lee Lewis U.S. navy	Anoka, Minn.	Stevens Point, Wis.	40,100 ft.	1,422 lb.	3 hr. 48 min.	Open	Crew used oxygen. A Strato Lab flight
1948—G.M.I.,* 202,000 cu.ft.	Sept. 26, 1956	H. Froehlich K. Lang General Mills, Inc.	Anoka, Minn.	Cresco, Ia.	42,300 ft.	2,075 lb.	About 6 hr.	Open	Highest manned open-basket flight
2000—G.M.I.,* 803,000 cu.ft.	Nov. 8, 1956	M. D. Ross Lee Lewis U.S. navy	Rapid City, S.D.	Valentine, Neb.	75,800 ft.	1,772 lb.	3 hr. 52 min.	Piccard-type sealed aluminum sphere	New unofficial altitude record. A Strato Lab flight
Manhigh I—W.R.,* 2,000,000 cu.ft.	June 2, 1957	Capt. J. W. Kittinger	South St. Paul, Minn.	Weaver, Minn.	96,000 ft.	1,213 lb.	6 hr. 32 min.	Winzen-type sealed aluminum capsule	New unofficial altitude record
Manhigh II—W.R.,* 3,000,000 cu.ft.	Aug. 19-20, 1957	Maj. D. G. Simons	Crosby, Minn.	Frederick, S.D.	101,500 ft.†	1,710 lb.	32 hr. 10 min.	Winzen-type sealed aluminum capsule	New official F.A.I. altitude record for manned flight
"Pleiades II" 30,000 cu.ft.	Sept. 18, 1957	Don Piccard	Valley Forge, Pa.	Spring Garden, Pa.	About 3,000 ft.	355 lb.	2 hr.	Open aluminum	First multiple-plastic-balloon flight
Strato Lab II—W.R.,* 2,000,000 cu.ft.	Oct. 18, 1957	M. D. Ross Lee Lewis U.S. navy	Crosby, Minn.	Hermansville, Mich.	86,000 ft.	2,395 lb.	9 hr. 20 min.	Piccard-type sealed aluminum sphere	Unofficial altitude record for two-man flight
98—R.I.,* 3,000,000 cu.ft.	Oct. 27, 1957	None	Brownwood, Tex.	Louisiana	137,750 ft.	510 lb.	10 hr. 30 min.	None	Altitude record for unmanned polyethylene balloons
2288—G.M.I.,* 3,755,544 cu.ft.	Oct. 4, 1958	None	Eniwetok, Marshall Islands	...	88,700 ft.	2,412 lb.	3 hr. 15 min.	None	Balloon destroyed by rocket fired by radio. Heaviest load for unmanned balloon
2385—G.M.I.,* 3,814,000 cu.ft.	Sept. 9, 1958	None	Anoka, Minn.	St. Charles, Minn.	105,350 ft.	1,538 lb.	18 hr. 57 min.	None	Largest Skyhook balloon
Strato Lab III—W.R.,* 2,000,000 cu.ft.	July 26-27, 1958	M. D. Ross Lee Lewis U.S. navy	Crosby, Minn.	Jamestown, N.D.	82,000 ft.	3,529 lb.	33 hr. 41 min.	Piccard-type sealed aluminum sphere	Heaviest load and duration records
Naval Research laboratory 10,000,000 cu.ft.	May 4, 1961	M. D. Ross Victor Prather U.S. navy	Aircraft carrier "Antietam," off Louisiana	Gulf of Mexico	113,500 ft.†	...	...	Open aluminum	Crew wore space suits. V. Prather killed in retrieval operations

*G.M.I. refers to General Mills, Inc.; W.R. to Winzen Research Inc.; G.T.S. to G. T. Schjeldahl Co.; and R.I. to Raven Industries, Inc. These organizations manufactured the various balloons.

†Altitude verified by the Fédération Aéronautique Internationale (F.A.I.).

foundation in Swarthmore, Pa.

These open-neck balloons were made from gores ("orange peelings") of the new film, attached to each other by vertical seams with cellophane tape which carried the main part of the load. Only the upper half of the balloon, measured vertically, was spherical. The lower half was conical. Both Johnson and Piccard built balloons of this design and flew them successfully in 1936 (*see* Table II). The one built and launched by Piccard (fig. 4), with the help of his students in the department of aeronautical engineering at the University of Minnesota, traveled a distance of 600 mi. carrying an automatic ballast-releasing device and radio equipment for reporting temperature, humidity and altitude during flight.

Confident in his plastic film balloons, Piccard went ahead with plans for manned flight and propounded a new theory. While it is true that the single sphere is the system with the smallest surface per unit volume, it is not the shape of the lightest possible aerostat. The stresses in an open-neck balloon at any location are proportional to the radius of curvature and proportional to the inside pressure difference, which in turn is proportional to the height above the appendix. This relation makes the stresses, and consequently the necessary thickness of the fabric (or film), proportional to the square of the diameter. The replacement of one large bag by eight small ones of the same total volume (fig. 5) multiplies the surface by two but cuts down the stresses to one-quarter, so that the total weight of the eight small balloons is only half the weight of the large balloon of equal volume. More generally speaking, if one single balloon is replaced by n smaller balloons of the same total volume, the necessary weight is reduced by a factor equal to the third root of n.

The theory cannot be contested, but the maneuverability of a multiple-balloon aerostat was vigorously questioned. Sponsored by the Kiwanis club of Rochester, Minn., Piccard made a solo open-basket ascent to 10,000 ft. in a multiple-balloon aerostat, the "Pleiades," using 98 Dewey and Almy latex sounding balloons (1937). When it was necessary to stop the ascent and bring the aerostat back to earth, Piccard simply eliminated one balloon, or more according to need, by cutting the string that held it to the load ring or by pulling the balloon down within reach and stabbing it with his knife. When, just before the landing, it became necessary to release several balloons in rapid succession, he shot them quickly with his revolver. He replaced the pulling of the rip panel of the conventional balloon by blasting off a large cluster of the balloons with a small charge of TNT.

After World War II new plastics were at hand, so that very large and efficient balloons could be built, and Piccard had plans ready for a flight to 100,000 ft. He was quietly seeking sponsorship when he met O. C. Winzen and fired him with enthusiasm for the plan. Winzen successfully approached both the U.S. navy and General Mills, Inc., and project Helios was started in 1946. It called for the construction of an aerostat employing 80 plastic

balloons of 250,000 cu.ft. each. The manufacture of the large plastic balloons was begun in 1947. These balloons were like the 1936 cellophane balloons, but larger, and like them, each balloon could be used only once. After experimentation with different films, polyethylene (0.001 in. thick) was chosen. The seams of the cellophane balloons had simply been taped because cellophane cannot be heat welded. For the seams of the polyethylene balloons Piccard combined heat welding and taping.

A corollary of the multiballoon theory explained earlier (fig. 5) is simple: if one balloon carrying 70 lb. will rise to 100,000 ft., then 80 balloons will lift over 5,000 lb. to the same altitude. The new balloons required the development of new methods of inflation and the training of special teams to handle each balloon. The new, lightweight pressurized cabin (fig. 3) mentioned above was under construction in the early summer of 1947 when project Helios was, unfortunately, terminated. The feasibility of putting a multiple-plastic-balloon aerostat into the air was declared impossible by the sponsors. Before the termination, however, J. and Jeannette Piccard were the first to launch one of the new 250,000-cu.ft. plastic film balloons successfully. Their method of inflation involved the use of an outer casing, or sleeve, which keeps the uninflated part of the balloon tightly together, preventing the wind from turning it into a huge sail. At the moment of release the inflation sleeve is ripped off. The project was still "classified," so that the balloon which carried no load was automatically ripped as soon as it was a few hundred feet off the ground.

The importance and usefulness of these balloons, now frequently called Skyhook balloons, was amply demonstrated after 1947. They were manufactured from polyethylene film by two firms in Minnesota and one in South Dakota. Another plastic balloon made from polyester film (Mylar), using a different design, was manufactured by still another firm in Minnesota.

Polyester films are stronger than polyethylene. Though for many years they were rarely used because they could not be heat welded satisfactorily (they still require a special adhesive for sealing the seams), they hold the altitude record for sounding balloons. (*See* Table II.)

Constant-level balloons are also built of polyester films. This constant-level balloon is a closed-neck pressure balloon, the gas volume of which is not affected by variation of temperature. If it is heated by the sun, the inside pressure increases without changing the volume of the displaced air. Its lifting force is, therefore, nearly constant, and the balloon has no primary reason to change altitude. The possibility of such balloons was long discussed in textbooks on ballooning, but the conclusion had always been that no balloon material was strong enough to withstand the increase of pressure produced by solar radiation. Normally balloons superheat in the morning sun and, as they rise, loose the expanding gas through the appendix. In order to maintain altitude, therefore, they are obliged to release ballast when they cool in the evening. Since plastic balloons are transparent, they are less heated by the sun. This fact in itself would not be sufficient to allow the building of constant-level balloons. By the late 1950s, however, there were plastic films which, weight for weight, were very much stronger than older balloon fabrics, and constant-level balloons could be, and were, built, launched and successfully flown by G. T. Schjeldahl Co., maintaining a constant level over a period of several days.

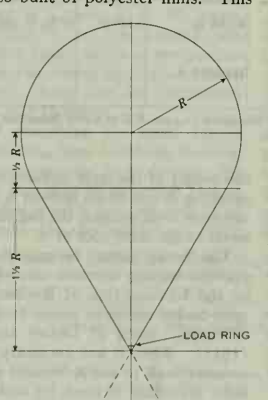

FIG. 4.—SCALE DRAWING OF SKYHOOK. THE PICCARD PLASTIC BALLOON

Further developments also took place in the shape of plastic balloons. Ralph Upson, professor emeritus of the University of Minnesota, proposed the "natural" shape (fig. 6) which takes the stresses off the film and transfers them to the tapes (now made of fibreglass) to a greater extent than occurs in the Piccard design. The disadvantage of the "natural" shape from the manufacturer's point of view comes from the fact that each time there is a need to change the size of the balloon or the load it is designed to carry, gores must be retailored, and the complicated calculation must be done by analogue computer. No two balloons of different size have exactly the same "natural" shape.

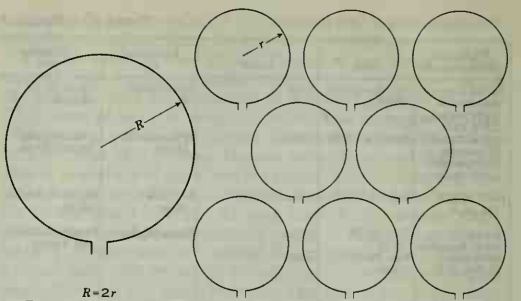

FIG. 5.—PRINCIPLE OF THE MULTIPLE VERSUS THE SINGLE BALLOON
For equal strength the material of the large balloon must be four times as strong and weigh four times as much per square inch as that of the small balloons

Three other shapes have been developed for the sake of economy rather than efficiency. Athelstan Spilhaus of the University of Minnesota introduced the "pillow" balloon. "Endless" plastic tube, as produced by the industry, is quickly formed into "pillows" by one straight transverse weld and one cut per balloon. These balloons were used in great numbers to send information behind the "iron curtain."

The Tetroon, a balloon shaped like a tetrahedron, designed by W. F. Huch, research fellow, and R. B. Thorness, engineer, at the University of Minnesota and first manufactured in Northfield, Minn. (Table II), requires only straight-line cuts and taping of flat film. The shape of the tetrahedron when inflated comes surprisingly close to that of a sphere, although the stresses are not uniform. In this manner, balloons, nearly as efficient mechanically as spherical balloons, are more simply and economically manufactured than the Skyhook.

Another economical balloon is the "milk-bottle" designed by Don Piccard, son of J. Piccard. It is made simply by tying off one end of a length of plastic tubing and binding the other end around a ring to which the load is suspended. D. Piccard used a complex of 12 of these to form a multiple-plastic-balloon aerostat, the "Pleiades II." In order to bring any manned aerostat back to earth, it is necessary to release gas in determined amounts. With a small number of balloons, cutting a balloon loose, as was done in the original "Pleiades" flight, would cause the loss of too great an increment of lifting power at any one time. "Valving" became necessary. Piccard accomplished this by pulling the top of a balloon down with a cord leading through the balloon until gas spilled out of the appendix, a much safer method from the fire hazard point of view than the historic method of valving. On his flight in Sept. 1957 Piccard proved the feasibility of his father's project—a multiple-plastic-balloon aerostat.

Manned Scientific Flights.—Many scientific experiments can now be handled by radio-sounding balloons. Manned flights, however, are still necessary for such experiments as photographing the spectrum of Mars. Automation has advanced very far in the past years, but man is still, as W. F. G. Swann said: "the best automaton yet created." For this reason manned flights to greater and greater altitudes are desirable, and science asks for them. The balloon has the advantage not only of being able to reach altitudes where the earth's atmosphere is very thin (approximately 0.001 atm.) but of maintaining an essentially stable platform there for hours, even days on end, while traveling very great distances.

As has been seen, however, single balloons of too great a volume are inefficient, although with better quality of plastic films and tapes extremely large balloons of good efficiency can be made. (Table II.) A Skyhook balloon of 3,000,000 cu.ft. has carried a load (unmanned) of 510 lb. to an altitude of 137,750 ft., while one of the same volume carried 1,710 lb. (manned) to only 101,500 ft. (Table II.) A single balloon of seven times this volume, however, would not be able to carry a sevenfold load to the higher altitude (137,750 ft.). On the other hand, a cluster of seven balloons, each of 3,000,000 cu.ft. capacity, would carry a 3,500-lb. manned laboratory to this great altitude.

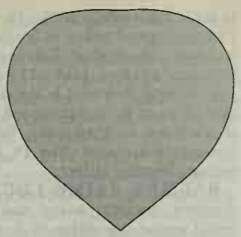

FIG. 6.—OUTLINE OF THE "NATURAL" SHAPE OF THE UPSON PLASTIC BALLOON

Compared to the Piccard balloon (Fig. 4), the horizontal circumference has been expanded and the vertical axis shortened. The meridien lines remain the same

The future of high-altitude manned ballooning lies therefore in the multiple-plastic-balloon aerostat.

See also Index references under "Balloon" in the Index volume.

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(J. F. Pd.; Je. P.)

BALLOONFLOWER (*Platycodon grandiflorum*), a Eurasian, showy perennial of the bellflower family (Campanulaceae) that is widely grown for ornament. It is an erect herb, from 18 to 30 in. high, with usually solitary, terminal inflated buds (whence the common name), which open to bell-shaped or deeply saucer-shaped, dark blue (pale blue, lilac or white in some varieties), 2–3 in. wide flowers. Dwarf and double and semidouble flowering forms exist. They are handsome, easy to grow, border plants.

(J. M. Bl.; X.)

BALLOT, in modern times a sheet of paper that a voter uses to indicate his choice of candidates in an election. Ballots are customarily deposited in a ballot box until the polls are closed and are then taken out and counted. The Australian ballot, so-called because of its origin, is a form of official balloting that affords the voter the chance to vote secretly. *See* Electoral Systems; Voting Machines.

BALLOU, HOSEA (1771–1852), U.S. Universalist theologian, for over 50 years the most influential leader of the Universalist Church, was born at Richmond, N.H., on April 30, 1771, the son of a Calvinistic Baptist minister. He was converted to belief in universal salvation in 1789 and began preaching the doctrine on a Calvinistic basis, substituting for the elect all mankind. He re-examined Calvinistic tenets, however, under the influence of Ethan Allen's deistic work *Reason the Only Oracle of Man.* The result of his rethinking of Universalist theology was forcefully presented in his most important book, *A Treatise on Atonement* (1805). Ballou placed great stress on the use of reason in religion, transferred Universalism from a trinitarian to a unitarian base and discarded the doctrines of original sin and vicarious atonement: Christ died not to reconcile God to man but rather as a demonstration of God's unchanging love for man. Between 1795 and 1805 Ballou's forceful preaching converted the greater number of Universalist clergymen to the new liberal approach. From 1817 he took the position that punishment for sin is limited to this life; at death the soul is immediately purified by divine love and enters the state of immortality. The controversy which ensued resulted in the secession of the "Restorationists," who insisted on belief in a limited period of punishment in the afterlife. Ballou set forth his position in *An Examination of the Doctrine of Future Retribution* (1834).

After circuit riding for several years, Ballou served churches in Portsmouth, N.H., Salem, Mass., and Boston (1817–52). He died at Boston on June 7, 1852. *See* also Universalist Church.

See the biography by O. F. Safford (1889) and Ernest Cassara, *Hosea Ballou and the Rise of American Religious Liberalism* (1958).

(Et. Ca.)

BALLYCASTLE, an urban district of County Antrim, N.Ire., 55 mi. N.N.W. of Belfast, on a bay of the same name opposite Rathlin Island, where Robert Bruce is said to have hidden in a cave. Pop. (1961) 2,643. At the foot of Glenshesk and close to Knocklayd (1,687 ft.), it has a pleasant strand. Cliffs run east, to reach their highest at Fair Head (626 ft.), and west past Carrick-a-rede Island, known for its rope bridge. Near the town are the ruins of Bonamargy Franciscan friary. Ballycastle became a market centre, fishing harbour and holiday town.

BALLYMENA, a municipal borough in County Antrim, N.Ire., on the river Braid. Pop. (1961) 14,740. It is 28 mi. N.N.W. of Belfast and is close to the fine desolate scenery of the Antrim plateau and the Glens of Antrim. A market town, it serves a wide countryside and its industries include the spinning, weaving, finishing and bleaching of linen and the manufacture of carpets and tobacco. Harryville Mote overlooking the Braid is an Anglo-Norman motte and bailey castle.

BALLYSHANNON (Béal Átha Seanaigh), a seaside town in County Donegal, Republic of Ireland, at the mouth of the Erne, 139 mi. N.W. of Dublin by road. Pop. (1956) 2,434. The town is built up the steep banks of the river and is crossed by a bridge connecting it with the suburb of The Port. O'Donnell castle, built in 1423, once stood north of the market yard. It was successfully defended by Hugh Roe O'Donnell against the English under Sir Conyers Clifford in 1597, demolished in 1602, rebuilt in 1610, again demolished and finally built over. The poet William Allingham was born in Ballyshannon. One mile northwest are the ruins of the once-famous Cistercian abbey of Assaroe.

The Erne river hydroelectric development scheme comprises two power stations, the Cathaleen's Fall power station at Ballyshannon and the Cliff power station near Belleek.

BALM, name applied to several plants of the mint family, especially *Melissa officinalis,* also called balm gentle or lemon balm, and cultivated for its fragrant leaves, which are used in flavouring. The term also is applied to *Melittis melissophyllum,* bastard balm; *Monarda didyma,* bee balm or Oswego tea; *Collinsonia canadensis,* horse balm; *Glecoma hederacea* and *Satureja* (*Calamintha*) *nepeta,* field balm; and *Molucella laevis,* Molucca balm or bells of Ireland. Aromatic exudations from species of *Commiphora* (trees and shrubs of the incense-tree family [*see* Burseraceae]) also may be referred to as balm. Balm of Gilead or balm of Mecca is the myrrhlike resin from *C. opobalsamum* of Arabia. The balsam fir (*Abies balsamea*) is sometimes called balm fir or balm of Gilead fir. The balm of Gilead poplar is *Populus gileadensis.* Balm of heaven is the California laurel (*Umbellularia californica*).

(J. W. Tr.)

BALMACEDA, JOSÉ MANUEL (1840–1891), Chilean liberal reformer and president, whose struggle to strengthen the presidency led to a major civil war, was born in Santiago on July 19, 1840. A scion of a wealthy family, he studied first for the church, but his trip to the Lima congress of 1864 as an aide to former Pres. Manuel Montt (*q.v.*) decided him on a political career. In 1870 he was elected to congress, where he soon showed qualities of leadership. From 1878 to 1881 he was minister to Argentina, in which post he succeeded in keeping Argentina from joining Peru and Bolivia against Chile in the War of the Pacific (*q.v.*). He returned to Chile to serve in the cabinet of Pres. Domingo Santa María (1881–86), where he energetically pushed anticlerical measures and promoted public works with the ever-growing public revenues derived from nitrates.

Balmaceda was elected president in 1886. During his regime public education was advanced and major achievements were made in several technical areas, including railroad construction. The president, however, was caught up in the legislative revolt against the executive, begun in the 1860s, which was aggravated by bitterness in certain sectors over the religious reforms. Balmaceda fought valiantly to prevent congressional erosion of the powers of the president, but his relations with congress deteriorated to the point where he was obliged to dissolve that body. This precipitated the Chilean civil war (*q.v.*). Congressional forces, supported by the navy, rose in revolt. After a hard-fought struggle that lasted eight months, Balmaceda's forces were finally defeated. He sought asylum in the Argentine legation where he committed suicide on Sept. 19, 1891. Balmaceda's defeat and death left conservative parliamentary government entrenched until the mid-1920s. *See* CHILE: *History.* (J. J. J.)

BALMER, JOHANN JAKOB (1825–1898), Swiss mathematician and physicist, discovered a formula basic to the development of atomic theory. He was born May 1, 1825, in Lausen, Basel-Land canton, Switz. A secondary-school teacher in Basel from 1859 until his death, he also was a part-time lecturer on geometry at the University of Basel from 1865 to 1890. In 1884 Balmer developed a formula representing the wave lengths of the spectral lines characteristic of hydrogen. This formula, although containing only one constant, represents all the lines of atomic hydrogen in the visible and near ultraviolet regions with perfect accuracy. The series is generally known as the Balmer series.

The Balmer formula was derived in 1913 from two simple postulates by Niels Bohr. As had already been suggested by Balmer, Bohr predicted other line series of hydrogen, and such series were subsequently found by others. The Balmer formula has served as a model for the formulas of other spectral series and is therefore fundamental to the field of atomic spectroscopy. For a description of the position of the Balmer formula in atomic theory, *see* QUANTUM MECHANICS: *The Bohr Atom.* (G. HG.)

BALMERINO, JAMES ELPHINSTONE, 1ST BARON (*c.* 1553–1612), Scottish favourite of King James (James VI of Scotland, later James I of Great Britain and Ireland), chiefly remembered for his zeal in the Roman Catholic cause, was the third son of Robert, 3rd Baron Elphinstone (d. 1602). He was made secretary of state in Scotland in 1598, accompanied James to England in 1603 and the following year was made Baron Balmerino. In 1605 he became president of the court of session. Balmerino's downfall was occasioned by his attachment to his religion. In 1599 a copy of a letter to Pope Clement VIII, ostensibly from James and addressing the pope in very cordial terms, was seen by Elizabeth I. The English queen asked James for an explanation, whereupon both the king and his secretary of state declared the letter a forgery. There the matter rested until 1608, when the existence of the letter was again referred to during some controversy between James and Cardinal Bellarmine. Interrogated afresh Balmerino admitted that he had written the compromising letter, that he had surreptitiously obtained the king's signature and that afterward he had added the full titles of the pope. In March 1609 he was tried, attainted and sentenced to death, but after a brief imprisonment he was released. He retired to his estates, where he died in July 1612.

Balmerino's elder son JOHN (d. 1649), 2nd baron, was restored to his father's title in 1613. He was prominent in opposing Charles I's ecclesiastical policy in Scotland and for this he was imprisoned in 1634. He died at Edinburgh on Feb. 28, 1649. His great-grandson ARTHUR (1688–1746), 6th baron, was a distinguished Jacobite and took part in the risings of 1715 and 1745. After the first of these he was pardoned (1733), but following his capture at Culloden in April 1746, he was tried, found guilty of high treason and executed (Aug. 18, 1746). On his death the Balmerino peerage became extinct.

BALMES, JAIME LUCIANO (1810–1848), Spanish ecclesiastic, political writer and philosopher, whose liberal ideas found strong opposition in Roman Catholic conservative circles, was born in Vich, Catalonia, on Aug. 28, 1810, and died there on July 9, 1848. Balmes was founder and editor of *El Pensamiento de la Nación,* a Catholic weekly, but he is best known for his *El protestantismo comparado con el catolicismo en sus relaciones con la civilización europea* (1842–44; Eng. trans., 1849), an able defense of Catholicism against the accusation of not sympathizing with the spirit of progress. His philosophical works are *El criterio* (1845), called Balmes' logic; *Filosofía fundamental* (1846; Eng. trans. by H. F. Brownson, 1856) and *Curso de filosofía elemental* (1847). A critical edition of his *Obras completas* by I. Casanovas was published in 33 vol. at Madrid (1948–50).

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BALMONT, KONSTANTIN DMITRIEVICH (1867–1943), was the leader of the Russian Symbolist poets of the late 19th century. He was born at Gumishche, in the province of Vladimir, in central Russia, on June 3, 1867. A student of Elizabethan drama and the works of Calderón, Poe and Shelley, he first became known as the translator of Shelley and apostle of his ideas. His extensive travels in South Africa, Mexico, New Zealand and Spain account for the exotic vein in his poetry. He produced his best work during the 1890s and the early years of the 20th century. The titles of the collections published during this period—*Pod severnym nebom* (1894; "Under the Northern Sky"), *V bezbrezhnosti* (1895; "In Boundless Space"), *Tishina* (1898; "Silence"), *Goryashchie zdanya* (1900; "The Burning Buildings"), *Budem, kak solntse* (1903; "Let Us Be Like the Sun")—indicate the stages of his development from pure aestheticism to an aggressive and partly anarchical Nietzschean poetry, which brought him immense popularity. He also wrote several volumes of prose. In 1918, following the outbreak of the Russian Revolution, he went to live in Paris. He died there in 1943.

BALMORAL CASTLE, a private residence of the British sovereign, is situated in the parish of Crathie and Braemar, Aberdeenshire, Scot., on the right bank of the Dee (there spanned by a fine bridge), 8 mi. W. of Ballater and 926 ft. above sea level. Anciently belonging to the Farquharsons of the Inverey branch, but forfeited by them after the Jacobite rising of 1745, the estate was acquired subsequently by the earl of Fife. By his trustees it was leased to Sir Robert Gordon, brother of the prime minister, the earl of Aberdeen. On Sir Robert's death in 1847 Albert, prince consort, acquired the reversion of the lease and later became the owner of the property, which he bequeathed to Queen Victoria. The royal family arrived at Balmoral on Sept. 8, 1848. The small castle of the Farquharsons, although much added to in modern times, soon proved itself inadequate and the present castle was begun in 1853 and completed three years later. The site of the old castle is marked by an inscribed tablet on the lawn in front of the present building. The architect of the new castle was William Smith of Aberdeen, but the prince consort exerted considerable influence on the external design. Built in a light gray local granite, the castle is a contemporary version of the Scottish baronial style, the principal feature being a 100-ft. tower. Many memorials to the royal family were erected in the grounds, with some fine trees planted by Prince Albert. The parish church of Crathie (1903), replacing the kirk of 1806, is 1½ mi. E. Farther down the river stands Abergeldie castle, an ancient keep of the Gordons, with modern additions, which after 1848 was leased by

the sovereign. It was inhabited by King Edward VII when prince of Wales. (W. D. S.)

BALNAVES, HENRY (1512?–1570), Scottish diplomatist, was one of the chief promoters of the Reformation in Scotland. Educated at the universities of St. Andrews (1527) and Cologne, where he became a Protestant, he was appointed clerk to the treasury in 1537 and an ordinary lord of session in 1538. In 1543, during the Protestant period of the earl of Arran's regency, he became secretary of state and was a commissioner for the proposed marriage of Mary Stuart and Prince Edward (afterward Edward VI of England), but after Arran's reconciliation with Cardinal Beaton (Sept. 1543) he was imprisoned in Blackness castle. On his release (1544) by English forces under the earl of Hertford he became a paid agent of England and during the seige of St. Andrews castle he acted as emissary of the rebels. Following the surrender of the castle (June 1547) he was imprisoned at Rouen, where he wrote *The Confession of Faith* (1584). Balnaves returned to Scotland and was restored in Feb. 1557. He took an active part in the religious rising of 1559 and was a commissioner for the treaty of Berwick (1560). He was again appointed an ordinary lord of session in 1564. On the fall of Mary he sided with the Protestant lords and was one of the earl of Moray's commissioners at the York proceedings in 1568, by which time he was a privy councilor. He died in Edinburgh in Feb. 1570.

(P. G. B. McN.)

BALOCHI (Baluchi). The term Balochi is used in its widest sense to describe all the populations inhabiting Baluchistan (Balochistan) in West Pakistan, but is more properly applied only to the tribes who speak the Balochi language. It should therefore exclude the Brahui-speaking tribes. The Balochi proper are divided into two groups, the Sulaimani and the Makrani, and these are separated from each other by a compact block of Brahui tribes. Branches of the Balochi tribe found in Sind and the Punjab belong to the Sulaimani group, while those of Seistan are Makrani.

The Balochi speak an Aryan language related to modern Persian and their original homeland lay probably on the Iranian plateau. There is little reliable information on their early history, though the tribe is mentioned already in Arabic chronicles of the 10th century A.D. The old tribal organization is best preserved among those inhabiting the Sulaiman mountains. Each tribe (*tuman*) consists of several clans and acknowledges one chief, even though in some *tuman* there are clans that stand in habitual opposition to the chief.

The Balochi are traditionally nomads with a preference for a pastoral style of life, but cultivation is becoming more and more common and every chief has a fixed residence. The villages are collections of mud or stone huts; on the hills enclosures of rough stone walls are covered with roofs of matting and so turned into temporary habitations. The Balochi raise camels, cattle, sheep and goats, and practise carpetmaking and embroidery. Their agricultural methods are primitive. They now profess Islam, but do not observe all the orthodox fasts and prayers, and among the tribesmen of the hills there are hardly any religious leaders (mullahs). They have the reputation of being singularly free from religious fanaticism and intolerance.

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(C. v. F.-H.)

BALOCHI LANGUAGE, spoken by the Balochi (*q.v.*) in Baluchistan and Sind in West Pakistan, in Persian Baluchistan and the eastern border districts of Iran, and in the Merv region in the Turkmen Soviet Socialist Republic, overlapping also into southern Afghanistan. The number of speakers in 1954 may have been about 1,000,000. Although it closely resembles modern Persian in structure and has borrowed words from Persian, Arabic and Indo-Aryan languages, Balochi is an independent branch of Iranian, retaining some very archaic features (*see* Iranian Languages). It belongs to the "northwestern" group of Iranian, having been brought into its present home during the middle ages, and it has no special affinity to its nearest east Iranian neighbour, Pashto. Brahui (*see* Brahui Language) has borrowed freely from Balochi. The language is divided into two dialect groups: the eastern (east of Quetta) and the western (in Makran, Iran, etc.).

Western Balochi is the more archaic. It has a very simple phonemic system. Thus, in western Balochi *brāt*, "brother," *āp*, "water," *gōk*, "cow," *rōch*, "day," *pād*, "foot," *drāj*, "long"; eastern Balochi *brāth*, *âf*, *gōkh*, *rōsh*, *phādh*, *drāzh*.

Characteristic of Balochi is the change of *w-* to *gw-*, as in *gwāt*, "wind," and of *hw-* to *w(h)*, as in *wāb*, eastern *whāv*, "sleep." Nasalized vowels are frequent. Balochi is written, but not to any great extent, in the Persian characters.

The grammar is simple, and there is no distinction of gender. The ancient case inflection is retained in a varying degree. There is an oblique case in *-a* or *-ā*, and a genitive singular in western Balochi, *-āi*, etc. (*aspāi*, "the horse's"). But in some dialects the genitive is identical with the nominative or the oblique. Thus the western Balochi, *tai pissaī gisā* or *taiī pita lōgā*, "in your father's house," corresponds to the eastern dialects, *thaī phith* (or *phisā*) *lōgh* (*ā*). The dative suffix is *-ār*, *-ārā*, and the oblique plural ends in *-ānı*, genitive plural *-āna*, or *-ānī*. Attributive adjectives precede the noun and add the suffix *-ēn*. Thus, *sharrēṅ āp*, "good water." The comparative suffix is *-tir*.

The personal pronouns are in the western: *man*, "I," genitive *manī*, *amā*, *mā*, "we," *tau*, "thou," genitive *taī*, *shumā* (eastern *shawā*), "you." The numerals follow the Persian except in the case of *sai*, "three," *chiār* (eastern), "four."

The verb has two bases: the present or simple root, from which the infinitive is formed by adding *-ag*, *-agh;* and the past, formed as in other Iranian languages by adding *t*, in many cases with changes in the final root consonant. Thus, *kushag*, "to kill," *kushta*, etc., "killed"; *rudag*, "to grow," *rusta*, "grew." Indefinite present first singular *kushāṅ*, *kushīn;* definite present *kushagāyān;* imperfect *kushagāyatān;* past *man kushta(g)*, intransitive past *man rasit(ag)āṅ*, "I arrived."

The so-called "passive" construction of transitive verbs in past tenses was no doubt the original one, and still prevails in some western dialects. Thus, *ē mardā ā mard jat*, "this man struck that man"; *ē mardā hamā mard kushtagant*, "this man has killed these very men." In some dialects, however, the object is put in the accusative/dative: *mardā apsārā kushta*, "the man killed the horse"; or the construction has been completely changed into the ordinary Persian one.

Literature.—Balochi possesses much simple and vivid popular poetry. The most original part is the epic ballads dealing with the early wars and settlements of the Balochi and recited in the assemblies of the clans by professional minstrels, who were, however, not poets themselves.

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(G. Mn.)

BALODIS, JANIS (1881–?), Latvian army officer, commander in chief of the army in his country's war of independence, was born on Feb. 20, 1881, at Trikate in the province of Vidzeme. He graduated from the military academy in Vilnius (Vilna) in 1902, was commissioned an officer in the Russian army and was wounded both in the Russo-Japanese War and in World War I. In Nov. 1918 he returned to Latvia and from the beginning participated in Latvia's war of liberation. For personal bravery, integrity and devotion to his troops Balodis became a legendary figure of that period. On Oct. 16, 1919, he was appointed commander in chief of the Latvian national army, and under his command the newly founded state saw its liberation. Subsequently General Balodis left the army and in 1925 was elected to the Latvian *saeima* (parliament). In Dec. 1931 he became minister of war. On May 15, 1934, he was appointed deputy prime minister in the cabinet of Karlis Ulmanis (*q.v.*). When on April 11, 1936, Ulmanis assumed the duties of the presidency, Balodis became the vice-president. Shortly after the Soviet army's occupation of Latvia, Balodis was arrested (July 21, 1940) and deported to the U.S.S.R. (A. Sp.)

BALQA (Al Balqa'), a *liwa* (district) of the Hashemite Kingdom of Jordan, includes the subdistrict of Salt. Pop. (1959 est.) 79,532. Area about 432 sq.mi. One of the most fertile areas of the country, it produces cereals, grapes and fruit of many kinds. It adjoins the district of Amman on the east and extends as far as the edge of the Jordan valley on the west.

(G. W. L. H.)

BALQUHIDDER (Gaelic, "the farm in the back-lying country"), a village of Perthshire, Scot., best known as the burial place of Rob Roy (*q.v.*), lies near the eastern end of Loch Voil, about 2 mi. W. of Balquhidder station and 28 mi. N.W. of Stirling by road. Population of civil parish (1951) 671. The Braes of Balquhidder, a lofty ridge, rise along the northern bank of the loch. The Maclaurins held the district from the 9th century until their Macgregor neighbours slew the chief and ousted the clan in 1558. Robert Macgregor, known as Rob Roy, died in a house beyond the west end of Loch Voil in 1734. His grave and those of some of his family are said to be marked by three tombstones in the old churchyard, although the rude carving on the stones indicates that these date from several centuries before the time of Rob Roy. The old kirk is a ruin and stands in front of the new one.

BALSA, the name given to a tree (*Ochroma pyramidale*) of the bombax family (Bombacaceae), called also corkwood, native to tropical South America and noted for its exceedingly light wood (Spanish *balsa*, a "raft" or "float"). The wood resembles clear white pine or basswood. Well-seasoned commercial balsa wood, which weighs only 6 to 8 lb. per cubic foot (although it may weigh as much as 25 lb. per cubic foot from very slow-growing trees), is the lightest commercial wood. Because of its buoyancy, about twice that of cork, it is admirably adapted for making floats for lifelines and life preservers. Its resiliency makes it an excellent shock-absorbing material for packing furniture and similar articles, and also for foundation pads for machinery. Because of its insulating properties, it is used for lining incubators, refrigerators and cold-storage rooms. Its lightness combined with high insulating power renders it extremely valuable as a material for constructing the various containers used in dry-ice transportation. It is also employed in the construction of passenger compartments for airplanes and in making model airplanes and boats.

BALSAM, a term properly limited to such resins or oleoresins as contain benzoic acid or cinnamic acid or both. Those balsams which conform to this definition make up a distinct class, allied by their composition, properties and uses. Those found in commerce are the balsam of Peru, balsam of Tolu, liquid storax and liquidambar. Balsam of Peru is the produce of a lofty leguminous tree, *Myroxylon pereirae*, growing within a limited area in El Salvador and introduced into Ceylon. It is a thick, deep brown or black, viscid oleoresin having a fragrant balsamic odour. It is used in perfumery. Though mentioned in the pharmacopoeias it has no medicinal value. Balsam of Tolu is produced from *M. balsamum*. It is brown, thicker than Peru balsam and becomes solid on keeping. It also is a product of equatorial America. It is used in perfumery and as a constituent in cough sirups and lozenges. Liquid storax is a balsam yielded by *Liquidambar orientalis*, a native of Asia Minor. It is a soft resinous substance with a pleasing balsamic odour, especially after it has been kept for some time. It is used in medicine as an external application in some parasitic skin diseases, and internally as an expectorant. An analogous substance is derived from *Altingia excelsa* in Java. Liquidambar balsam is derived from *Liquidambar styraciflua*, a tree found in the United States and Mexico. It contains cinnamic acid but not benzoic acid.

Of so-called balsams, entirely destitute of cinnamic and benzoic constituents, the following are found in commerce: Mecca balsam or balm of Gilead, from *Commiphora opobalsamum*, a tree growing in Arabia and Ethiopia. When fresh it is a viscid fluid with a penetrating odour, but it solidifies with age. For balsam of copaiba *see* Copaiba. Under the name of wood oil, or Gurjun balsam, an oleoresin is procured in India and Indonesia from several species of *Dipterocarpus*, chiefly *D. turbinatus*, which has the odour and properties of copaiba and has been used for the same purposes. Wood oil is also used as a varnish in India and forms an effective protection against the attacks of white ants. Canada balsam or Canada turpentine is an oleoresin yielded by the balsam fir, *Abies balsamea*, a tree that grows in Canada and the northern part of the United States (*see* Canada Balsam).

The garden balsam is an annual plant, *Impatiens balsamina*, family Balsaminaceae, and the balsam apple is the fruit of *Momordica balsamina*, family Cucurbitaceae.

See also Resins.

BALSHAM, HUGH DE (d. 1286), English Benedictine monk, was bishop of Ely and one of the founders of the collegiate system at Cambridge university. After having been subprior of the monastery of Ely, he was elected by his brethren bishop of Ely in 1256. King Henry III, however, chose another man for the bishopric, and it was only after much trouble that the pope confirmed his election in 1257. In 1280 Hugh provided lodging for scholars at the Augustinian hospital of St. John in the nascent university at Cambridge, but, the arrangement proving unsuccessful, the bishop separated the students from the hospital and used some of the revenue of the church of St. Peter to establish in 1284 a hall for the students which came to be known as Peterhouse.

See *Dictionary of National Biography*, vol. 1, with bibliography.

(E. McD.)

BALTIC, THE. The Baltic exchange, or Baltic Mercantile and Shipping Exchange, Ltd., originated in London in the 17th century, when ships' captains and merchants met to do business in various coffeehouses, from 1744 at one called the Baltic. The exchange is unique today as a world market for fixing cargoes for tramp ships, and has other markets for the sale and purchase of grain in bulk, for dealing in oilseeds and for chartering aircraft. Its 2,500 members represent shipowners and merchants, and negotiations are verbal; hence the importance of the Baltic motto: "Our Word our Bond." The exchange—in St. Mary Axe since 1903—is in the midst of London's shipping community. In 1956 Queen Elizabeth II opened a new wing to the exchange, containing a spacious banqueting suite.

BALTIC LANGUAGES. A branch of the Indo-European (*q.v.*) linguistic family spoken on the southeastern shores of the Baltic sea, the Baltic languages (B.L.) include modern Lithuanian (Lith.) and Lettish (Let.), or Latvian, and now extinct Old Prussian (O.Prus.) as well as the dialects of the Curonian (C.), Semigallian (Sm.) and Selonian (Se.) tribes. (*See* also Lithuanian Language; Lettish [Latvian] Language.)

Lacking a common genuine name, the designation B.L. (*Baltische Sprachen*), first suggested by F. Nesselmann in 1845, has replaced from the end of the 19th century the misleading terms of Lettic or Lettish, Lithuanian and Letto-Lithuanian. The Lithuanian philologist K. Buga, utilizing Tacitus' (*De Germania*) *Aestiorum gentes*, proposed a term Aistian (*aisčių kalbos*) which, however, has not been generally accepted in linguistic literature. Within Indo-European (I.E.), Baltic belongs to the satem group which also includes Slavonic, Indo-Iranian, Armenian and Albanian and is characterized by the change of the primitive I.E. palatals $*k'$, $*\hat{g}$ to sibilants in contrast with a mere dispalatalization in the centum group (Italic, Greek, Teutonic, Celtic, Tocharian and Hittite). Thus, corresponding to the primitive I.E. word **kmtóm* "hundred" on one side are Lith. *šimtas*, Let. *simts*, Old Church Slavonic (O.Ch.S.) *sŭto*, Sanskrit (Sans.) *çatám*, Avestan *satəm* and on the other, Latin (Lat.) *centum*, Greek (Gr.) *hekatón*, Gothic (Goth.) *hund*.

Baltic and Slavonic.—Baltic in its primitive form is more closely related to Slavonic than to any other branch of I.E. Both have a number of common features in phonology and morphology as well as in vocabulary and syntax. This led many scholars in the 19th century to the assumption of a Balto-Slavonic linguistic unity, placed (T. Milewski, 1948) between 2000 and 1500 B.C., a concept never disproved though often attacked. (*See* Slavonic Languages.)

Most of the earlier scholars working on this problem based their conclusions on a bare enumeration of actual similarities between Baltic and Slavonic. They neglected to take into consideration the possibilities of a dialectal I.E. inheritance, parallel development due to close vicinity, late origin and borrowing.

Among the exclusively Balto-Slavonic innovations may be mentioned: (1) a dual representation of I.E. syllabic **r̥, *l̥, *m̥, *n̥* by *ir, il, im, in* and *ur, ul, um, un* (*cf.* Lith. *vilkas* "wolf" = proto-Slavonic [Pr.S.] **vĭlkŭ* and Lith. *tulžti* "to soak" = Pr.S. **tŭlstŭ* "thick"; (2) certain accent shifts (Lith. *dūmai* "smoke" = Russian (Rus.) *dým*, genitive *dýma* in opposition to Sans. *dhūmàḥ*, Lith. *rankà* "hand," accusative singular *rañką* = Rus. *ruká, rúku*) and tone correspondences (Lith. *várna* "crow," *varnas* "raven" paralleled by Serbo-Croatian *vrâna, vrân*); (3) dative plural in *-mus* (Old Lithuanian [O.Lith.] *vilkamus* = Pr.S. **vĭlkomŭ* in contrast with Sans. *vṛbébhyaḥ*); and (4) genitive plural **nōs(s)ŏn* "of us" (*cf.* O.Prus. *nuson*, Lith. *mūsų*, O.Ch.S. *nasŭ*). On the other hand, the innovation in the genitive singular Lith. *vilko*, Let. *vilka* = Pr.S. **vĭlka* (originally an ablative form) is not shared by O.Prus. And the formation of the definite adjective by adding the pronoun **jo-* (*cf.* Lith. *basàsis* from *bãsas* + *jìs* and Pr.S. **bosŭjĭ* from *bosŭ* + *jĭ* "the barefoot one"), frequently quoted as exclusively Balto-Slavonic, occurs also in Avestan and is rather a comparatively late parallel development. If this feature were old, one would expect in Slavonic **bosošĭ* or at least **bosŭšĭ* (from **bosos*+*jĭs*). The Baltic forms show also enough discrepancy (standard Lith. *baltàsis*, dialectal *baltàjis* and *baltùjis*, Let. *baltais* "the white one," O.Prus. *pirmoys* "the first one," O.Lith. genitive singular *pajoprasto* for modern *pãprastojo* "the simple one") to be considered pre-Baltic.

In the vocabulary there are actually only about 100 words exclusively Balto-Slavonic in form and meaning (Endzelin); *e.g.*, Lith. *kárvė* "cow," *kiáunė* "marten," *péntis* "heel, butt-end," *rankà* "hand," *pirtìs* "kiln" = Pr.S. **korva, *kuna, *pęta, *rǫka, *pirtĭ*.

On the other hand, one must take into account the numerous differences which separate Baltic and Slavonic not only in vocabulary (*cf.* Lith. *diẽvas* "god," *výras* "man," *kẽlias* "road," *rãtas* "wheel," *lãbas* "good" as against Pr.S. **bogŭ, mǫžĭ, *dorga, *kolo, *dobrŭ* in the same meanings) but also in phonology (*cf.* Lith. *o*, Let. *ā* and both *uo* from I.E. **ā, *ŏ* fused in Slavonic into *ā*; also Pr.S. **vĭrchŭ* "top," **sŭchŭ* "dry," locative *trĭchŭ* "three": Lith. *viršùs* but *sañsas, trisù*) and in morphology (especially in the verbal systems). The migration of the pre-Balts to the northeast, probably around 2000 B.C., severed the contact with the pre-Slavs and thus led to a separate linguistic development on both sides. A new contact, as late as the 6th century A.D. in the east, but much earlier in the southwest, was established again by the Slavonic expansion. This is reflected in a number of correspondences between Old Prussian and Slavonic unknown to East Baltic (*cf.* the consonant groups *tl, dl*, dialectally preserved in Old Prussian as in West Slavonic, but changed to *kl, gl* in East Baltic; pronominal forms *tebbei, mien, wans, mais* equaled by O.Ch.S. *tebě, mę, vy, moji* in opposition to Lith. *tãvie*>*táu, manè, jùs, mãnas;* in vocabulary *assanis* "autumn," *dalptan* "chisel," nominative plural *maldai* "young," *waisei* "you know"=Pr.S. **(j)esenĭ, *dolto, *moldŭ, *vesi* but Lith. *ruduõ, káltas, jáunas, žinaĩ*=Let. *rudens, kaẽts, jaũns, zini*).

Besides Slavonic, Baltic may have had some contact with only one other member of the I.E. family—Germanic (*cf.* Lith. *vienúolika* "eleven," *dvýlika* "twelve," O.Prus. *ains* "one," dative singular *nautei* "need" = Goth. *ainlif, twalif, ains, nauþs*).

Proto-Baltic.—The earliest form in the development of the Baltic languages may be called proto-Baltic (Pr.B.). Its constitution as an independent linguistic group, to judge from archaeological data, may have taken place not later than the end of the 2nd millennium B.C. Because of its peripheral and isolated position Baltic from the very beginning was less affected by changes, characteristic of central I.E. languages. The later great migrations had also no apparent impact which might have stimulated linguistic change. Persecution, short of extinction, also tends to drive a language underground and so preserves it from rapid internal change. Because of this retarded development, Baltic duly claims the title of the most archaic of all living I.E. languages. The original phonological system, especially vocalism (practically all short and long vowels excepting **o, *a* and **ə* which fused into *a*; diphthongs; pitch accent; also final *s, r, n*) and numerous morphological features (seven of the eight I.E. cases including vocative, dual, three genders, supine), has been preserved with such a fidelity that modern Lithuanian plays in the comparative grammar of Indo-European a role equal to that of classical Greek, Sanskrit, Italic and Gothic. In many instances Baltic presents forms which are much closer to Indo-European than those of other languages recorded 2,000-2,500 years ago. For instance, Lith. *sūnùs* "son" is identical with the reconstructed I.E. **sūnus*, while the other languages show newer developments (*i.e.*, Sans. *sūnúḥ*, Goth. *sunus*, Old English *sunu*, O.Ch.S. *synŭ*, Russian and Polish *syn*). And I.E. **gʷĭwos* "alive" survives in Lithuanian with slight change as *gývas* but not so in others: Pr.S. and O.Ch.S. *živŭ*, Sans. *jīváḥ*, Lat. *vīvus*, Goth. *qius*, Old English *cwicu* "living," Old Irish *biu, beo*, Gr. *bíos* "life." The richness of inherited forms has even been expanded by special Baltic innovations. For instance, to the old I.E. locative singular in **-oy/-ey* surviving in adverbial function (*cf.* O.Prus. *obītai* "in the morning," Lith. *namiẽ*<**namei* paralleled by Gr. *oĩkoi, oĩkei* "at home") have been added four new forms (*cf.* modern Lith. *kalnè* "in, on the mountain," *kalnañ* "into, onto the mountain" and O.Lith. and dialectal *kalniẽp* "by the mountain," *kalnóp* "to the mountain" from *kálnas* related to Lat. *collis*<**kolnis* and English *hill*<**hulni-*). This practice of creating additional case forms by adding postpositions may well be due to West Finnish influence. The close contact between the Balts and the ancestors of the modern Finns, dating back to pre-Christian times, is attested to by several hundred Baltic loanwords present in all West Finnish languages including the faraway Mordvin. For instance, Estonian *tagijas* "thistle," Finnish *taivas* "sky" and *hanhi* "goose" point to Pr.B. **dagijas, *deivas* and **žansis*, the protoforms of modern Lith. *dagỹs, diẽvas* "god" (O.Prus. still *deiws*) and *žąsis* (O.Prus. *sansy* and dialectal Lith. *žansis*), and Let. *dadzis, dìevs* and *zùoss*. The borrowed Finnish *seinä* "wall" and *heinä* "hay," *tarha* "enclosure" confronted with Lith. *síena* and *šiẽnas, daržas* "garden" prove beyond doubt that Lith. *š, ž* originating from I.E. **k̂, *ĝ̂* represent the proto-Baltic phonetic state and a very early stage of palatalization preserved also in Sanskrit (*cf.* above *šimtas*=*çatám*), another peripheral language. The rest of the satem languages underwent a second palatalization resulting in *s, z*. On the other hand, the conservatism of Baltic is not absolute. The proto-Baltic consonantism, intact in Old Prussian and slightly changed in Lithuanian, shows no trace of I.E. aspiration or labiovelar stops. The verbal system has been simplified in a sweeping way. Only the old present and future tenses were retained while the imperfect, aorist and perfect were replaced already in proto-Baltic by a newly created preterit characterized by the stem vowel *ā* or *ē* (*cf.* Lith. *vẽdė-me* "we led," *sėjo-me* "we sowed" = Let. *vedēm, sējā-m* against present tense Lith. *vẽda-me, sėja-me* = Let. *veda-m, sēja-m*).

The early dialectal differentiation of Baltic led at first to a split into West Baltic (W.B.) and East Baltic (E.B.). This, to judge from certain archaeologic and linguistic data (emergence of tribal cultures, common designations for iron and steel: Lith. *geležìs, pliẽnas*, Let. *dzèlzs, pliens*, O.Prus. *gelso, playnis*), may have occurred not later than 500–300 B.C. The Greek geographer Ptolemy of the 2nd century already knew about the existence of separate Old Prussian tribes (*Galindai kaì Soudinoí*).

West Baltic.—This group is represented solely by Old Prussian and a closely related dialect of Suduvians, or Jatvingians, both decimated through early wars and finally germanized in the 17th century. Old Prussian is even more archaic than Lithuanian. For instance, it preserves Pr.B. **ei* (*cf.* examples, above) and **tj, *dj* (*median* "forest" = Lith. dialectal *mẽdžias* = Let. *mežs*), neutral nouns (*assaran*<**ezeran*=Pr.S. **[j]ezero* and masculine Lith. *ẽžeras*), many inflectional forms and vocabulary items unknown to East Baltic (*cf.* genitive singular *deiwas*<I.E.**-oso*, like Old English *dómæs*, genitive singular *stessei* "this"=Sans. *tasya*, dative singular *kasmu* "who"=Sans. *kasmāi; emmens*<**enmens* "name" =Pr.S. **ime:* Lat. *nōmen; panno* "fire"=Goth. *fōn, aglo* "rain"= Gr. *achlús* "mist," *dadan* "milk"=Sans. *dádhi* against Lith. *vařdas, ugnìs, lietùs, pienas* = Let. *vārds, uguns, lietus, piẽns*). Old Prussian shows closer ties to both Slavonic (*see* above) and Germanic than either Lithuanian or Lettish. For instance, 33 vocabulary

items common only to Slavonic and 19 to Germanic have been counted (Endzelin). All this reflects prehistoric contacts (*cf.* also the change of Pr.B. *š, ž* into *s, z*, as in Slavonic). (*See* examples, above.) The independent character of Old Prussian points to deep dialectal differences in proto-Baltic which, most likely, never was so uniform as, for instance, proto-Slavonic. A 16th-century report relates that a Lithuanian could understand Old Prussian "only very little," which is not quite true in respect to Lithuanian and Lettish even four centuries later.

East Baltic.—East Baltic includes modern Lithuanian and Lettish, also Curonian or Kurish, Semigallian and Selonian, the dialects of minor Baltic tribes. After the initial split of proto-Baltic into two groups the larger East Baltic continued as a uniform linguistic entity for quite a long time. Historical records of the individual existence of East Baltic people date from the 9th (for Curonians) to the 13th (for Selonians) centuries. But linguistic data allow a more precise and detailed determination of the emergence of separate languages from primitive East Baltic. The oldest Russian loanwords in Lettish (*cf. sùoģis* "judge," *kūkes* "Christmas meal," *žerbiņš* "sort" from Old Russian [O.Rus.] *sudjá, kutjá, žerebej*) and differences between Lettish, Lithuanian and Old Russian forms of some place and river names (*cf.* Let. *Rucava, Seseve, Rīga* = Lith. *Rūkiava, Šešėvė,* dialectal *Ringà;* Let. *Cēsis, *Rēzite* =O.Rus. *Kěsi, Rěžica;* Let. *Pededze*<**Pedeģe:* Estonian *jõgi* "river") demonstrate that the most characteristic phonetic innovations of Lettish are comparatively young. The slow process of its individualization began after A.D. 700 and ended around 1100 with the monophthongization of nasal combinations (*cf.* Let. *mūks* "monk" borrowed from Old Norse *munkr* around A.D. 1000).

The emancipation of Semigallian and Selonian, to a large part because of their geographical position, apparently coincides in time with that of Lettish. But peripheral Curonian may have assumed its shape already around A.D. 400–600. This is confirmed by the development of a rich Curonian prehistoric civilization after A.D. 100. The main reason for the disintegration of primitive East Baltic is to be seen in population shifts and early migrations leading to occupation and baltization of previously West Finnish (Livonian) territories. The ancestors of the Latvians, properly Latgallians, Selonians, Semigallians and Curonians moving in successive and overlapping waves, took possession of the larger part of Latvia as late as A.D. 100–700. The Curonian expansion beyond the Venta and Abava rivers proceeded only after 1000. And latvianization of the Livonians has continued into the 20th century.

Lithuanian, thanks to its stable central—or rather rear-guard—position, was saved from superseding and assimilating non-Baltic languages with the exception of some Slavonic influx from the southeast. This explains its conservative character as against Lettish. A later north and west expansion of Lithuanian (1400–1700) to depopulated territories, formerly held by other East Baltic and also by Old Prussian (beyond the Nemunas [Neman] river) tribes, brought no change, except dialectally, in this respect. Lettish is much more advanced and simpler both phonetically and morphologically. Its younger forms in most cases can be traced back to the older ones still current in standard Lithuanian. Marked simplification has been achieved in Lettish by dropping (*a, e, i*) and shortening (*ā, ē, i, ū* > *a, e, i, u*) vowels in final position, by extensive monophthongization (*an, en, in, un* > *uo, ie, ī, ū,* finally *ai, ei, au* > *i, u*) and by morphological analogies and generalizations (same endings for accusative and instrumental in singular and plural, pronominal inflection of nouns, no inflection for conditional). The former affricates were eliminated (Pr.B. **tj, *dj*> *č, dž*>*š, ž; cf.* examples, above) and new ones developed (*cf.* Let. *acs* "eye," *cers* "stump," *cieš* "suffers," *dzīvs* "alive," *dzeguze* "cuckoo" as compared with Lith. *akìs, kẽras, keñčia, gývas, gegužė*), a process which parallels Slavonic palatalizations. Several characteristic innovations, such as *s, z* for Pr.B. *š, ž* (*cf.* examples, above), fixed accent on the first syllable and abandoning of grammatical gender in the Livonian dialect, are due to the influence of the Finnish substratum.

From the three extinct East Baltic dialects there are no written records, except proper names from the 13th to 15th centuries and phonetic and vocabulary dialectisms in Lettish and Lithuanian dialects. Curonian, spoken as late as 1600 (in Latvia), presents a typically transitional dialect between Lettish and Lithuanian. It preserved the combinations *an, en, in, un* like Lithuanian and Old Prussian, but, on the other hand, had *s, z* for *š, ž* and *c, dz* from *k, g* under the same condition as Lettish (*cf.* medieval *Sentatze, Zintere, Swente* = Lith. *Santakà, Giñtaras, Šventóji;* Let. dialectal *dziñtars* for *dzìtars* = Lith. *giñtaras,* O.Prus. *gentars* "amber"). There are also some links to Old Prussian (palatal *t', d'* from **tj, *dj*; Let. dialectal *du-cele* "two-wheeled cart" = O.Prus. *kelan* "wheel"). And this is quite obviously due to their prehistoric contact along the lower course of the Nemunas river.

The Semigallians and Selonians merged with the neighbouring Latvians and partially with the Lithuanians already around 1400. To judge from the scarce name material in contemporary sources and modern dialectisms, Semigallian must have been very close to Lettish, if not a dialectal variant of it. Selonian was rather more independent as evident from the partial preservation of the groups *an, en, in, un.* The same is testified by the accent shift of North Lithuanian in former Curonian and Semigallian but not Selonian territory.

Galindian.—The Russian chronicles mention fighting in the 11th-12th centuries a warlike tribe of Golyad (O.Rus. *Goljadĭ* < **Goleďi* = Pr.B. **Galindā:* Lith. *gãlas* "end"; *cf.* also O.Prus. *Galindo,* a tribal district), settled above the Protva river (near Mozhaisk). The tribal name survives in eight different place and river names in the former governments of Moscow and Orel. Further detailed place-name studies, conducted by K. Buga and M. Vasmer, established that all White Russia and bordering areas as far as Kalinin (Tver) and Tula were inhabited by Balts prior to the East Slavonic expansion covering those lands around A.D. 500–600. The Baltic roots preserved in the name material speak rather for the very ancient character of Galindian. One notes Pr.B. *š, ž* and several vocabulary items older in form than those used in Lithuanian (*cf. Žukopa,* a river name: **žukas* + *apē* paralleled by O.Prus. *suckis* "fish" and *ape* "creek," Lith. *žuksparnis* "osprey" but only *žuvìs* "fish" and *ùpė* "river").

Documents.—Written records of the Baltic languages are of late date. An undated minute German-Old Prussian vocabulary, compiled around 1400, is followed solely by three catechisms (1545 and 1561). The quite abundant and philologically very valuable Lithuanian religious literature begins in 1547. The first Lettish writings, unfortunately in corrupt language, appear beginning 1585. The beginnings of the standard languages of both Lithuanian and Lettish dated from the time of their national revival in the 19th century followed by vigorous development after the gaining of national independence subsequent to World War I, now once more extinguished (1939).

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(AV. S.; J. WH.)

BALTIC SEA (Ger. OSTSEE; Swed. ÖSTERSJÖ; Russ. BALTISKOYE MORE; Fin. ITÄMERI), a sea extending between latitude 54° and 66° N. and longitude 9° and 30° E., surrounded by Sweden, Denmark, Germany, Poland, the republics of Lithuania, Latvia and Estonia (incorporated into the U.S.S.R. in 1940), the U.S.S.R. and Finland.

The main axis runs approximately southwest to northeast, and the length from Kiel to Haparanda is 1,700 km. (1,056 mi.). The average width is about 200 km. (124 mi.). The Baltic connects with the North sea by a channel between Denmark and the south of Sweden. The boundary between the two seas is commonly taken to be along a line from the Skaw to the Swedish coast. The North sea section of this channel is called the Skagerrak (*q.v.*), the Baltic section the Kattegat. At its southern end the Kattegat is split by the Danish islands into three sections—Öresund (the

Sound), the Lille Baelt (Great Belt) and the Store Baelt (Little Belt)—which lead to the Baltic sea proper. The total area of the sea is 422,300 sq.km. (163,050 sq.mi.).

Formation.—The Baltic consists of two sections of geologically different origin. North of the Ahvenanmaa Islands the Gulf of Bothnia is a sunken trough in the heart of the Fennoscandian shield; *i.e.*, the area of Archean rocks forming the surface of Finland and most of Sweden. The trough was probably formed by faulting and later deepened by ice action. The true Baltic, south of the Ahvenanmaa Islands, occupies a basin created by subaerial denudation during the long interval from Late Paleozoic to Tertiary times. Its surface was further modified by river action during the Tertiary period and again later when it became the main channel for ice streams during the Ice Age. The Paleozoic shales and limestones, such as are now exposed in Gotland, Öland and Bornholm, were more easily weathered than the older rocks of the Bothnian area.

Four phases are identified in the postglacial evolution. An enlarged Baltic sea with a probable outlet by way of Lakes Hjälmaren, Vänern and Vättern, and known as Yoldia sea, succeeded the northward retreat of the ice. Its limits, reaching a maximum *c.* 7500 B.C., are recognized by the distribution of shells of a salt-water mollusk *Yoldia arctica.* Minor uplift in the southwest, severing the North sea connection, converted the Baltic basin into a fresh-water lake, which occupied an area larger than the present Baltic area. The extent of this so-called Ancylus lake, which reached a maximum *c.* 6500 B.C., is identified by the distribution of the shells of the fresh-water snail of the same name. The third phase, associated with the opening of the Danish outlets and uplift around the coasts of Sweden and Finland, is named after *Litorina,* a salt-water snail. It reached its maximum extent *c.* 4500 B.C. The effects of the present phase of continuing, though differential, emergence are especially evident around the Gulf of Bothnia. The local detail of land emergence is well illustrated in the successive Land Survey maps of Vaasa province in Ostrobothnia.

Depths.—The narrow Danish straits appear to be the drowned valleys of streams that cut their way back across the low barrier which hemmed in the Ancylus lake. All three, and especially the Lille Baelt, are too shallow for easy navigation by big modern ships. The deep channel of the Store Baelt is both narrow and winding and even Öresund (23 ft.) is not deep enough for the larger ocean liners. East of the Danish archipelago the sea deepens slowly to more than 164 ft. between the Swedish coast and the islands of Rügen and Bornholm. Within the Baltic proper there are four basins or deeps separated from one another by sills, the latter generally marked by the occurrence of islands. The first, east of Bornholm, reaches a depth of 344 ft. The large central basin surrounds Gotland and shows soundings of 1,539 ft. to the west off Landsort, and of 820 ft. to the east of the island. A minor extension in the Gulf of Danzig (Zatoka Gdańska) is more than 200 m. (656 ft.). The main Bothnian basin between the Ahvenanmaa and Kvarken Islands reaches 294 m. (965 ft.) in its western part, and the inner basin north of the Kvarkens 128 m. (420 ft). A central channel 50 m. (164 ft.) deep reaches almost to the head of the Gulf of Finland.

Salinity.—The outlets of the Baltic are so narrow and shallow that it is virtually a lake. This is further emphasized by the fact that the sea receives the drainage of a land area more than four times as great as its own area; *i.e.*, 1,663,000 sq.km. (642,084 sq.mi.) to 422,300 sq.km. (163,050 sq.mi.), including such large river basins as those of the Vistula and Oder, as well as that of the Neva bringing the overflow of the great Russian lakes. In addition, all this region receives at least a moderate rainfall on lands whose soils are already saturated after the spring thaw. Salinity is therefore low in all parts. In the Kattegat, freely connected with the North sea, it is 30°/₀₀ (30 per mille or 3%), but falls to 15°/₀₀ in the belts and 8°/₀₀ east of Moen. In the Gulf of Finland it has dropped to 6°/₀₀ and in the Bothnian area to 2°/₀₀. Off Haparanda the water is no more than slightly brackish. Westerly storm winds sometimes force salt water through the entrance channels but this quickly spreads in a thin layer over the deepest parts of the sea bed.

Results of Freshness.—The low salinity and freshness of the Baltic waters has two important results. It is responsible for the long winter freeze-up of the ports and also for the poverty of its marine life. Even Stralsund, just within the Baltic proper, is closed by ice on an average of about one month a year. All the ports of the Gulf of Finland and the Gulf of Bothnia are closed for shorter or longer periods, as long as three to four months in the inner reaches. Icebreakers are commonly employed to prolong the open period of ports which are always subject to closure, and to battle with the ice of ports which are more marginal; *e.g.*, Helsinki.

Marine life in the Baltic offers a remarkable contrast with the abundance in the North sea, the number of species present being less than one-tenth of those found in the latter area. Species present in both are markedly diminished in size; *e.g.*, the Baltic herring (strömming) is no bigger than a sardine and the cod only about one-fifth the weight of those found on the Norway coasts.

Movements.—The great inflow of land water, but slightly reduced by evaporation, also raises the level of the Baltic above that of the North sea and the open ocean. Even in the Kattegat there is a difference of 10 cm. (3.9 in.) and this rises, as the distance from the outlets increases, to 22 cm. (8.65 in.) off Bornholm, 31 cm. (12 in.) off Stockholm and 38 cm. (15 in.) near the heads of the Gulfs of Bothnia and Finland. Because of the lower density of the Baltic waters some difference of level would be necessary to maintain equilibrium, but the inflow of river water is more than sufficient to secure this. Levels are lowest in spring, when rainfall is usually slight and the main thaw in the northern and higher regions has hardly begun. Highest levels are reached in August, often a rainy month, or in early September. Northeasterly gales, because of their long fetch, cause high waves and a piling of water along the Polish and German coasts which often cause much flooding and damage. Southeasterly winds in spring drive floating ice toward the Danish archipelago and may delay the opening of the ports after the winter freeze.

Because of the surplus water accumulating in the Baltic there is usually an outflow through the channels to the North sea. This is mainly concentrated on Öresund, because the main stream hugs the Swedish coast, and it may create there a current of three to four miles an hour. Westerly gales drive the saltier North sea water chiefly through the Store Baelt. Though this denser water quickly sinks to the floor of the deeper basins the surface movement, backed by the prevailing southwesterly winds, continues along the German coast and helps to produce the characteristic features of spit (*nehrung*) and lagoon (*haff*). Tidal movements are almost completely absent from the Baltic.

Coasts.—The Baltic coasts show great variety. In the Archean area the shores are fringed by innumerable rocky islets (skerry guard) along the edge of an uplifted coastal plain. The plain is largely composed of resorted morainic materials but its surface is broken by rocky hummocks, obviously coastal skerries when the sea level was higher than in modern times. In central and southern Sweden the coasts are generally lower except where outcrops of older rock emerge above the marine clays and sands of postglacial age. In the southwest, low cliffs, regular coastal outlines and few islands are the dominant features.

The southern and southeastern shores of the sea are almost everywhere low and smooth in outline, carved for the most part from morainic materials by the action of the eastward-flowing current and the westerly winds which give rise to it. The Danish coasts have many short stretches of cliff and little bays offering easy access to the land. From the Danish frontier to Lübeck bay is found the *förden* type of coast, clearly produced by submergence, which is still in progress there and in the southwestern islands of the archipelago. The *förden* are long, straight-sided and deep inlets believed to have originated as the valleys of streams flowing beneath the ice sheets. They provided excellent harbours for such ports as Flensburg and Kiel when ships were of smaller size than those of modern times. The *bodden* coast from Lübeck bay to and including the Oder estuary is extremely irregular and also a product of submergence. In their irregular form and shallowness the *bodden* offer a marked contrast to the *förden*. En-

trance to them is partially blocked by islands of morainic material or, as in the case of Rügen, of chalk. Many of them have been linked together by sandspits which partially explains their odd forms.

East of the Oder (Odra) mouth coastal outlines are smooth. Great sandspits (*nehrungen*), capped by dunes, have been formed by the eastward drift and the local wind and wave action; *e.g.*, Frische Nehrung and Kurische Nehrung. These spits have converted into lagoons the depressed areas along the old shore lines; *e.g.*, the Vistula lagoon or Frisches Haff (Zalew Wislany). The mouths of the Oder, Vistula and Neman (Memel) and the Gulf of Riga have been partly molded by glacial action. Each of them occupies a "tongue basin" formed by a lobe of the retreating Scandinavian ice sheet.

Climate.—The modifying effect of the North Atlantic drift is scarcely felt in the Baltic region, nor has the sea itself more than a slight effect on temperatures, for the air over it seldom differs by more than 2°–3° F. from that over the neighbouring land. Its main influence is of a somewhat unusual kind and results from the freezing of the surface waters. The long period of thaw in the spring slows the advance of that season and the slow spread of surface freezing similarly prolongs the autumn. The presence of open water away from the coasts during the whole winter in the central and southern areas has some little effect in checking the rigour of the winter cold.

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(T. HER.; W. R. ME.)

BALTIMORE, GEORGE CALVERT, 1ST BARON (d. 1632), English statesman, whose name is associated with the foundation of Maryland, son of Leonard Calvert and Alice, daughter of John Crosland of Crosland, was born in 1578 or 1579 at Kipling in Yorkshire and educated at Trinity college, Oxford. After traveling on the continent, he became secretary to Robert Cecil, afterward earl of Salisbury. In 1606 he was appointed clerk of the crown in Connaught and Clare, in 1608 a clerk of the council, and he was returned to parliament for Bossiney in 1609. He assisted James I in his discourse against Vorstius, the Arminian (Remonstrant) theology professor of Leiden, and in 1613 took charge of the Spanish and Italian correspondence. The same year he was sent on a mission to Ireland to investigate grievances. He was appointed clerk to the privy council in 1605; was employed in missions to France (1611) and the Palatinate (1615); was knighted in 1617; became a secretary of state in 1619; and was given a pension of £1,000 a year in 1620.

He represented successively Yorkshire (1621) and Oxford university (1624) in the house of commons, where it fell to him in his official capacity to communicate the king's policy and to obtain supplies. He was distrusted by the parliament and was in favour of the unpopular alliance with Spain and the Spanish marriage. On Feb. 12, 1625, after he had declared himself a Roman Catholic, he gave up his office, was created Baron Baltimore of Baltimore in the Irish peerage and received a grant of large estates in Ireland. Henceforth he was seen little in public life, and his attention was directed to colonial enterprise.

In 1621 he sent Capt. Edward Wynne to Newfoundland and established a small settlement named Ferryland, and in 1623 he procured a charter for the colony under the name of Avalon. In 1627 Baltimore visited the colony for a short period and a year later returned with his family to take up residence there. In the course of this extended visit conflict arose over his Catholic practices, the saying of Masses and the priests who accompanied him to Avalon. In addition, the severe climate took its toll in death and illness among the company so that Lady Baltimore left the colony for Virginia in the autumn of 1628. Baltimore therefore petitioned the king for a land grant in a more temperate climate and without waiting for the reply sailed for Jamestown to join Lady Baltimore.

But Baltimore was forbidden to settle there unless he took the oaths of allegiance and supremacy. He returned home and died on April 15, 1632, before a new concession was secured, the charter of Maryland passing the great seal on June 20, 1632, in favour of his son CECILIUS (CECIL) CALVERT, 2nd baron Baltimore (1605–75), who founded the colony.

Baltimore wrote *Carmen funebre in D. Hen. Untonum* (1596); *The Answer to Tom Tell-Troth . . .* (1642) is also attributed to him, and Anthony Wood mentions Baltimore as having composed "something concerning Maryland." He married Anne, daughter of George Mynne of Hertingfordbury, Hertfordshire; after her death in 1622 he remarried, and it was the 2nd Lady Baltimore who accompanied him to America in 1628. His second son, LEONARD, became first governor of Maryland in 1634.

George Calvert's grandson, CHARLES CALVERT (1637–1715), 3rd baron Baltimore, was the son of Cecilius Calvert and Anne Arundell, daughter of Lord Arundell of Wardour. He was commissioned governor of Maryland in 1661 and succeeded as proprietor of the colony when his father died in 1675. Like his grandfather, Calvert was a Catholic, and since those of his faith were a decided minority in the colony, antipopish feeling proved a serious handicap. Matters were further aggravated by the hostility of the Susquehanna Indians, and by the need to defend his territorial jurisdiction against claims by William Penn. Antagonism in the assembly led Calvert, in 1670, to restrict suffrage by property qualifications and sometimes to set aside acts passed by the assembly. Finally, after the English Revolution of 1688, he was deprived of the province. He returned to England and was later accused of taking part in two popish plots but was never arrested. He died in London on Feb. 21, 1715. His son, BENEDICT LEONARD, had conformed to the established church in 1713 and thereupon had Maryland restored to him.

See William Hand Browne, *George and Cecilius Calvert* (1890).

BALTIMORE, chief city of Maryland and sixth in size in the United States, lies at the head of tidewater upon the Patapsco river, one of the many deepwater estuaries of the Chesapeake bay. The commercial and industrial life of the city developed around the tributaries of the Patapsco.

Baltimore is situated not only on deep water, but also at the fall line of the Piedmont region. Within a few miles of the water the land rises to 200–300 ft. above sea level. The valleys of the streams which flow through deep ravines toward the Patapsco and its branches are mostly parks, while surrounding heights are sites of residential developments.

The city covers an area of 91.93 sq.mi., of which 78.72 sq.mi. is land and 13.21 sq.mi. water surface.

HISTORY

Early History.—The founders of Baltimore, which is named after the family of the Barons Baltimore who established Maryland in the early 17th century, sought only to provide an outlet for the tobacco grown locally. Half a dozen such "tobacco ports" were chartered in the same year (1729). There was no appreciable development until about 20 years later when it was found that flour had an immediate market in Ireland and Scotland. Surrounding landowners began to abandon tobacco culture for wheat and to build flour mills along their little streams. The city's real growth began at that time.

Generally speaking, the wheat growers and the merchants who profited by their labour came to dominate the city in the economic sense, while the tobacco-growing aristocracy determined the city's social life.

The Revolution.—At the outbreak of the American Revolution, Baltimore was a bustling port of about 6,700, whose trade, despite British restrictions, extended to the Caribbean, over northern Europe and far into the Mediterranean. The merchants were in the ascendancy and carried the city and the colony into the patriots' column.

During the Revolution, the town grew rapidly in importance. It had developed a hardy breed of seafaring men and its own type of sailing vessel, the Baltimore clipper. Numerous privateers were fitted out and preyed upon British shipping. On the land, too, the citizens of Baltimore made their mark; the "Maryland line," for example, held against the British in the battle of Long Island while George Washington was making his escape across

the East river.

The continental congress held its sessions in Baltimore in 1776.

The 19th Century.—Baltimore boomed more spectacularly after the war when the assumption of the state debt by the federal government suddenly gave the merchants access to new credit with which to exploit the markets freed from British restrictions. Tobacco and flour buyers from Bremen, Ger., and other Hanseatic towns moved in and became a significant element in the community life. The iron industry increased while copper smelting became a new industry. By 1797 Baltimore obtained from the general assembly the right to dissociate itself from the surrounding countryside and call itself a city.

The War of 1812 saw Baltimore privateers put to sea again. The British, following the sack of Washington, attempted the reduction of Baltimore. The British land forces were repulsed and the fleet, after vainly attempting to silence Fort McHenry, finally sailed away. The fort's flag, which survived the 30-hour bombardment and is now preserved in the Smithsonian institution, inspired Francis Scott Key to write "The Star Spangled Banner."

Meanwhile, Baltimore merchants sent their buyers westward in search of wheat for their mills and ships. They met the competition of the Erie canal by beginning the construction (1827) of the Baltimore and Ohio railroad, determined to reach the Ohio river with this new means of transportation.

Political struggles of the 1850s cast a blight over the city. The Know-Nothing party gained control, and riots and confusion were the order of the day. Lincoln's election in 1860 and the outbreak of the American Civil War brought the troubles to a climax. A period of disorder was followed by military occupation. Every established routine of life and trade was interrupted or broken. The effects lingered for decades.

The 20th Century.—Up to the time of the great fire of 1904, the physical aspect of the city had changed little since the Civil War. The usual residence was red brick, with white marble steps. There were miles of streets lined with these little Georgian edifices. Business was largely individual. While it manufactured a wide range of products, Baltimore was essentially a commercial rather than an industrial town. Its chief business was jobbing and the south was its chief customer.

The great fire broke out on Feb. 7, 1904, and spared but few buildings in the business district. Most of the changes in the city date from the fire. Streets were widened, sewers installed and modern paving laid. A few years later a modern system for the purification of water was provided. The old red-brick Georgian houses were outmoded and with them went much of the old charm. Baltimore became a more bustling, more efficient, more strident city than ever before.

The changes thus begun were accelerated by World War I and the impetus it gave to trade, particularly the export of coal and wheat. Imports, too, were stimulated by the opening of new iron mines and oil wells in the Caribbean area. The existing steelworks were enlarged many times, and modern oil refineries constructed. Industries tributary to these basic ones were attracted to the city.

In a relatively short time, the economic basis of Baltimore changed. It became a heavy-industry town as well as a commercial and small-industry one.

The shift brought changes, also, in the character and appearance of the inhabitants. Industrial workers, both white and Negro, poured in, chiefly from the south and southwest. For the first time the city learned that it had real slums.

The process of change continued through the depression of the 1930s and was accelerated again by the onset of World War II. Streets became noisy traffic arteries. Hundreds of blocks of old row houses were demolished in the name of slum clearance, and subsidized housing projects erected in their places. The Georgian tradition of beautiful brickwork was not lost in the suburbs, however, and some of the sections such as Guilford, Roland Park, Homeland, Ten Hills and others are quiet, dignified and, in a modest way, beautiful.

During World War II war industries and steel plants greatly expanded. Sixteen new industries and expansions in 90 plants were announced in the first year after Pearl Harbor, and the boom continued throughout the remainder of the war. In addition to being an important shipbuilding, steel and aircraft manufacturing area, Baltimore became a major production centre of high-octane gasoline. In 1944 a large plant for the production of extruded magnesium shapes was completed.

The end of World War II brought a decrease in shipbuilding and ship-repair work. However, the port of Baltimore flourished. (See *Commerce* below.)

After World War II Baltimore pioneered in attacking urban blight and in the eradication of slum conditions by stepping up law enforcement implemented by a minimum standard housing code and a housing court, the first of its kind in the United States. An Urban Renewal and Housing agency, which in the late 1950s embarked upon a 20-year $900,000,000 program, was designed to integrate the city's antiblight and slum efforts.

Historic Sites.—Among the best-known historical sites in Baltimore are the Washington monument, completed in 1829, and the Battle monument (1827) dedicated to the defenders of the city in 1814. Among many others are the Francis Scott Key monument and the double equestrian memorial to Generals Lee and Jackson. Throughout the city are numerous statues honouring famous men.

Fort McHenry and Flag house, where the fort's famous flag was made, are popular sites, as are the 234-ft. Shot tower, once used in the manufacture of shot; the Mount Clare station (1830), the first passenger and freight station in the U.S.; the grave of Edgar Allan Poe; and many old homes. By law, the U.S. flag may fly both night and day at Fort McHenry and Flag house.

POPULATION

Baltimore's population in 1960 was 939,024, making it the nation's sixth largest city. The city is surrounded by a ring of suburban communities. The city of Baltimore together with Baltimore, Anne Arundel, Carroll and Howard counties comprise the Baltimore standard metropolitan statistical area, with a total population of 1,727,023 in 1960. Baltimore county, on the east, north and west of the city, had a population of 492,428 in 1960, and Anne Arundel county to the south had 206,634 persons. (For comparative population figures *see* table in MARYLAND: *Population.*)

ADMINISTRATION AND FINANCE

Baltimore operated under a charter granted by the state of Maryland until 1918 when the city was allowed to adopt a charter which was not a part of the state law. This charter was replaced by another independent charter in 1946. Nevertheless the city must obtain the approval of the state legislature in order to borrow money, except for emergency purposes; the city acknowledges the authority of the legislature to enact measures of local concern.

The city's chief elective officers are the mayor, the president of the city council and the comptroller. The city solicitor and the director of public works are appointed by the mayor. The unicameral city council possesses important legislative powers. Many fiscal powers, however, are granted to the director of public works and the board of estimates. The mayor possesses an item veto on appropriation measures.

The chief source of income is the property tax which yields about 30% of the city's total revenue. The city receives considerable income from state-collected, locally shared revenue, state and federal aid and revenue from public service enterprises. The city's leading expenditures are: education, public works, welfare, police, debt service and fire protection. The city's net funded debt was more than $300,000,000 by the end of the first decade after mid-20th century.

COMMERCE, INDUSTRY, AND TRANSPORTATION

Transportation and Commerce.—Baltimore, the eastern terminal of one of the principal and historic trade routes between the east coast and the middle west through the Appalachian mountain passes, is one of the busiest ports in the United States, handling about 40,000,000 short tons of cargo annually. The value of

foreign trade handled annually was approximately $1,000,000,000 and more after mid-20th century.

The port has many advantages. It comprises approximately 40 mi. of developed water front and is subject to only minor tide variations. The port is not disturbed by severe storms, heavy seas, currents or tidal disturbances; and it is virtually free of ice. The port provides access to the sea through both the Chesapeake bay and the Chesapeake and Delaware canal. Closer than other eastern ports to several inland centres, the port makes possible lower overland freight rates to shipping.

The principal north-south highway and railroad arteries of the east coast pass through the city, and trunk line and short line railroads with important terminal facilities serve the port. The railroads own and operate most of the piers accommodating ships in overseas trade. Facilities include about 270 piers, wharves and docks. Specialized piers handle bulk cargoes such as coal, grain, ores and fertilizers.

Baltimore's shipbuilding and repair facilities are among the world's finest. The port is served by more than 90 steamship lines providing more than 260 regularly scheduled sailings each month to more than 250 foreign ports.

Excellent highways stem from Baltimore in all directions and motor-truck accommodations have been added to the port's facilities. More than 150 interstate truck lines connect the city with the north, south and west. The 6,300-ft.-long Patapsco river vehicular tunnel (1958) provides a by-pass for through traffic.

International and domestic air trade are handled at the two municipal airfields. Friendship International airport, the facilities of which rank with the most modern in the country, is equipped to handle all types of air traffic. Harbor airport has facilities for both land and sea aircraft.

Industry.—By 1960 there were more than 1,900 industrial establishments in the Baltimore metropolitan area which employed more than 200,000 persons and paid over $1,000,000,000 annually in wages and salaries. Manufacturing establishments in the Baltimore area include the Bethlehem Steel corporation which has an annual ingot capacity of 8,200,000 net tons; a spice, tea and extract company; and producers of sulfuric acid, bichromate, portable electric tools, bottle closures, high-tension electrical insulators, men's straw hats, and venetian blinds and parts. The area also leads in fertilizer production and basic refractories. Other industries include copper refining, sugar refining and the production of aluminum, stainless steel, aircraft, telephone cable, electronic equipment and tin containers.

Leading industry groups, with their approximate percentages of the total number of manufacturing employees in the 1950s, were: primary metal industries, about 20%; transportation equipment, more than 15%; food and kindred products, more than 10%; apparel and other fabric products, about 7.5%; fabricated metal products, printing and publishing, and chemicals and allied products, more than 5% each; electrical machinery, nonelectrical machinery, and paper and allied products, less than 5% each.

EDUCATION AND CULTURAL ACTIVITIES

Public education in Baltimore is under the direction of a nine-member board which appoints the superintendent and other members of the department of education. The school system enjoys more independence from state control than do county units. The integration of schools for white and Negro students was carried into effect in Sept. 1954.

The major institution of higher learning located in Baltimore is the Johns Hopkins university. Its college of arts and sciences, school of engineering and school of business are at Homewood, in the northern part of the city. Across town are the medical school and the school of hygiene and public health (in connection with the Johns Hopkins hospital) and McCoy college which offers special courses for part-time adult study.

Johns Hopkins university's special undertakings include a laboratory of applied physics at Silver Spring, Md.; the School of Advanced International Study, Washington, D.C.; the Arctic Research laboratory, Point Barrow, Alaska; the Institute for Cooperative Research; the Thomas C. Jenkins Laboratory of Biophysics; the McCollum-Pratt institute for the study of "trace" elements; the Isaiah Bowman School of Geography and several others.

Goucher college, formerly called the Woman's College of Baltimore, was established by the Methodist Church in 1885. The official connection with the church was dissolved in 1914. In 1941 the college, formerly located in the city, began the construction of new buildings at Towson, a suburb, and formally began moving there in 1950. The college had disposed of the last building on the old campus by 1953. Enrollment by the end of the 1950s exceeded 700.

Loyola college, founded in 1852 and conducted by the Society of Jesus, had a full-time enrollment of about 700.

For girls the Roman Catholic Church operates the College of Notre Dame of Maryland, with an enrollment of about 750 full- and part-time students.

Morgan State college was organized originally by the Methodist Episcopal Church for the higher education of Negroes. Taken over by the state in 1939, it was provided with an extensive campus inside the city limits of Baltimore. Enrollment included about 2,000 students annually.

The undergraduate department of the University of Maryland is at College Park, closer to Washington than to Baltimore. But the professional schools of law, medicine, pharmacology and dentistry, as well as the nursing school and the hospital, are all in Baltimore.

The state owns and operates, in Baltimore, the Maryland institute, a day and night school for training architects and mechanical draftsmen as well as giving instruction in the fine arts. The Rinehart School of Sculpture is a particularly successful part of this academy.

The Peabody institute, established by endowment from George Peabody, the Massachusetts-born banker who made much of his fortune in Baltimore, was originally made up of a library, an art gallery and a conservatory of music (endowed in 1868, the first school of its kind in the United States). As other galleries came into being, the art gallery was abandoned. The library contains a large collection of specialized works and periodicals of great value to the scholar. The conservatory ranks as one of the major schools of music in the country.

Baltimore has two major art galleries. The municipally owned Walters Art gallery was the gift of Henry A. Walters whose father, William T. Walters, assembled the original collection. The collection includes examples of the works of most of the Italian, French and English classicists, both painters and sculptors, and is especially rich in Byzantine craftsmanship and medieval manuscripts. Since 1929 the Baltimore Museum of Art has been largely municipally owned and maintained. Its original building was successively enlarged to house a long series of bequests from private collectors. Some of the notable gifts were the Epstein collection, mostly of Renaissance painting and sculpture; the Jacobs collection, largely English and French of the 18th and 19th centuries; and the Cone collection, chiefly French moderns, especially Henri Matisse and Pablo Picasso. There is also a Maryland wing for rooms from typical houses of the colonial period and the Sadie A. May young people's art centre. The Enoch Pratt Free library (opened in 1884), originally endowed but later mostly supported by taxes, is Baltimore's chief public library. The Peale museum, built in 1814 by Rembrandt Peale, is a municipal museum of local history. The Maryland Historical society has, in addition to the usual collection of portraits and memorabilia, large numbers of manuscripts, including the logs of some of the famous merchantmen and privateers of the 18th and 19th centuries.

Baltimore has its own symphony orchestra, and an opera and theatre season.

PARKS AND RECREATION

Baltimore's department of recreation and parks maintains about 60 parks, athletic fields, swimming pools, golf courses and similar facilities. The city is the home of the professional football team, the Baltimore Colts; the Baltimore Orioles of the American Basehall league; Pimlico Race track; and has complete water recreation facilities. School and college athletics are well attended and Balti-

more is the principal U.S. centre of lacrosse.

See also Index references under "Baltimore" in the Index volume.

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BALTISK (BALTIYISK or BALTIISK), a town and port of Kaliningrad *oblast* of the Russian Soviet Federated Socialist Republic, U.S.S.R., formerly the German Pillau in the province of East Prussia, stands at the tip of the narrow peninsula between the Vislinski gulf (Frisches Haff) and the Baltic sea, on the northern side of the entrance to the gulf. The town is chiefly an outport for Kaliningrad (formerly Königsberg), with which it is linked by rail and ship channel. There are metalworking and light engineering industries and ship repairing. (R. A. F.)

BALTS, a group of nations belonging to the Indo-European linguistic family (*see* BALTIC LANGUAGES) and living on the southeastern shores of the Baltic sea. To it are ascribed not only the Lithuanians and the Letts (Latvians) but also several nations now extinct, namely the Prussians (Germanized at the beginning of the 18th century); the Curonians (Lettonized in the 16th century); the Semigallians and the Selonians (extinct in the 14th century). The eastern Baltic tribes, spread in Belorussia and western Russia, were Slavonized after the northward expansion of the Slavs (7th–13th centuries).

The name Balts is derived from the Baltic sea; it is a neologism, used since the middle of the 19th century. An older name applied to the Balts is Aistians, also not a real national name of the Balts but taken from *Aestiorum gentes,* mentioned by Tacitus in A.D. 98. Tacitus located the *Aestiorum gentes* on the right shore of the Baltic sea and described them as collectors of amber and energetic cultivators of crops and fruits. The Gothic writer Jordanes of the 6th century A.D. wrote that the Aestii lived to the east of the mouth of the Vistula and occupied the longest stretch of the Baltic coast.

The Anglo-Saxon traveler Wulfstan, who visited present East Prussia in the 9th century, mentioned that the land of the Balts (Estum or Estland, not to be confused with Estland, the German name for Estonia) was very big, had many cities and a surplus of honey and fish. Designations of the separate Baltic tribes in historic records appear as early as the 2nd century A.D.; *e.g.,* Ptolemy mentioned "Galindai" and "Soudinoi" (later also called Jatvingai), the tribal names of the western Balts (Prussians). The chronicles of the 13th century mention 11 separate Prussian tribes.

The Curonians, who once lived in western Lithuania and western Latvia, are mentioned in Scandinavian records from the 7th century. Alongside these early historic records, archaeological material also shows that the Baltic group was differentiated into small tribes as early as the 1st millennium B.C., but a fully documented picture of the distribution of the Baltic tribes can be established only on the basis of the written history of the 12th–13th centuries A.D.

Origin, Distribution and Prehistory.—As the archaeological material suggests, the northeastern Indo-Europeans, from which the Baltic linguistic group developed, went to the eastern Baltic area and what later became western central Russia during the expansion period of the Indo-Europeans before and about 2000 B.C. They took to the forested zone of northeastern Europe knowledge of agriculture and cattle raising. The newcomers occupied a large territory reaching northward to southwestern Finland and eastward to the upper Volga basin. However, in the northern Baltic area and along the upper Volga these food producers did not survive and were amalgamated with the local hunters and fishermen during the second half of the 2nd millennium B.C.

In the southeastern Baltic area between the Oder (Odra) and Dvina (Daugava) rivers, in Belorussia and western Russia, this culture persisted throughout the Bronze and Iron Ages to *c.* A.D. 500. The wide extent of the Balts in the east is witnessed not only by a continuous archaeologically reconstructed culture, but also

FIG. 1.—AREAS OCCUPIED BY THE BALTIC PEOPLES FROM THE BEGINNING OF THE 2ND MILLENNIUM B.C. THROUGH THE 13TH CENTURY

by the distribution of river and place names of Baltic origin in the upper Dnieper, upper Dvina, upper Volga and upper Oka basins. Also, hundreds of Baltic loanwords in the Finno-Ugrian languages indicate an affinity between the Finns and Balts. The many loanwords in the Volga Finnic languages must have been borrowed directly from the eastern Balts when they were settled in central Russia, as early as the 2nd millennium B.C. The name of the Volga river is explained as Baltic, connected with the Lithuanian *ilgas,* "long." Finally, the extension of the Balts to the Moscow-Kaluga-Tula line is best witnessed by the existence of the easternmost Balts, the Galindians (the "Golyad" of the Russian chronicles), until the 12th century or later and by numerous Baltic "islands" preserved until the 19th and even 20th centuries around Smolensk, Vitebsk and Minsk. The Baltic character of finds in graves and hill forts is maintained in central Russia until the 6th and 7th centuries A.D. Ornaments and tools were of the same style as those found in eastern Lithuania. Hill forts in Belorussia are still called "Lithuanian hill forts." The south-north expansion of the Slavs between the 6th and 8th centuries cut off the eastern Balts from their western core. About the 8th century the Slavs had already reached the Minsk-Polotsk-Lake Ilmen line.

In the west the Balts were confronted with the Germanic expansion. In the last centuries B.C., Gothis and other eastern Germanic tribes took possession of Pomerania and the lower Vistula area. In the beginning of the 13th century the Teutonic Order of the Cross founded its castles on the Vistula mouth and, after unceasing wars between 1231 and 1288, conquered the Prussians. The Teutonic Order of the Sword, established in 1201 in Riga, caused the disintegration of the Curonians and Semigallians.

The individual prehistoric culture assigned to the proto-Balts and early Balts developed in the course of the first half of the 2nd millennium B.C. The culture along the Baltic seacoasts bears the name "Baltic seashore culture" (*Hafküstenkultur*); the eastern branch in central Russia is labeled the "Fatianovo culture." Both groups were in a transitional stage from the Stone Age to the Metal Age. Baltic amber, being an item of transcontinental trade, played an extraordinary role in the evolution of civilization along the Baltic coasts. The growth of the Bronze Age culture was largely influenced by impulses from central Europe, the Unetice and Lusatian civilizations. In the second half of the 2nd millennium B.C., there existed between the Oder and Dvina rivers a classical Baltic Bronze Age culture distinctive in its locally produced metal types, pottery and burial rites in barrows surrounded by stone rings.

During the period of Scythian, Celtic and Germanic migrations, the Baltic culture maintained its individual features. The continental branch, distributed between eastern Lithuania and Latvia and the upper Volga-Desna river, lived a rather secluded and peaceful life. The western Balts were considerably influenced by Germanic and Celtic cultures. The most prosperous centuries

were from the 2nd to the 5th A.D. because of extensive trade with the Roman empire. Thousands of graves and hill forts of this period have been found to contain typically Baltic artifacts unique in their form and geometric decoration. From the cultural centre in the Neman (Nemunas) basin influences of the Baltic culture radiated to Estonia, Finland and to central Russia. Trade with Scandinavia started during the Bronze Age. Wars and trade between the Scandinavian vikings (Danes and Swedes) and the Balto-Curonians and coastal Prussians started in the 7th century and lasted to the 12th century.

History.—The written history of the Balts begins in the 12th–13th centuries A.D. To face the threat from the Russians and from the Teutonic Order (*q.v.*), established in the 13th century along the borders of the Balto-Prussian territory, the Lithuanians consolidated themselves into a powerful state (*see* LITHUANIA). The Teutonic Order, intending to expand over the Prussian and Lithuanian territory, met with well-organized resistance. Nevertheless it succeeded in conquering the Prussians during the course of the 13th century (*see* PRUSSIA). The struggle with the Lithuanians lasted about 150 years until allied Polish and Lithuanian armies dealt a decisive blow to the order at Grünwald (Tannenberg) in 1410. Thus, German expansion to the east was checked, and the Germans were unable to annex the lands between Prussia and their Livonian colony, established as early as 1158 (*see* LIVONIA).

The growth of the Lithuanian state coincides with the 14th and 15th centuries, when Lithuania was ruled by the Gediminas (1316–41) dynasty. During the reign of Algirdas (1345–77) the eastern borders of Lithuania reached the same areas that in prehistoric times were occupied by the Baltic Galindians, west of Moscow, and to the Black sea in the south. The same territory was maintained during the reign of Vytautas (1392–1430). This extent of the Lithuanian empire in the east, covering about 350,000 sq.mi., protected western Europe as well as part of Russia and the Ukraine from Tatar rule.

After the union between Lithuania and Poland in 1569, the Lithuanian idea of statehood gradually receded. In 1503 Lithuania began to lose some of its eastern provinces to the Russians. Because of the danger of Muscovite invasion, the duchy of Livonia concluded a union with Lithuania in 1561. The Baltic areas of the Lithuanian-Polish federal state as well as the Latvian provinces were divided between Russia and the German kingdom of Prussia in the partitions of Poland in 1772, 1793 and 1795. The major part of Lithuania and all Latvia (*q.v.*) was under Russian rule until 1918; after World War I the independence of Lithuania and Latvia was restored. In June 1940 both states were occupied by the U.S.S.R. Between 1941 and 1944 the Soviet occupation was temporarily interrupted by the German invasion in World War II, but in 1944 the Russians returned.

Religion and Mythology.—The pre-Christian Baltic religion was a typical farmer's religion, closely related to the other Indo-European religions. Sky was considered the male aspect of nature, with its phenomena—light, fire, sound and the separate sky bodies, the sun, the moon and stars. Earth represented the female aspect of nature, with its plants, hills, stones and waters. The interaction of these two stimulated and protected the power of life. The ancient meaning of *dievas* ("god") was inseparable from the meaning of "sky." The sky deity was conceived as thunder and called Perkunas (Lithuanian), Perkunis (Prussian), Perkons (Latvian). His functions were to fertilize the earth and protect human and animal life.

The sun and the moon had a particular influence on the well-being and regeneration of earth life. In songs, the sun and moon frequently appear as personified beings. The personified earth deity was called by the Lithuanians Zemyna, by the Latvians Zemes Mate ("earth mother"). There were also protecting demigoddesses of the forests, fields, stones, waters, animals, crops and homesteads. They were called by the general name *deive* and also had individual names. The 13th-century Volhynian chronicle preserves several mythological names, though in distorted form. More reliable are those of the Lithuanian Medeine, the goddess of forests; Zverine, the goddess of animals; Angis (Andij), the snake god; and Kalvelis, the smith.

FIG. 2.—MAP SHOWING DISTRIBUTION OF BALTIC TRIBES IN 12TH AND 13TH CENTURIES

All Balts had a goddess of fate, Laima. She leads the human life from birth to grave and man is unable to change her decisions. In songs Laima is closely connected with the sun. In Latvian beliefs three other demigoddesses with analogous functions are preserved—Mara, Dekla and Karta. In Lithuanian and Latvian folklore, fairies (*laumes*) are clever and beautiful women with long blond hair and long breasts, perfect spinners and weavers, good, motherly and helpful until they are angered. The 16th-century sources mention the gods of the Old Prussians—Pikulas, Autrimpas, Patrimpas, Okopirmas and Suaxtix (Zvaigzdikis ?)—but their exact functions are not recorded. The most developed cults were those of forests, trees, fire, sun and snakes and that of the dead. Fire in ritual use was called *gabija*. Cult places were on *alka*-hills or other sacred places having names with the roots *ram-* or *rom-*. All religious ritual was based on the belief in the eternity of cosmic life. The human spirit was conceived of as a dynamic force which did not perish with the body but migrated into another living body, plant or animal.

As Christians, Lithuanians are Roman Catholic, Latvians either Lutheran or Roman Catholic. During the 12th and 13th centuries German missionaries converted the Latvians and their kindred tribes. Christianity was officially brought to Lithuania in 1387, after the grand prince Jogaila (Jagiello) married Queen Jadwiga of Poland and was baptized in 1386.

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BALUCHISTAN, the southwestern part of the province of West Pakistan, derives its name from its chief inhabitants, the Baloch or Balochi (Baluchi). It extends from the Gomal river in the northeast to the Arabian sea in the south and from the borders of Iran and Afghanistan in the west and northwest to the Sulaiman mountains and Kirthar hills in the east. Its coastal section is known as Makran (*q.v.*), which continues into Iran.

Politically it includes the Quetta and Kalat divisions. The former consists of the districts of Quetta-Pishin, Sibi, Loralai, Chagai and Zhob, with attached leased areas, agency territories and tribal areas (Mari and Bugti). The latter includes the former states of Kalat, Kharan and Makran (now constituted as districts). Area 132,909 sq.mi. (including Las Bela). The former state of Las Bela, though a part of Baluchistan, is now a district in the new Karachi division formed in 1961. In its continuity to the west lies the Irani Baluchistan.

PHYSICAL GEOGRAPHY

Geology.—The mountain ranges of Baluchistan are formed of Cretaceous and Tertiary beds, forming part of an extensive system of Tertiary (Alpine-Himalayan) times arranged as if in a festoon hanging southward between the Pamirs and Mount Ararat. The outer edge is looped up at Sibi to form the subsidiary festoon of the Mari and Bugti hills to the east. Outside (*i.e.*, south of) the folds lie the horizontal deposits of Makran and within them the stony desert of northwestern Baluchistan. Besides the Cretaceous and Tertiary beds, Jurassic rocks occupy considerable areas of Baluchistan. Triassic beds lie along the south side of the upper Zhob, and limestone bearing fossils of fusuline Foraminifera have also been found there. With the exception of the Upper Cretaceous and Lower Tertiary, especially in northwestern Baluchistan, there is an extensive development of volcanic tuffs and conglomerates probably contemporaneous with the Deccan traps of India. Great masses of syenite and diorite were intruded during the Tertiary period, and within the curve of the folded belt a line of recent volcanic cones stretches from western Baluchistan into eastern Iran. The sharp bends of the hill ranges around the Kachhi plain have contributed to the instability of this area and have made it seismically important; Quetta was subjected to violent earthquakes in 1931 and 1935, that of the latter year being a major disaster (*see* QUETTA).

Relief and Drainage.—The great break in the mountains about Sibi, and the line of the Bolan and Khojak passes followed by the railway from Sukkur on the Indus to Chaman on the Afghan frontier, divide Baluchistan into two distinct parts. To the northeast, hedged in between Afghanistan and the Indus plains, stretch long ridges of rough highlands. The average breadth of this highland lobe is 150 mi., but in the north it narrows to less than 100 mi. along the Gomal river. It is mainly inhabited by Pathans. Southwest of the railway is a square block of territory measuring about 300 mi. by 300 mi., primarily the home of the Brahui and the Balochi, but with a great variety of physical conditions and inhabitants. Between southwestern Baluchistan and the northeastern lobe is the wedge-shaped Kachhi plain.

Northeastern Lobe.—This area is bounded by the Sulaiman range on the east and the Toba-Kakar range in the northwest. The main central range of the Sulaiman, decreasing in height from north to south, forms the dominant geographical feature of northeast Baluchistan. Toward the north of the range is a group of peaks forming an oblong massif known as Kaisargarh (Kasi-Garh) or, more generally, as the Takht-i-Sulaiman ("Solomon's throne") from a celebrated shrine or *ziarat* of that name near its southern abutment. The highest point in the range is 11,290 ft. In the northern part extremely narrow gorges constitute a striking feature. These clefts provide means of communications through the mountains.

From the main Sulaiman range a number of hills curve away westward to merge in the broad mountain core which abuts the uplands of Quetta-Pishin, where are found some of the grandest peaks in Baluchistan: Khalifat (11,434 ft.), south of Ziarat; Takatu to the north of Quetta; Chehiltan (Chiltan) to the southwest; and the great square-headed Murdar to the south. The highest peak is Zarghun (11,738 ft.), northeast of Quetta, which lies in the midst of the mountains, on an open plain formed by the high-level tributaries of the Pishin Lora river, 5,500 ft. above the sea.

Kachhi Plain.—The curved recession of the Sulaiman ranges to the northwest leaves a flat alluvial plain, Kachhi, to the south, striking deep into the Baluchistan mountain system. Kachhi is a land of dust storms and violent winds, where the temperature does not fall below 100° F. in summer and drops below freezing point in winter.

Bolan-Khojak Gap.—The Bolan-Khojak gap provides an important line of communication across the central Brahui range and, to the north, across the Khwaja Amran mountains. It connects Sibi with Chaman, via Quetta. With many a detour the direction remains roughly from southeast to northwest. The route has three sections: (1) the Bolan pass (*q.v.*); (2) the middle part between Darwaza and Kila Abdullah; and (3) the Khojak pass. This latter pass, in the north, runs across the Khwaja Amran range and connects Kila Abdullah with Chaman.

Southwestern Quadrangle.—The square block of southwestern Baluchistan, with its mountain folds opening fanwise from the Kalat plateau in the northeast, naturally drains south and west, either to the Arabian sea or to the swamps of Lora and Mashkel. The Hab river between the Pab and the Kirthar ranges, the Purali, or Porali (the ancient Arabis or Arabius), draining the low-lying flats of Las Bela, the Hingol (the ancient Tomerus) and the Dasht in Makran are all considerable streams, draining into the Arabian sea and forming important arteries in the network of internal communications. An exception to this pattern is the Mula, which carries the floods of the Kalat highlands eastward through magnificent gorges into the Kachhi plains and forms one of the most important of the ancient highways from the lower Indus plains to Kandahar. To the north are the long lines of the Sarawan ridges, enclosing narrow fertile valleys and passing southwest to the edge of the Kharan desert. Some streams, like the Kuar, drain northward to the Pishin Lora, which itself flows westward into the Hamun-i-Lora marsh and desert. To the northwest of the plateau lies the Kharan desert, with intermittent river channels often lost in the sand waves before they reach the Mashkel swamps on the borders of Iran. The principal ranges are the Ras Koh in the north; the Siahan range (separating Makran and Kharan) and the central Makran range, running northeast and southwest, in the centre; and the Talar-i-Band or Makran coast range (Bahr-i-Garr) in the south. To the southwest are the long sweeping valleys of Rakhshan and Panjgur which, curving northward, likewise discharge into the Mashkel. The mountainous seaboard of Makran south of the Panjgur and west of the Hingol is poorly watered by the long lateral Dasht (Kech or Kej) river and several smaller mountain streams. The eastern frontier of southern Baluchistan follows the foot of the Kirthar range, whose limestone walls rise sheer for thousands of feet.

Climate.—Excluding the coastal strip in the south, Baluchistan has a subtropical continental climate marked by extremes of temperature and aridity. Kachhi and the Chagai-Kharan area are two of the hottest and driest regions of the Indo-Pakistan subcontinent. In the Zhob-Loralai and Quetta-Sarawan regions in the northeast, though the winter is very cold, the summer is cool and pleasant. The annual rainfall on the whole is less than 8 in., increasing to about 15 in. at Shahrig in the northeast and falling in the northwest to under 3 in. Most of the rain occurs in winter as a result of western disturbances. Summer rains from the monsoons are important only in the northeast. The coast has moderate temperatures and low rainfall and is dominated by a steady inflow of sea breeze in summer.

Extensive changes have taken place in the climatic conditions, as is shown by the remains of forests now entirely desiccated. Wanton destruction of forests may have been a factor in the widespread desiccation of large areas of the Baloch highlands, where evidence of ancient irrigation works and of cultivation attests to a once flourishing civilization and suggests slow but persistent climatic variations.

Vegetation.—Generally speaking, the country is scantily clothed with vegetation and most of the hills are bare of forest growth. On the plains and lower highlands trees and herbs are conspicuously absent, and the bare stony soil supports a desolate jungle of stunted scrub, the individual plants of which are almost all armed with spines, hooks and prickles of diverse appearance. In the upper highlands the vegetation is extremely varied according to local conditions. There are extensive fruit gardens in the

northeast highlands, and wild olives are also found. There are numerous groves of date palms in Makran where the date is the staple food.

Animal Life.—Transport is almost entirely by camels. Donkeys are also owned by every nomadic family. Sheep (of the fat-tailed variety) and goats are numerous and constitute much of the agricultural wealth. The quality of the wool is coarse. The goats are generally small and not very hardy. Thickly built bullocks are bred in the hills. An excellent breed of cattle comes from Nari in Kachhi. The Sarawan and Kachhi produce the best horses in Baluchistan. The question of fodder is one of the most difficult in Baluchistan since there is not much grass in the greater part of the country, and horses and bullocks chiefly subsist on the straw of cereals. The waters off the coast swarm with fish and mollusks, the former including sharks, perch, catfish, herrings and pomfrets.

HISTORY

The earliest trace of human occupation goes back probably to the end of the 4th millennium B.C., when the climate was better and rainfall heavier. The whole area abounds in *dhambs* or mounds, the sites of prehistoric settlements, dating mainly from the Chalcolithic period (Bronze Age), and in part contemporary with the Indus valley civilization. The settlements were in the valleys and at the foot of the hills. The complex relationships of these sites have yet to be established, but their chief centres are the Quetta (Bolan pass) and Zhob valleys, and Kalat (Nal valley) in the northeast and the Makran (Kulli) in the south. There is evidence of trade from the Makran coast reaching Mesopotamia and southern Persia, and of an Indus valley trading station at Sutkagen Dor.

In addition to a reference in the Avesta (*q.v.*) to Vara Peshin-Anha, which has been identified as the Pishin valley, Herodotus states that Mykians—the Maka of the Bisotun (Behistun) inscription—were included in the 14th satrapy of the Persian empire as organized by Darius in the 6th century B.C. Makran, the name of the southwestern coastal area of Baluchistan and the neighbouring Iranian territory, has been taken to mean "the land of the Maka." But nothing is known of the area until the time of Alexander (*q.v.*) the Great. After his victories in India, he crossed Las Bela and Makran (*qq.v.*) from east to west in 325 B.C., with the main body of his troops, while his admiral, Nearchus, coasted along their shores to the Persian gulf and kept such an accurate log that many of the ports and headlands mentioned can be identified. Craterus, in charge of the invalids and elephants, left Alexander in the Indus delta, marched through the Mula pass and northern Baluchistan, and rejoined him in the Halil Rud valley (Iran). Thereafter little more is known of Baluchistan, which probably passed under the control of the Parthians (*see* PARTHIA) and later of the Kushan dynasty. About this time Buddhism flourished in Baluchistan. In the 7th century the Arabs overthrew the Persian empire and gradually annexed its outlying provinces. In 707 Mohammed bin Kasim captured various strongholds in Makran, advanced into Sind and established the Muslim power in the Indus valley. The Arabs ruled Baluchistan from Khuzdar in Jhalawan until the 10th century.

When Persia regained its independence upon the gradual weakening of the caliphate, Baluchistan was included in the empire, but its chiefs were practically independent, so long as they furnished military contingents when called upon. From 1595 to 1638 the province formed part of the Mogul empire. The Balochi, who gave their name to the country, are comparatively recent arrivals. They apparently entered Baluchistan in the 11th and 12th centuries, being driven out of Persia by the Seljuks. They conquered western Makran but failed to seize the uplands of Kalat. Their rivals, the Brahuis, who occupy the highlands of Sarawan and Jhalawan in Kalat, are of Dravidian stock. They rose to power in the 17th century under their chief Kambar, who overthrew a dynasty of Hindu rajahs, and since this period Muslims have been dominant throughout Baluchistan. Kambar's descendant, Abdulla Khan, conquered the fertile district of Kachhi. After Nadir Shah of Persia avenged the Afghan invasion of his country and captured Kandahar, he appointed Abdulla's successor Nasir Khan I as *beglerbegi* or "chief *beg*" (modern Turkish bey) of Baluchistan in 1739. Upon the assassination of Nadir Shah in 1747, Ahmad Shah Durrani (*q.v.*) founded the kingdom of Afghanistan. Nasir Khan at first acknowledged his overlordship but in 1758 rebelled. He was defeated by Ahmad Shah in the field, but the Afghan was unable to capture Kalat and a treaty was negotiated.

British Control.—The political connection of the British government with Baluchistan commenced with the outbreak of the first Afghan War in 1839 when it was traversed by the army of the Indus and was afterward occupied to protect the British lines of communication through the Bolan pass to Kandahar. In the attack on Kalat, the khan Mir Mehrab Khan was killed. His son Mir Nasir Khan II later regained Kalat. The first British treaty with Kalat state was negotiated in 1854. From 1856 to 1876 its history was a chronicle of anarchy, revolt and outrage. By the treaty of 1876 the independence of Kalat was recognized, the khan agreeing to co-operate with the British governor general. In furtherance of the defense of India, the position at the head of the Bolan pass, which included Quetta and the surrounding country, was occupied; in 1879, as a result of the second Afghan War, by the treaty of Gandamak, Sibi and Pishin were annexed. In 1891 Sir Robert Sandeman extended British authority over the Zhob valley, between Pishin and the old frontier of India. In 1899 Nushki, and in 1901 the area now known as Nasirabad subdivision, were acquired from Kalat on perpetual lease. Thus the province of British Baluchistan came into being. The khans of Kalat continued to rule until 1955 when the state was merged in West Pakistan.

In the wake of World War I came the famine and influenza which took a heavy toll of life. The earthquake of May 31, 1935, caused great destruction at Quetta, Mastung and Kalat. In Quetta between 22,000 and 25,000 persons perished and property worth hundreds of millions of rupees was destroyed. In 1947, when the province became a part of Pakistan, its alien (as distinguished from indigenous) Hindu and Sikh population, numbering about 48,000 (1941 census), mainly employed in trade, defense and civil service, almost all returned to India and about 30,000 Muslim refugees found their way into the province from India.

The States.—Before 1947, the whole centre and south of Baluchistan was either in practice or nominally feudatory to the khan of Kalat, but during British rule the independence of three other leading chiefs was asserted or recognized. Las Bela's obligation to Kalat had for many years been confined to a formal duty to supply military aid; Kharan emerged as a separate state in 1940; and Makran became independent of Kalat in 1948, when all three acceded to the new dominion of Pakistan. Kalat itself joined shortly after. In 1952 the four states formed an entity called the Baluchistan States union, and in 1955 they were merged in the newly integrated province of West Pakistan, forming part of the Kalat division.

Jirga System.—An important feature of the administration of the region is the jirga (assembly) system which dates back to the days of Nasir Khan I who sought to consolidate the warring tribes by associating them with the administration. It was revived by Sir Robert Sandeman in 1877. In essence the system retained the rule of tribal chiefs through tribal custom, but under British supervision. Petty matters were settled by the village jirga. Intertribal disputes and differences were referred for final settlement to a provincial jirga, held annually at Sibi. These jirgas were known as *shahi darbars* until the inception of Pakistan. The jirga still continues as a recognized system. It is both a judicial and executive body dealing with day-to-day problems of tribesmen. The *sardar* ("headman"), *motabars* and elders constitute a jirga. Membership is almost hereditary. Internal and intertribal matters are decided on the basis of age-old conventions, customs and traditions.

When the jirga meets a "Sibi week" is celebrated. Several hundred members of the jirga are awarded *sanads* ("certificates") and *khalats* ("prizes") by the governor for meritorious services. An industrial exhibition, horse and cattle show, sports and races are also popular events.

THE PEOPLE

Baluchistan has an average density of only ten persons per square mile but in the Kalat division the average is only seven, falling to two in the districts of Chagai and Kharan. The total population in 1961 was 1,384,000 (including Las Bela). Almost all the people are Muslim; the largest Hindu minorities are in the Sibi (9%) and Kalat (2%) districts. They are chiefly agricultural and pastoral and transhumance is practised in the hilly areas. Because of isolation illiteracy is widespread.

The Meds, the Pathans and the Jats appear to have been the inhabitants of Baluchistan at the time of the Arab invasion. The Meds now, as then, live along the coast of Las Bela and Makran and are fishermen. They are the Med of the Arab chroniclers and may well be the Ichthyophagi of Alexander's time. The general habitat of the Pathans is the compact block of highland country in the northeast of the province, comprising the districts of Quetta-Pishin, part of Sibi and Loralai and the whole of Zhob. The chief indigenous Pathan tribes in Baluchistan are Kakars, Tarins and Shiranis, the Kakars being the most numerous. The Pathans are tall, robust and well-built. The Jats, less numerous, are cultivators in Kachhi and Las Bela. (*See* PATHAN; JAT.)

Beside Pathans the chief indigenous races are the Balochi and Brahui. The word Baloch means nomads or wanderers. Baloch legends suggest that they derived from Arabia or Aleppo, but more probably they are Iranian. They entered Baluchistan from Kirman and Seistan through Makran and slowly spread through the province in two main divisions, western and eastern. Many moved eastward to Kachhi, Sind and Punjab. They tend to be shorter than the Pathan and wear their hair long. They are expert riders. The western Baloch predominate in Chagai district and Makran and their important tribes include Nausherwani, Rakhshani, Boledi and Gichki. The Nausherwani, an Iranian group, appear to be identical with the Tahuki or Tahukani of Iranian Baluchistan. The Boledi were once the ruling race of southern Baluchistan. The Gichki are the dominant race in Panjgur and Kej in Makran where they ousted the Boledi. Tradition suggests that they were originally Hindus who made their way to Makran from the east in the 16th or 17th century. The Rind are the main tribes of the eastern Baloch. Of them, the Mari and Bugti tribes, who occupy the southern buttresses of the Sulaimans, are the most numerous. They are almost certainly of Arab extraction and claim to be Kurdish. They came to Sind either with the Arab conquerors or later and remained there mixed with the original Hindu inhabitants. (*See* BALOCHI.)

The Brahuis are a confederacy of tribes occupying the highland country of Sarawan and Jhalawan in the Kalat division. They are also found westward in Chagai and Kharan and even in Makran. In view of their Dravidian language their origin has been a subject of great speculation. Their own explanation is that the word Brahui is derived from an eponymous ancestor, Braho (a modification of Brahim or Ibrahim), who was a descendant of Mohammed's uncle Mir Hamza. (*See* BRAHUI.)

Languages.—The chief indigenous languages spoken are Balochi, Pashto (*q.v.*), Brahui and Jatki (or Jagdali). Balochi is spoken by nearly a third of the population and in more than half of Baluchistan (*see* BALOCHI LANGUAGE). Pashto, the language of the Pathan tribes, is spoken in the northeastern districts. Brahui is found in the centre of the country around Sarawan and Jhalawan (*see* BRAHUI LANGUAGE). The term Jatki includes a number of local languages, which fall into two main groups resembling Sindhi on one side and western Punjabi (Lahnda) on the other (*see* SINDHI LANGUAGE; LAHNDA LANGUAGE). Jatki is more scattered and is spoken in Kachhi, Las Bela, Sibi and Barkhan (west of the Punjab border). (K. S. AD.)

For the economy *see* PAKISTAN: *The Economy*.

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BALUCHISTAN (BALUCHESTAN), a region in the southeast of Iran, previously within the province of Kerman but from 1959 united with Seistan (*q.v.*) in one province (*ostan*) with the capital at Zahedan. The province has an area of 68,661 sq.mi. and a total population in 1956 of 428,363. Baluchistan is the least developed of all Iranian regions partly because of the singularly harsh environment and partly because of the prevailing social conditions. Precipitations are scarce and mostly fall in a few violent rainstorms causing floods and heavy erosion. The region consists largely of broken uplands, or lowlands submerged in oppressive heat for eight months of the year. The nomadic element, Balochis and Brahui (*qq.v.*) with many admixtures, was dominant to the detriment of cultivation, which obviously much receded during historic times. Sedentary groups include descendants of old Iranian stock, Indians (Jat) and some remnants of an old primitive stratum. Camelback raiding and internal warfare was common. Besides tribal areas there existed a number of petty principalities, partly paying allegiance to the khanate of Kalat.

REGION OF BALUCHISTAN, DIVIDED BETWEEN PAKISTAN AND IRAN

Frequently claimed by the more potent rulers of Persia, this western part of Baluchistan in its wider sense was conquered by Persia piecemeal during the 19th century, and its boundary was fixed by an international boundary commission in 1872. The government has striven for final pacification and economic rehabilitation. Settlement was assisted by the construction of dams (Bampur-Iranshahr). A motorable road was opened from Zahedan to the minor port of Chah Bahar. Zahedan (pop., 1956, 17,495) and Zabol (in Seistan) are the only towns of importance. Zahedan is connected by rail to Quetta, West Pakistan; it is a road junction for the roads from Pakistan to western Iran and from the U.S.S.R. through Meshed to the Gulf of Oman, and has an airport.

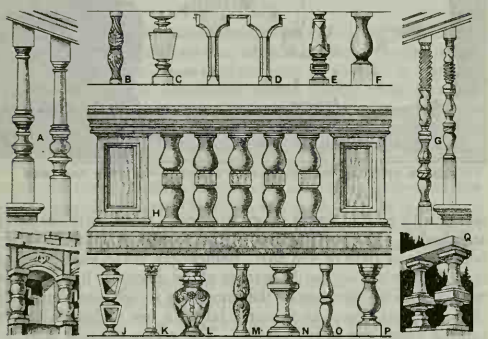
The coastal region, which extends into Pakistani Baluchistan, is known as Makran (*q.v.*). (H. Bo.)

BALUE, JEAN (*c.* 1421–1491), French cardinal, the treacherous minister of Louis XI, was born at Angles-sur-l'Anglin, in Poitou, of obscure parentage. He became almoner to Louis XI, bishop of Evreux in 1465 and cardinal in 1467. About that time Balue was compromised in the king's humiliation by Charles the Bold, duke of Burgundy, at Péronne and excluded from the council. He then intrigued with Charles against his master; their secret correspondence was intercepted, and on April 23, 1469, Balue was thrown into prison—but not, as has been alleged, in an iron cage. In 1480, through the intervention of Pope Sixtus IV, he was set at liberty and went to live in Rome. He received the bishopric of Albano and afterward that of Palestrina. In 1484 he was even sent to France as legate *a latere*. The government of Anne de

Beaujeu appointed him representative of the French court to the Holy See. He died in Ancona in 1491.

BIBLIOGRAPHY.—Henri Forgeot, "Jean Balue, cardinal d'Angers," *Bibliothèque de l'école des hautes études,* fasc. 106 (1895); E. Déprez, "La Trahison du cardinal Balue," *Mélanges de l'école française de Rome* (1899); P. Champion, *Louis XI,* 2nd ed., vol. ii (1929).

BALUSTER (sometimes incorrectly written "banister"), one of a series of small posts supporting the coping or handrail of a parapet or railing. Colonnettes are shown as balusters in Assyrian palaces by contemporary bas-reliefs and are similarly used in many railings of the Gothic period. Although no Greek or Roman example of the baluster is known, the Italian Renaissance designers made great use of it, employing, instead of the medieval colonnette, forms richly molded and usually round. The Renaissance balusters generally had a capital, a base and a vase-shaped form between. In early Renaissance work a form similar to two vases set base to base is frequent. The later Renaissance architects



EXAMPLES OF BALUSTERS

(A, G) Georgian Colonial (G: Hancock house, Boston, 1737); (B, F, H, K, M, O, P) Italian Renaissance (H, Library of St. Mark's, Venice, c. 1550); (C, E, N) modern baroque variations; (D) French Gothic, Chartres cathedral, 13th century; (I) Saxon romanesque; (J, L) Italian baroque; (Q) modern French

codified balusters into orders like columns, and those of the baroque went to the other extreme of fantasy in baluster form. The term "baluster shaft" is used of any similar vertical shaft such as those found dividing the windows in Saxon work.

BALUZE, ÉTIENNE (1630–1718), French scholar, notable both as the author of historical works and as the collector and publisher of documents and manuscripts, was born at Tulle, near Limoges, on Nov. 24, 1630. He was educated at the Collège St. Martial at Toulouse, where he studied chiefly ecclesiastical history and canon law, becoming in 1654 secretary to the archbishop of Toulouse, a historian of note. Just before the archbishop's death in 1662 he entrusted Baluze—who had already brought out several works of his own—with the task of publishing all his papers.

After five years as secretary to the bishop of Auch, in 1667 Baluze entered the service of Colbert as his librarian, a post he was to hold for more than 30 years. In 1670 he received the additional appointment of professor of canon law at the Collège Royal. He published his *Concilia Galliae Narbonensis* in 1668, following this with other important works, including *Capitularia regum Francorum* (1677), *Miscellanea* (1678–83), *Nova collectio Conciliorum,* (1683, only one vol. published) and *Vitae Paparum Avenionensium* (1693). He also edited the works of many ecclesiastical writers. During this period he was in correspondence with other scholars and readily put at their disposal what his own researches revealed. In 1700 he relinquished his position as librarian, having enormously enriched Colbert's collection of books, and in 1707 was appointed director of the Collège Royal. In 1708 appeared his *Histoire généalogique de la maison d'Auvergne,* undertaken at the request of the cardinal de Bouillon. In this, which purported to trace the cardinal's descent from the counts of Auvergne in the 9th century, Baluze made use of documents already proved to have been forged. De Bouillon fled abroad, and Baluze, having been deprived of all his offices, was banished for some years from Paris. While in exile he completed his *Historia Tutelensis* (1717).

Baluze died in Paris on July 28, 1718.

See R. Fage, *Les Oeuvres de Baluze, cataloguées et décrites* (1882), É. Fage, *Étienne Baluze: sa vie, ses ouvrages, son exil, sa déjense* (1899).

BALZAC, HONORÉ DE (1799–1850), French novelist, one of the greatest writers of fiction of all time, was born in Tours on May 20, 1799. His parents, by whom he was much influenced, were strongly individual characters. His father, whose surname was originally Balssa, was a self-made man of southern peasant stock who had obtained a legal training for himself and held responsible administrative posts for 43 years under Louis XVI and Napoleon. From him Balzac derived his enthusiasm for Laurence Sterne and Rabelais. Balzac's mother, who belonged to a well-to-do family of Paris cloth merchants, was 32 years younger than his father. She was overrigid in her treatment of children, and Balzac later deplored what he felt to be a lack of maternal affection. It was this which he sought in some of his personal relationships in subsequent life. Several of his stories contain reflections of his childhood and growth to manhood in conditions often far from happy. He saw little of family life during his early years; he was sent to school at Vendôme from the age of 8 to nearly 14 and did not return home during this period. He was particularly close to his sister Laure, 16 months younger than himself. To her he poured out his youthful convictions about the high destiny which he was sure awaited him.

Although his relations with his mother were often strained, Balzac was to turn to her for help on many occasions, especially during periods of financial stress. She was preoccupied with occultism and mesmerism and with the mystical philosophy of Swedenborg. This started Balzac's own interest in these and similar topics. He was greatly fascinated by hypnotism and magnetism and by all that he could discover concerning the fantastic or supernatural. He eagerly adopted J. K. Lavater's theories of the supposed connections between physical appearance and character or destiny and was equally attracted by F. J. Gall's system of phrenological deductions. The more solidly based ideas of the scientists Geoffroy Saint-Hilaire and Cuvier also held a compelling interest for him.

All this marked his work profoundly. He not only looked for the spiritual or mystical truths underlying outward realities but was also convinced that an inescapable relationship existed between external circumstances and the ways in which individual lives might be expected to develop. A man's antecedents, environment, upbringing and profession would all shape his destiny. New conditions or some apparently insignificant turn of events might bring out latent possibilities in his character and set him on a different route. For these reasons Balzac gave much space in his novels to a minute description of all the physical factors by which his characters found themselves surrounded—the towns and streets in which they lived, the houses which both expressed and formed their personality, the clothes which were so much a part of themselves, the signs and gestures by which they gave themselves away.

To describe and interpret the age in which he lived was Balzac's greatest aim. He was well qualified for such a task. He was a close and accurate observer, with great powers of assimilation and an amazingly retentive mind. He was also an omnivorous reader who took all knowledge for his province, a man of intense imagination and creative power and a visionary with an intuitive understanding of human nature which he himself compared to second sight.

Far-reaching changes were taking place in France in Balzac's lifetime. The echoes of the Revolution of 1789 were still reverberating, and the structure of French society was being transformed. Balzac grew up under the regime of Napoleon I, whose name held a particular magic for him, as for many of his contemporaries. It was partly a desire to be a Napoleon of the pen that fired his own ambitions. He wrote about the Napoleonic era in several works, notably *Une Ténébreuse Affaire* (serialized 1841;

authorized ed. in book form, 1842),[1] a story of conspiracy which anticipates the modern detective novel. He chiefly concentrated, however, on the quarter century following Napoleon's defeat in 1815, and this period provides the setting for more than two-thirds of his stories, with particular emphasis on the years of the Restoration, 1815–30. Unlike some authors of the romantic generation, Balzac had no desire to escape from his own times. To others, the period often seemed a colourless anticlimax after the excitements of Napoleonic days. To Balzac, it represented adventure and achievement. One of his great gifts was for seeing possibilities for the storyteller in material that might have appeared commonplace.

Literary Beginnings.—Balzac was first intended for the legal profession. He was registered as a student in the law faculty of Paris university from 1816 to 1819; during this period, he was also a clerk in the office first of a solicitor, then of a notary. He was to utilize his experiences and his knowledge of judicial procedure in many stories, for instance *Le Colonel Chabert*, *Le Contrat de mariage* and *César Birotteau*. From the first, however, he was convinced that his true bent was for literature. In 1819, his parents agreed to let him try his hand as a writer. He established himself in a garret near the Arsenal in Paris, with an allowance of 1,500 fr. per annum. To prove himself, he wrote a verse tragedy, *Cromwell*, which he read to an unenthusiastic family audience in 1820. An opinion was sought from François Andrieux, the future secretary of the Académie Française, whose verdict was that Balzac might employ his time better than by composing tragedies or comedies. A more colourful version of this episode is given by Balzac's sister Laure in her informative but not always accurate reminiscences (Laure Surville, *Balzac, sa vie et ses oeuvres, d'après sa correspondance*, 1858), where Andrieux is reported as saying that Balzac should occupy himself with anything but literature. Balzac, sure that he had only to persevere to establish himself as a genius, resolutely disregarded Andrieux's advice. He constantly tried to launch himself as a dramatist and, toward the end of his life, cherished the notion of adapting all his novels for the stage so as to earn better financial rewards. His plays were almost invariably unfortunate. (*See* D. Z. Milatchitch, *Le Théâtre d'Honoré de Balzac* and *Le Théâtre inédit d'Honoré de Balzac*, 1930).

From 1819 to 1825, Balzac was chiefly occupied with experiments in fiction, and from 1825 to 1828 with various ill-fated business ventures. From the early 1830s onward, he also produced many journalistic writings on a variety of topics, from theories of government to questions of elegance. With his awareness of new developments, he was among the first to recognize the growing power of the press. Many of his novels first appeared as serials in newspapers, a fashion which became popular in the middle 1830s. He founded various short-lived periodicals—the first of them, the *Feuilleton des journaux politiques*, in 1830—which he hoped would serve him in his ambitions for a political career. This, however, never materialized. His political convictions shifted in various directions, but in the main he favoured a benevolent autocracy. Similarly, after alternating between mysticism and irreverence, he eventually proclaimed his support for the Catholic Church.

Balzac's first attempts at fiction are represented by a fragment entitled *Falthurne* (probably late 1820; ed. by P. G. Castex, 1950) and by a longer unfinished work entitled *Sténie, ou les erreurs philosophiques* (attributed to 1820–21; ed. by A. Prioult, 1936). Both remained unpublished until the 20th century. They show his interest in philosophical speculation and metaphysical inquiry and also his determination from the outset to establish himself not merely as a novelist but as an intellectual leader. He felt too that it was the function of the modern novelist to do what epic poets had done for earlier generations.

After *Falthurne* and *Sténie*, from 1821 to 1825, Balzac wrote a number of unsigned or pseudonymous stories, either in collaboration with various second-rate authors or on his own. The full extent of this activity remains uncertain, but he is known to have been partly or wholly responsible for at least eight of these stories. He had no illusions about their merits and never admitted them to his collected works. They were potboilers, but they were also deliberate exercises in different forms of writing, parodies or imitations of elements then fashionable in literature. Balzac drew from many sources: popular thrillers, melodrama, the English tale of terror, the works of Rousseau, Diderot, Richardson, Scott, Byron, Goethe, Chateaubriand and James Fenimore Cooper. Long neglected, these youthful productions have been much studied since. They show him anticipating themes and character studies typical of his later works. (*See* A. Prioult, *Balzac avant la Comédie humaine, 1818–29*, 1936).

Literary efforts not proving sufficiently remunerative, Balzac became a publisher in 1825 and a printer in 1826. In 1827, he bought a type-foundry as well, but disaster soon followed. In 1828, he was narrowly saved from bankruptcy and left with liabilities of at least 60,000 fr. From now on his life was to be one of mounting debt and almost incessant toil.

Balzac spent far more than he could afford on luxuries of every kind: personal adornment, furnishings, paintings, *objets d'art*, exquisite coffee. His passion for collecting grew to resemble that of his hero in *Le Cousin Pons*. He paid off obligations by incurring others, promised work that he could not complete in time and had interminable arguments with publishers over broken contracts. Long spells of seclusion, when he worked for 15 or 18 hours a day, alternated with brief excursions into the fashionable world and periods of recuperation in the country. He was for ever conjuring up wonderful schemes to provide a short cut to fortune and, however often they came to naught, always believed that his next venture would bring riches beyond compare. It was partly this ability to live in a realm of make-believe that enabled him to write so convincingly.

In his financial difficulties, Balzac received substantial advances from his mother and from Madame de Berny (Laure Hinner; 1777–1836), whom he first met in 1821. Madame de Berny was a goddaughter of Louis XVI and Marie Antoinette; her father had been a court musician, and her mother a lady's maid to the queen. She was 22 years older than Balzac, and the mother of a large family; she gave him a warmth of affection which he had never previously known, and her death in 1836 was one of his deepest griefs.

Balzac also owed much to Madame Carraud (Zulma Tourangin; 1796–1889), whom he first met in 1819. The wife of an instructor at the military academy of Saint Cyr, she represented all that was best in the liberal *bourgeoisie* of the period. She was a wise and loyal friend for many years. (See *Honoré de Balzac: Correspondance avec Zulma Carraud*, revised ed. by M. Bouteron, 1951.)

Balzac's relationship with the duchesse d'Abrantès (Laure Junot [*q.v.*], the widow of one of Napoleon's marshals), whom he probably met in 1825, was of a different character. She enlisted his help in writing her memoirs, fascinated him with reminiscences of the Napoleonic period and helped him to gain a foothold in the fashionable world—to which he sought admission partly because of *amour-propre*, partly for self-advancement, partly in order to study a mode of life that could never be adequately imagined from outside.

Themes and Ideas.—During the 1820s, Balzac was working his way toward the road which he was to follow as a novelist. One of his first intentions, in emulation of Scott, was to write a sequence of stories depicting the history of France from the earliest days. Only subsequently did he decide to become the historian of his own times and to give his works the cohesion of a vast chronicle in which every novel would be like but one chapter in the whole.

The first novel that Balzac signed with his own name, *Le Dernier Chouan* (1829; entitled *Les Chouans* in 1834) ranks as a historical novel in so far as it deals with a royalist insurrection of 1799. It points decisively, however, toward that representation of contemporary life which was henceforth to be his main concern, though he never lost his interest in the past or in the lessons to be learned from it. At intervals up to 1841, he wrote over a dozen more works of fiction dealing with events prior to 1800, from the time

[1]The dates given in this article for first publication in book form are those of the French editions authorized by Balzac. They were sometimes preceded by Belgian editions pirated from the serial publications.

of Dante (*Les Proscrits*, 1831) to the French Revolution (*Un Épisode sous la terreur*, 1831).

Balzac's opportunities for observing the contemporary scene were increased by constant journeys in France and different parts of Europe. His wide circle of friends and acquaintances brought him into contact with many walks of life. He knew both provincial and metropolitan life as few writers have done. No French novelist has drawn material from such a diversity of regions, but Paris provided the background for many of his stories, and it was there, in a variety of districts, that he chiefly lived from 1814 onward. His home in what is now the Rue Raynouard—with a trapdoor enabling him to escape from his creditors into the street behind—was later transformed into the Balzac museum.

The contrast between the provinces and the capital became his constant theme. No theme is more typically Balzacian than that of the ambitious young provincial fighting for advancement in the competitive world of Paris. Here, Balzac believed, the effects of modern civilization could be seen in their most extreme and demoralizing form. He admired those who were ruthless, astute and, above all, successful in thrusting their way ahead and was attracted by the theme of the individual in conflict with society: the adventurer, rebel or criminal. He was reproached for making his villains more vigorous and interesting than his virtuous characters. Nevertheless, he strongly condemned a social system in which moral principles were being replaced by money values.

These topics provided material largely unknown, or unexplored, by earlier writers of French fiction. The individual in Balzac's stories does not live in a world remote from material difficulties, but is continually affected by the pressure of outward circumstances. Conversely, his own actions are represented as spreading out in widening circles, bringing their consequences to bear, not upon himself alone, but upon many others too. This is particularly the case with some of the central characters in the novels. They are the victims and the embodiment of some ruling passion: avarice, excessive paternal affection, feminine jealousy, vindictiveness, the mania of the collector, the curiosity of the scientist, the artist's desire for perfection. Once such an obsession has gained a hold, Balzac shows it growing irresistibly in power and blinding the person concerned to all other considerations. The typical structure of his novels from the early 1830s onward is determined by this approach: there is a long period of preparation and exposition, then tension mounts swiftly to an inevitable climax, as in classical tragedy.

Literary and Social Success, 1830–32.—In 1830, Balzac suddenly acquired celebrity with a skittish and cynical essay, the *Physiologie du mariage*. The six stories in his *Scènes de la vie privée*, 2 vol. (also 1830), increased his reputation. He began to frequent some of the best-known salons of the day and redoubled his efforts to set himself up as a dazzling figure in society. His resplendent waistcoats, his turquoise-studded cane, his tilbury and two horses made him the talk of the town, as he intended. He adapted for his own use the armorial bearings of an ancient noble family with which he had no connection and assumed the honorific particle "de." The first publication in which he used this particle was *La Peau de chagrin*, 2 vol. (1831), a story of the fantastic symbolizing one of his most constant themes, viz., the way that vital energy might be dissipated by the satisfaction of desires.

This work gained him many new readers. In particular it brought him, in Sept. 1831, an admiring but pseudonymous letter from a lady who in Feb. 1832 revealed herself to be the marquise de Castries (Henriette de Maillé, duchesse de Castries in 1842). Balzac was captivated by her beauty and by the fact of her belonging to one of the oldest noble families of France. She introduced him to her circle and, in 1832, invited him to join her on a trip to Italy. They parted company, however, in Geneva, in circumstances never fully explained. Balzac's pride was deeply wounded, but he did not break with her completely; they corresponded, and sometimes met, almost to the end of his life.

Madame Hanska.—Meanwhile Balzac had received a letter from another lady admirer which altered his whole existence. Written, it is thought, on Feb. 28, 1832 (the day of Balzac's first letter to Madame de Castries), and posted from Odessa, it was signed "l'Étrangère" and told him he would never know the writer in any other way. Balzac acknowledged this by a personal advertisement in the *Gazette de France* of April 2. The lady wrote again on Nov. 7, and this time he replied by an advertisement in *La Quotidienne* of Dec. 9. Her identity was soon revealed. She was Éveline Hanska (née Ewelina Rzewuska; 1800–82), a Polish countess, the wife of an immensely wealthy landowner 22 years older than herself. She and Balzac first met at Neuchâtel late in Sept. 1833 and agreed to marry when she was free. They met again in Geneva from Dec. 1833 to Feb. 1834 and in Vienna between May 16 and June 4, 1835. Balzac traveled there in great style, aided by an advance from Edmond Werdet, his long-suffering publisher; he was introduced to Metternich and other leading members of Austrian society. He did not see Madame Hanska again until 1843, 20 months after her husband died in Nov. 1841.

Balzac's courtship was mainly conducted through a voluminous correspondence, later published as *Lettres à l'Étrangère* (vol. 1–2 ed. by the vicomte C. de Spoelberch de Lovenjoul, 1899–1906; vol. 3–4 ed. by Marcel Bouteron, 1933–50). Here he poured out his hopes and anxieties and gave Madame Hanska a constant progress sheet recording the efforts he was making to realize his ambitions. Of her letters to him only those of Nov. 7, 1832, and Jan. 8, 1833, have survived: the rest were destroyed at her wish.

Projects and Achievements, From 1832.—To put himself in a position to marry Madame Hanska became Balzac's great incentive. He was now at the peak of his creative power. In the period 1832–35, he produced more than 20 works, including *Louis Lambert* (first published as *Notice biographique sur Louis Lambert*, 1832), *Le Médecin de campagne* (1833), *Eugénie Grandet* (1833), *La Recherche de l'absolu* (1834), *Le Père Goriot* (serialized 1834–35; in book form 1835), his masterpiece, and *Le Lys dans la vallée* (part serialized 1835; in book form, 2 vol., 1836). Among the shorter stories were *Le Colonel Chabert* (1832), *Le Curé de Tours* (1832), *La Femme abandonnée* (1832), the trilogy entitled *Histoire des treize* (1833–35) and *Séraphita*, a highly mystical work which he dedicated to Madame Hanska (1834–35). Between 1836 and 1839, he wrote *Le Cabinet des antiques* (in periodicals, 1836–38; in book form 1839), the first two parts of *Illusions perdues* (1837, 1839), *Les Employés* (serialized as *La Femme supérieure*, 1837; in book form, retitled, 1838), *Histoire de la grandeur et de la décadence de César Birotteau* (1837 but dated "1838"), *La Maison Nucingen* (1838), *Le Curé de village* (fragments 1839; in book form 1840) and parts i and ii of *Béatrix* (1839). Between 1832 and 1837, he also published three sets of *Contes drolatiques*. These stories, Rabelaisian in theme, are written with great verve and gusto in an ingenious pastiche of 16th-century language.

That the *Contes drolatiques* should have been written by the author of *Séraphita* reflects part of Balzac's many-sided personality. To most people he seemed full of exuberant vitality, talkative, jovial and robustious, egoistic, credulous and boastful. George Sand was among the few to see a deeper aspect of his nature, but even she did not know the Balzac who perhaps resembles his hero Louis Lambert, detached from the workaday world and searching out mysterious regions of abstract thought.

It is hard to imagine how Balzac combined this literary work with his many other activities. In spite of frequent assurances to Madame Hanska, he formed other attachments. In 1834, he met an Englishwoman, Sarah Lowell, Countess Guidoboni-Visconti, who meant much to him for several years. He went twice to Italy on business for her husband and her, and they often helped him financially, especially over his purchase in 1837 of a property called Les Jardies at Ville-d'Avray (Seine-et-Oise). There he built a house and, among other projects, thought of growing 100,000 pineapples at a price defying all competition, but everything went calamitously wrong and he eventually sold the property at enormous loss. In 1838, he visited Sardinia, in search of silver mines left by the Romans, to find that someone had already obtained the concession. In 1839, with Gavarni the artist, he vainly tried to save from execution a notary and writer called Sébastien Peytel, in his view wrongly accused of murder. He also became president of the Société des Gens de Lettres, founded to protect the rights of authors, for which he had been vigorously campaigning. In 1835

Balzac had bought a major interest in the *Chronique de Paris,* but he gave it up after six months, with a debt of 45,000 fr. In 1840 he made his last attempt to launch a periodical, the *Revue parisienne.* This ran to three issues, mainly written by himself, and included his famous tribute to Stendhal, then unrecognized.

Balzac produced several notable works in the years 1841–42. These included *Une Ténébreuse Affaire* (*see* above), *La Rabouilleuse* (serialized as *Les Deux Frères* and *Un Ménage de garçon en province,* 1841–42; in book form as *Les Deux Frères,* 2 vol., 1843, but dated "1842"), *Ursule Mirouët* and *Albert Savarus.* After this the rate slowed up appreciably. Increasing ill-health made him anxious about completing a task whose limits he was constantly extending. He was beset by financial cares and troubled by Madame Hanska's continual postponements of their marriage. Her reasons have been much debated, but she had many legal difficulties to overcome and some cause for hesitation before marrying a debt-encumbered foreign author.

In 1844, using a subject which Madame Hanska had suggested, Balzac produced *Modeste Mignon.* He also began *Les Paysans* (13 ch. serialized 1844; completed by his widow, 1855). In 1846 and 1847 he published the last two parts of *Splendeurs et misères des courtisanes,* the first two having appeared in 1843–44. His last two masterpieces were *La Cousine Bette* and *Le Cousin Pons* (serialized 1846 and 1847 respectively as parts i and ii of *Histoire des parents pauvres;* in book form as *Les Parents pauvres,* 2 pt., 1847–48). With *La Rabouilleuse,* they constitute his most sombre pictures of human depravity, but they also emphasize loyalty and self-sacrificing devotion. After 1847, Balzac began no work which he lived to complete.

La Comédie humaine.—Throughout his career, Balzac's general plan for his fiction grew more ambitious. He explained his intentions, as they developed, in various letters and prefaces. In 1830, in his *Scènes de la vie privée,* he had begun the process of grouping his stories together. This was carried further in *Études de moeurs au XIXe siècle,* 12 vol. (1834–37), which prepared the way for the publication of his collected works under the title *La Comédie humaine* (probably inspired by that of Dante's *Divine Comedy*).

This edition, illustrated by Gavarni, Daumier, H. Monnier and other leading artists, began to appear in 1842. By 1848, 17 volumes had been published. In 1855, after Balzac's death, it was reprinted, with the addition of three further volumes: vol. xviii concluded the *Comédie humaine,* while vol. xix contained Balzac's plays and vol. xx his *Contes drolatiques.*

The sales of the *Comédie humaine* proved disappointing, and in 1845 Balzac drew up a catalogue for a second and enlarged edition of 26 volumes. This gave the titles of 51 new works which he proposed to include, but only one of these was eventually completed. This was *Les Frères de la consolation,* entitled *L'Envers de l'histoire contemporaine* when finally published in book form (1855). He subsequently wrote five more works whose titles had not appeared in his 1845 list, namely: *Gaudissart II, Un Homme d'affaires, Petites misères de la vie conjugale, La Cousine Bette* and *Le Cousin Pons.* These brought the total of works comprised in the *Comédie humaine* to 91, the three component parts of *Sur Catherine de Médicis* being regarded as one work.

Balzac divided *La Comédie humaine* into three main compartments: *Études de moeurs, Études philosophiques* and *Études analytiques.* The first, 14 volumes of the edition of 1842–48, is subdivided into scenes of private life, provincial life, Parisian life, political life, military life and country life. Balzac, however, rated some of the stories in his *Études philosophiques* above the more realistic novels by which he was mainly known in his lifetime.

These divisions were somewhat artificial, and Balzac often regrouped them without finding an entirely satisfactory arrangement. It became increasingly difficult as his design grew more far-reaching and its ramifications more intricate. His achievement, he told Madame Hanska in 1844, would consist in having carried a whole society in his head. This reaffirmed ambitions expressed to her in a letter of Oct. 26, 1834. His "human comedy," as he explained in his famous preface of 1842, was intended to include 2,000 to 3,000 outstanding characters. This number, he believed, would serve to represent contemporary life in all its complexity. (In his letter to Hippolyte Castille of Oct. 11, 1846, he gave the figure as 4,000 to 5,000.) In the end, the total number of named characters in the *Comédie humaine* is estimated to have reached 2,472, with a further 566 unnamed characters. In addition, a number of historical personages appear under their real names.

Balzac did not quite realize his tremendous aim of making his novels comprehend the whole of society at that time. His projected scenes of military and political life were only partially completed, and there were certain other gaps, for instance in regard to the new class of industrial artisans. Nevertheless, no novelist has thronged his pages with men and women drawn from so many different spheres, nor with characters so widely representative of human passions and frailties, projected with dynamic and convincing force. Their salient features are heightened and sometimes exaggerated to caricatural proportions; they are both types and individuals. Together they make up the picture of an age, but they belong, in many cases, to all humanity.

It was a picture not merely of diversity, but also of interdependence. Balzac saw society as a unit, a great drama with endless links and relationships. He conveyed this by a technique which he first applied systematically in *Le Père Goriot* in 1834, after experimenting with it earlier, viz., by making the same characters reappear in one story after another. His previous works were rewritten to bring them into line, and henceforward Balzac used this method more and more extensively.

Many of Balzac's difficulties arose from his striving for perfection. He would not allow anything to be published before he was fully satisfied, and some of his works were rewritten a dozen or more times. These strenuous revisions were not limited to stylistic details. He often began with a relatively simple subject, but let fresh ideas come crowding in during composition, until finally the story went far beyond his first intention. Even when it was in print he would frequently introduce new variations on his theme, as successive editions appeared. His characters too lived on in his mind, sometimes changing considerably before acquiring their final shape.

Balzac's method was almost invariably to reinforce, to emphasize and amplify. There are lengthy digressions in which he aired his knowledge or expounded his views, but at its best his expression is remarkably graphic and sometimes tersely epigrammatic. His command of the French language was probably unrivaled, and, although unsuccessful as a playwright, he was a master of dialogue. His sardonic humour saves even his more pessimistic stories from being uniformly dark, and he had a real gift for comedy. He gave the French novel new dimensions and helped to make it a major form of literature.

Last Years.—During Balzac's last years, the strain of work became excessive, though at times he was still buoyed up with thoughts of achievement. After many disappointments, he met Madame Hanska in Germany in 1845, and they traveled with some happiness in Belgium, Holland and France. He visited her at her estate of Wierzchownia in Volhynia in 1847 and went there again in Sept. 1848 for a longer period, his health by now gravely impaired. On Jan. 11 and 18, 1849, he was a candidate for the Académie Française, but was twice defeated, receiving only two votes each time. He married Madame Hanska at Berdichev on March 14, 1850. In May they journeyed to the house in the Rue Fortunée in Paris, which he had partly furnished with her money. From then on Balzac was ill most of the time until his death, Aug. 18, 1850. His funeral took place Aug. 21, in the cemetery of Père Lachaise; Victor Hugo

HISTORICAL PICTURES SERVICE

HONORÉ DE BALZAC, DETAIL FROM A DAGUERREOTYPE, ABOUT 1848

pronounced the funeral oration.

Manuscripts and Editions.—After Balzac's death, many of his manuscripts were destroyed. The vicomte Charles de Spoelberch de Lovenjoul, a Belgian scholar, devoted much of his life to collecting Balzac items of every kind. He left them, after his death in 1907, to the Institut de France. They now are in the Lovenjoul collection at the Château de Chantilly. Marcel Bouteron was curator for over 30 years; Jean Pommier succeeded him.

For Balzac's complete works *see* the edition by M. Bouteron and H. Longnon, 40 vol. (1912–40), and *L'Oeuvre de Balzac,* ed. by A. Béguin and J. A. Ducourneau, 16 vol. (1949–53). *La Comédie humaine* is also published in the Pléiade series, ed. by M. Bouteron, 11 vol. (1935–60). A further important edition of Balzac's *Oeuvres complètes,* by La Société des Études Balzaciennes, began to appear in 1956. *See* also, in addition to the editions mentioned in the text, *Les Cahiers balzaciens,* ed. by M. Bouteron, 8 vol. (1923–28), and *Honoré de Balzac: Letters to His Family 1809–1850,* ed. by W. Scott Hastings (1934; Fr. ed. 1950). There are valuable editions of separate works by S. de Lovenjoul, M. Bouteron, M. Allem, B. Guyon, M. Bardèche, P. Bertault, P. G. Castex, G. Robert and G. Matoré (conjointly), M. Regard, A. Adam and J. Pommier. *See* also the excellent anthology edited by J. Merlant: *Honoré de Balzac, morceaux choisis* (1912).

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See further S. C. Gould, "The Present State of Balzac Studies," *French Studies,* xii (1958). (S. C. GD.)

BALZAC, JEAN LOUIS GUEZ DE (*c.* 1597–1654), French man of letters, one of the original members of the Académie Française and a critic who exercised an important influence on the development of classical French prose. He belonged to a family called Guez (who had a house at Balzac near Angoulême) and was baptized on June 1, 1597. After studies at the University of Leiden (1615), some youthful adventures and a period in Rome (1620–22), he hoped for a political career and wrote in defense of Richelieu's administration. When he saw, however, that Richelieu would never satisfy him, he retired to his country house, to maintain relations with Parisian literary circles chiefly by correspondence. Elected to the Académie Française in 1634, he rarely attended its sessions. He died at Balzac on Feb. 18, 1654.

Balzac's publications include *Le Prince* (1631), a political treatise which shows a remarkable understanding of politics despite its pompous style; and *Le Socrate chrétien* (1652), which gives the conclusion of his ethical thinking, a synthesis of Stoicism and Christianity. Far more influential, however, were the *Lettres* (actually short political, moral and literary dissertations) in numerous editions, continually being expanded, from 1624.

Superficially, Balzac can be described as a baroque writer. He was strongly influenced by the moral philosophy of ancient Rome and so, inevitably, by Seneca's style, and he modeled his work on the collections of letters, in the baroque manner, which were then being published in Italy. The affectation and the subtleties of his style were deliberately contrived to take the reader by surprise, and he did in fact achieve by this means some unusual and remarkable effects. On the other hand, he fought against the influence of the 16th-century writers, recommended logical exactness and the precise use of terms and upheld the same linguistic principles as did his friends Chapelain and Vaugelas. His reputation was high in his lifetime, but declined quickly after his death. His friend Valentin Conrart edited his complete works (1665).

See A. Adam, *Histoire de la littérature française au XVIIe siècle,* vol. i and ii (1948–51). (AE. A.)

BAMAKO, the capital of Mali, is situated on the west bank of the Niger, between the river and the steep flank of the Mandingo plateau. It is one of the most picturesque towns of west Africa and an important commercial centre. Population (1960) 130,800. When occupied in 1880 by Capt. Joseph Gallieni, Bamako was a settlement of a few hundred inhabitants grouped in villages. It became the capital of the former French colony in 1908 and then assumed its present general layout. It is now a large town, with a huge market, a botanical and zoological park, institutions for research, many schools and an active artisan community. Its decorative gardens give it an air of freshness. The government headquarters is about 3 km. (1.9 mi.) distant on the Koulouba spur, the hospital on another spur and the European town between the railway station and the Niger. Of the old African quarters only that of Bozola remains, a "village" with winding lanes where fishers' nets are dried. New African quarters surround the town to east and west, with mud huts built on plots in chessboard or star formation, often surrounded by a wall enclosing a courtyard.

Bamako stands where the Dakar-Niger railway meets the river, which is navigable upstream as far as Kouroussa in Guinea but interrupted downstream by the Sotuba rapids. A bridge over the river was completed there in 1960. The town is also on international air routes. (J. D.)

BAMBARA (BANMANA), a Negro people who live in the upper Niger region of the Republic of Mali and speak a language of the Mandingo group. They numbered (1960s) about 1,000,000 and are sedentary agriculturalists who also own cattle. Those Bambara who are not cultivators are organized into endogamous castes of craftsmen. They live to a great extent intermingled with other tribes, and there is no centralized organization. Small districts made up of a number of villages are each under a dominant family which provides a chief, or *fama.* The succession is patrilineal, passing from senior to junior first through one, then through the next generation. The *fama* has considerable powers derived from his role as a representative of the original inhabitants of the district, and is involved mystically in agricultural operations. The Bambara are distinguished by their indigenous method of writing and they also have a remarkable system of metaphysics and cosmology, to which French anthropologists have paid much attention. The associated cults, prayers and myths play an important part in the life of the people. Sculpture in wood and metal is well developed and has religious bearings. Mid-20th-century changes include the introduction of peanuts, rice, and cotton as cash crops, and migration to larger towns of French origin. (I. C.)

The historical Bambara kingdoms of Segu (Ségou) and Beledugu were evolved under the direction of ruling lineages of mixed Fulani (*q.v.*) origin during the 17th century. Bambara homeland appears to have been in the country between the towns of Bougouni and Sikasso from which they expanded in a northeasterly direction. By the 12th century they were occupying the banks of the Niger between Bamako and Macina where they constituted the bulk of the peasantry under the then flourishing Mali empire.

Segu, always the more important kingdom, attained considerable power under Kaladian Kulubali (reigned *c.* 1652–82) who was able

to assert his independence of the Moorish governor of Jenné (Djenné) and is even said to have conducted a successful attack upon Tombouctou. After a decline the state was virtually recreated by a great warrior chief Mamari Kulubali (reigned *c.* 1712–55). He based an efficient military autocracy upon a large slave army, destroyed Sounsana (near Mourdiah), the capital of Beledugu, and imposed his suzerainty upon the Fulani of Macina. N'Golo Diara (reigned 1766–90), the founder of a new dynasty at Segu, extended his authority over Jenné and Tombouctou. Meanwhile the Massasi, the defeated ruling family of Beledugu, had withdrawn westward and established a relatively stable kingdom in Kaarta. In 1796 Mungo Park (*q.v.*) found a war in progress between Kaarta and Segu.

The Bambara kingdoms were finally overthrown by the *jehad* of the Tukulor marabout Omar el-Hadj who seized Kaarta in 1854 and Segu in 1861. Occupied by the French during their campaigns on the upper Niger (1876–90), the area was included in French West Africa until 1958 and thereafter formed successively part of the Republic of the Sudan within the Mali federation and part of the Republic of Mali (1960). *See* also MALI, REPUBLIC OF; MANDINGO; AFRICA: *Ethnography (Anthropology): West Africa.*

The mass of the Bambara agriculturalists have always been strongly attached to their traditional religion, a typically Sudanese animism in which hierarchical associations of initiates play an important role. Some confusion of tribal nomenclature arises from the fact that in local Muslim usage the term Bambara is often used to mean "pagan" and applied to any non-Muslim community.

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BAMBERG, a town in the *Land* of Bavaria, Germany, the chief town of the administrative district of upper Franconia, is built on seven hills in the wide valley of the Regnitz river, 2 mi. above its confluence with the Main, and 39 mi. N. of Nürnberg. Bamberg is also an archiepiscopal province. Pop. (1961) 74,115. It is first mentioned in 902, and the Babenberg family derives its name from it. A see was founded there in 1007 by the emperor Henry II, and from the middle of the 13th century the bishops were princes of the empire. In the Domplatz ("Cathedral square") is the medieval Imperial cathedral, containing many notable statues, the tomb of Henry II and his wife Kunigunde and a wooden altar carved by Veit Stoss. The bishop's palace, built between 1571 and 1576, lies to the west of the cathedral and houses a local history museum. To the north is the New palace, built between 1695 and 1704 and containing the splendid apartments of the prince-bishops and a collection of pictures; there is a beautiful rococo rose garden in the courtyard. On the hill above is the former Benedictine abbey with the baroque St. Michaelskirche and in the southern part of the town, on the Kaulberg, is the Carmelite church with Romanesque cloisters and the Gothic upper parish church. On the Altenberg to the southwest of the town is the chapel of the ancient *Schloss* ("castle") which contains the memorials to the counts of Babenberg and some interesting stained glass windows. Opposite the civic theatre is the Ernst Hoffmann house where the poet and composer lived from 1808–13. Industries include textiles and other clothing, shoes, fine porcelain, electrical equipment and beer. There is extensive market gardening.

BAMBERGER, LUDWIG (1823–1899), German economist and publicist and a leading authority on currency matters in Germany, was born of Jewish parents in Mainz on July 22, 1823. The Revolution of 1848 interrupted his studies in French law and he became a republican radical and a newspaper editor. He took part in the republican rising in the Palatinate in 1849, escaped to Switzerland and was in France when condemned to death *in absentia* in 1852. He worked as manager of the Paris branch of a London bank until 1866 when the amnesty enabled him to return to Germany. He had become an admirer of Bismarckian policy and dissociated himself from all democratic groups. In 1868 he was returned by Mainz to the *Zollparlament.* In 1870, at Bismarck's request, he participated in the Franco-German peace negotiations and in 1871 he became a member of the *Reichstag* as a National Liberal.

Bamberger obtained the standardization of the German coinage, the adoption of the gold standard and the establishment of the Reichsbank. An ardent free trader, he refused to follow Bismarck in his policy of protection, state socialism and colonial development after 1878, though he had supported him in his attempts to nationalize the railways and in his outlawing the Socialist party. In 1880 he left the National Liberal party and with his followers formed the so-called *Sezession.*

Thenceforth Bamberger belonged to the circle of the crown prince Frederick and his wife Victoria, being for years the trusted adviser of the princess. He left politics in 1892 but remained the recognized authority on currency, his most important disciple being Karl Helfferich. He died in Berlin on March 14, 1899. A five-volume edition of his works appeared between 1894 and 1898, *Bismarck Posthumus* in 1899, *Ausgewählte Reden und Aufsätze über Geld- und Bankwesen* in 1900 and his private diary, under the title *Bismarcks grosser Spiel,* in 1932.

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BAMBOO, any member of the Bambusoideae, a subfamily of the grasses (*q.v.*). The bamboos have age-old connections with fishing, papermaking, landscape gardening, handicrafts, the fine arts and even poetry.

General Importance and Use.—Bamboos minister to many material needs of oriental peoples, having long been creatively exploited in handcrafts. In heavily populated areas, bamboo is the one suitable material that is cheap and plentiful enough to supply the need for economical housing. Besides this, it provides the raw material for hundreds of objects in daily use in the home and in the pursuit of a livelihood. The young shoots are eaten as a vegetable everywhere in the orient; the living plants provide a decorative or protective hedge about homes or villages. Scholars, artists and epicures have celebrated the admirable qualities of bamboo in paintings and verse.

The suitability of bamboo tools and bamboo fibres for making paper was demonstrated many centuries ago by Chinese artisans. Fine papers of many varieties and adaptations can be made from bamboo pulps. *Bambusa vulgaris* and *Melocanna baccifera* rank high in performance, both in the mill and in the field, though most of the pulp manufactured from bamboo comes from other species —principally *Dendrocalamus strictus* and *Bambusa arundinacea*— because larger and more accessible natural stands of these species are available. Most of the bamboo pulp made in India is used for blending with weak (short-fibred) pulps from other sources to make wrappings and stationery. High-grade bamboo pulps can be used in the pure state for coated or uncoated book and magazine papers. Fibre with a high length-to-diameter ratio gives many bamboo pulps a special versatility.

Modern Uses.—New uses for bamboo products have been developed, and new significance found in old uses. Tabasheer, found within the culm (hollow aerial stem) internodes of many tropical bamboos, consists almost entirely of amorphous silica in a microscopically fine-grained state; it has excellent properties as a catalyst for certain chemical reactions. From the white powder abundantly produced on the outer surface of young culms of a Chinese bamboo, many substances have been isolated, among these being a crystalline compound related in chemical composition to the female sex hormone. Liquid diesel fuel has been prepared from bamboo culms by distillation. The enzymes nuclease and deaminase, in addition to an enzyme that dissolves fibrin and another capable of hydrolizing salicin, have been extracted from bamboo shoots. Glucuronic acid and L-xylose have been isolated in a crystalline state from the juice of bamboo shoots. An aqueous extract of bamboo shoots showed superiority over conventional media for the culture of certain pathogenic bacteria; this extract, when added to tuberculin, increased the intensity of responses to the skin test.

Dried mature bamboo leaves may be used for deodorizing fish oils, and in both the eastern and western hemispheres the foliage of many bamboos has long been used for forage. Improvement of the management of grazing range in the coastal plain of North Carolina, where a native bamboo is the principal source of browse for beef cattle, was the objective of a 14-year project in which three state agencies and three agencies of the U.S. department of agriculture collaborated with fruitful results.

Young shoots of many tropical species of bamboo contain lethal amounts of cyanogens. The digestive processes of herbivores destroy the poison, but in India cattle sometimes die when they are allowed to eat too freely of the toxic young shoots, of which they are very fond. Boiling readily drives off the volatile cyanogens, so there is no risk involved for man in eating the cooked shoots.

Morphological and Growth Characteristics.—Bamboos are set off from other grasses by the predominance of certain structural characters, many of which are considered to be "primitive." The most easily recognizable vegetative features of the bamboos are the woodiness and strong branching of the stems, the stalked leaf blades, and the marked dimorphism between the sheaths clothing young culm shoots and those borne on the leafy twigs. To these may be added such floral characters as well-developed scales at the base of the flower, usually three in number, and a pistil consisting of a more or less well-developed column, bearing one, two or three (rarely more) stigmas. No single character is diagnostic, however, and the boundary between bamboos and other grasses is not sharp.

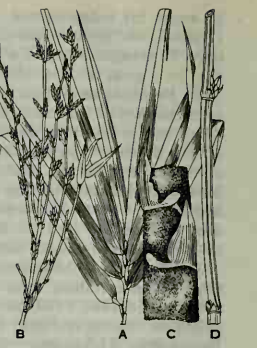
BY COURTESY OF U.S. DEPARTMENT OF AGRICULTURE

Moso bamboo (*Phyllostachys pubescens*), a hardy Chinese bamboo introduced at an early date in Japan, where it is cultivated extensively for its edible shoots and its useful culms. It is cultivated in Europe and the United States

Bamboos may be propagated by seed (though because of the rare occurrence of fruit, this method is seldom applicable), by division and by cuttings. They are described as hungry plants which well repay generous treatment. They will flourish in a rich, not too stiff loam, and for the first year or two should be well mulched. They should be sheltered from winds and well watered during the growing period. When being transplanted, the roots should be disturbed as little as possible.

Bamboos range in size from dwarfs a few inches high to giants with stems reaching 8 in. in diameter and 120 ft. in height; some are slender climbers with stems about an inch in diameter that often exceed 200 ft. in length. Most bamboos are thornless, but a few kinds have sharp spines consisting of specialized twigs or modified aerial roots.

Range.—Of uneven geographical distribution, bamboos appear more or less prominently in the natural vegetation of many parts of the tropical, subtropical and mild-temperate regions of the world, from sea level to the snow line. They are found in the greatest abundance and variety on the southeastern borders of Asia, from India to China and Japan. No native bamboos have been found in the vast Eurasian continent north and northwest of Tibet and China. The island of Madagascar is particularly rich in endemic species, having more known kinds than all of Africa. Two endemic species have been described from Australia. In the western hemisphere, the natural distribution of bamboos extends from southern United States to the southern end of Argentina and Chile. The geographical distribution has been greatly modified by human intervention, many natural stands having been more or less completely destroyed in clearing land for agriculture. The canebrakes of the United States have become extremely reduced in number and extent. *Guadua aculeata*, a giant species once abundant locally in several countries of Central America, has been almost completely eliminated by excessive harvesting of the culms for building purposes. On the other hand, an introduced species, *Bambusa vulgaris*, has been naturalized in large areas on the island of Jamaica, in the wake of a sort of migratory agriculture in which stakes freshly cut from culms of this bamboo, used to support yam vines, take root and produce thriving colonies. *Sinobambusa tootsik*, a Chinese bamboo once highly prized as a garden ornamental in Honolulu, has come to be regarded as a dangerous weed there, because it escaped from cultivation and now dominates many acres of once pure native vegetation. In Africa, Europe, the British Isles and the United States, introduced bamboos have found an important place as ornamentals and as a source of fishing poles, garden stakes and fencing, and materials for handicrafts and for interior trim and home decoration. Bamboo forests are effective stabilizers of soil and run-off. Many little-known but promising exotic species are confined to introductory gardens, where basic studies are performed to determine their usefulness in the local economy as potential sources of food, paper pulp, etc. (F. A. McC.)



COMMON BAMBOO (BAMBUSA VULGARIS) SHOWING THE VEGETATIVE AND FLOWERING PARTS TAKEN FROM THE VISIBLE PART OF THE PLANT
(A) Leafy twig, (B) flowering branch, (C) section of young shoot, (D) section of young culm showing internodes, nodes and branch buds

BAMBURGH, a coastal village of Northumberland, Eng., (pop. [1951] 407) lies 50 mi. N. of Newcastle upon Tyne by road. It has coast guard and lifeboat stations and is the head of one of the ancient "shires" of the county. The principal feature is the ancient castle, built above a 150-ft. cliff, formed by the Whin sill which there, as in the Farne Islands to the northeast, outcrops boldly. The fortress was founded in the 6th century by Ida (*q.v.*), the first king of the Bernicians, and is associated with St. Oswald of Northumbria (*q.v.*), "the fair-handed." It remained the principal fortress of the kings of Northumbria and later of the earls of Northumberland. Rebuilt after the Conquest, its Norman keep, surrounded by magnificent later walls and buildings, now much altered and restored, still dominates the scene. Defended by Henry VI and his tragic Queen Margaret, it became, heroically, the "last stay of the Red Rose in the North," and withstood a ruinous siege in 1464. The parish church is dedicated to St. Aidan (*q.v.*), who founded the original building and died in a small shelter attached to its west end in 651. In 1121 it became a monastery of Austin canons, dependent on Nostell priory; part of a fortified tower remains of this establishment. The village also had a leper hospital (1256–1376) and a Dominican priory (1265–1539) of which traces remain. Attempts were made in 1255 and 1332 to build up the village as a borough and considerable privileges were granted by royal patrons; but the lack of any commercial harbour and the ruin caused by Scottish raids and civil war brought these to nothing. The place is now chiefly remembered as the birth and burial place of Grace Darling (*q.v.*) and has a museum, belonging to the Royal National Lifeboat institution, with relics of her famous rescue. (Mi. G. C.)

BAMBUTI, the commonest name for the 35,000 pygmies of the Ituri forest, in the northeast Republic of the Congo (formerly the Belgian Congo). Also known as Twides, Aka (northern Ituri) or Efe (eastern), they are the purest race of pygmies in Africa, averaging under 4 ft. 6 in. Much lighter in colour than their Bantu and Sudanic neighbours, they also differ in blood type and other

physical characteristics, and are probably the earliest inhabitants of the area. Various pygmoid groups are found in other parts of the equatorial forests (*see* BATWA).

The Bambuti are nomadic hunters and gatherers living in small bands that vary in composition and size throughout the year, but which are generally patrilineal groups of from 10 to 25 individual families. The tropical rain forest provides all their basic needs; food, fresh water from innumerable streams and springs, firewood and clothing. Huts are made simply by forming a beehive-shaped frame of sticks covered with phrynium leaves. A camp is lived in for about a month and then abandoned.

Technology is limited to the necessities of a hunting and gathering economy. The Efe hunt with bow and arrow; elsewhere nets and spears are used.

There are no chiefs, not even any formal councils of elders; problems and disputes are settled by general discussion. The Bambuti believe in a benevolent forest deity, and important occasions, including the maturity of boys and girls, marriage and death, are marked by special songs designed "to rejoice the forest." The music is complex in rhythm and harmony, but visual art is virtually nonexistent. Music, dance and mime provide a means of reinforcing accepted values and form the basis of religious expression.

Marriage is by sister exchange. Few pygmies are polygynous, and family bonds are strong and lasting. The Bambuti show little concern with afterlife; the dead are buried in or near their hut and the camp is then abandoned.

There is a loose exchange relationship with neighbouring Bantu tribes, and an apparent adoption of some of their customs. Such acculturation is superficial, however, in spite of the use of a common language.

Archaeological evidence is lacking, but early Egyptian records show that the Bambuti were living in the same area 4,500 years ago.

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BAMFORD, SAMUEL (1788–1872), English radical reformer, who was the author of several widely popular poems (principally in the Lancashire dialect) showing sympathy with the condition of the working class, was born in the town of Middleton, Lancashire, on Feb. 28, 1788. He became a working weaver and earned great respect in northern radical circles as a reformer; but he was moderate in policy and jealous of rivals. He formed a Hampden club in Middleton in 1817 and met William Cobbett, Henry Hunt, William Benbow and Sir Francis Burdett. The same year, although he was an opponent of violence, he was arrested and imprisoned. In 1819 he was arrested again as a result of attending and speaking at the Manchester meeting known as Peterloo (*q.v.*) and was sentenced to 12 months imprisonment. Bamford lost some of his popularity when he left his trade and became a journalist in London (*c.* 1826). He was also disliked for his work as a special constable during the Chartist riots. But he continued to press for reform of working-class conditions, on which his *Passages in the Life of a Radical* (1840–44) and *Early Days* (1849) are very illuminating, although marred sometimes by personal prejudices. He died at Harpurhey, Lancashire, on April 13, 1872, and was accorded a public funeral, attended by thousands.

(A. BRI.)

BAMIAN, a town in the Parwan province of Afghanistan. The town lies about 80 mi. W.N.W. of Kabul in a valley of the Hazara country near the main road link between Kabul and the northern provinces of Mazar-i-Sharif, Kataghan, Badakhshan and Maimana. The valley is that of the Bamian river, lower known as Surkhab, which flows northward via Kunduz toward the Amu-Darya (Oxus). It lies north of the main ranges of the Koh-i-Baba, the western extensions of the Hindu Kush. The main road connection with Kabul is via the Shibar pass (9,800 ft.) and the town of Bamian is at 8,480 ft. Pop. (1962 est.) 42,182. It has a government hotel.

The early history of Bamian is obscure. It first appears in Chinese sources of the 6th century A.D., and was visited by the Chinese pilgrim Hsüan Tsang (*q.v.*) in the 7th century. In those days it was a great centre of Buddhism with more than 1,000 monks. The language, script and coinage differed but little from those of Turkistan. Then as now its chief glory lay in the hundreds of man-made caves cut into the cliffs north of the town, and the two great Buddha figures which have since excited the wonder of both Arab and European travelers. They too are carved from the living rock and finished with fine plaster. They probably date from the 6th–7th centuries, although formerly they were thought to be somewhat earlier. The larger figure is 175 ft. high, the lesser is 120 ft. In style they recall the Gandharan school of northwest India and north Indian work of the 5th–6th centuries generally. When Hsüan Tsang saw them they were glistening with gold and jewels. The caves are of various forms and many bear traces of fine fresco painting which links them with contemporary caves in Sinkiang. The modern town lies below the caves. To the south is the Muslim fortress of Shahr-i-Gulgula, largely dating from the 9th–12th centuries and destroyed by the Mongols. About 11 mi. E. of Bamian is the pre-Muslim fort of Shahr-i-Zohak. In the 7th century Bamian was ruled by princes probably of Hephthalite extraction (*see* HEPHTHALITES) but subject to the western Turks. Its princes first accepted Islam in the 8th century. It was invaded by the Saffarid ruler Yakub ibn Layth in 871, and its Buddhist idols were carried off to Baghdad. Later Bamian became subject to the Ghaznevids (*see* GHAZNI), and in the 12th century a branch of the Ghorid dynasty ruled there (*see* GHOR). In 1221 the town was sacked by Genghis (Jenghiz) Khan (*q.v.*) and its inhabitants exterminated. Since that time it has never regained its former glory.

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BAMILEKE, a name of uncertain origin for 90 west African peoples in the Bamileke region of the Republic of Cameroun, who share a common culture, which resembles that of the Tikar people. Their origin is uncertain, but it has been suggested that under pressure from the Fulani in the 17th century they moved southward in a series of migrations from the region now occupied by the Tikar proper. They number 500,000, of whom 455,000 inhabit the small, independent kingdoms within the Bamileke region. They do not refer to themselves as Bamileke, but use the names of the 90 kingdoms to which they belong.

Each of these states was ruled by a king (*Fon, Fong, Fo, Foeh*) whose position was hereditary within a localized patrilineal lineage. At least in Bafoussam subdivision, he was assisted by his queen mother (*Mafo*).

The Bamileke practise sedentary farming, with fallowing. Their staple crops are maize, taro and peanuts. Men clear the fields, build houses and engage in crafts, and women do most of the farming. They have a few livestock, but these and hunting play minor roles in their economy.

Their square houses have conical thatched roofs surmounting latticework walls made of raffia poles with the interstices filled with mud. Chiefs' houses are decorated with carved door frames and house posts. Brass casting is not reported, but in other respects their art resembles that of Tikar in content as well as style.

Ancestor worship is the dominant form of religion. The lineage head preserves the ancestral skulls and offers sacrifices to them. Charms and medicines are prepared by doctors (*nganga*) who also practise divination by interpreting the earth spider's manipulation of marked blades of grass. Some Bamileke have been converted to Islam, mainly in the north, and others to Christianity.

The Bamileke are enterprising people who have played an important role in the economic development of Cameroun. Since 1910

an estimated 45,000 have left their homes and settled as farm labourers, farmers and traders in areas toward the coast, and among the Bamum, Nyokon and Banen to the east and southeast.

See R. LeCoq, *Les Bamileke* (1953); F. C. Egerton, *African Majesty* (1939). (WI. B.)

BAMPTON, JOHN (1690?–1751), English divine who gave his name to one of Protestant Christendom's most distinguished lectureships, was educated at Trinity college, Oxford, M.A. in 1712 and became canon of Salisbury. He died on June 2, 1751. His will directs that eight lectures shall be delivered annually at Oxford in the university church on Sunday mornings in full term, "between the commencement of the last month in Lent term and the end of the third week in Act term." Since 1895 the Bampton lectures have been given every second year. Their importance may be gauged by the amount of controversy that has arisen over the Bampton lectures of various theologians—*e.g.,* Charles Gore's (*q.v.*) of 1891 on the incarnation, William R. Inge's of 1899 on mysticism, Hastings Rashdall's of 1919 on the atonement and R. H. Lightfoot's of 1934 on *History and Interpretation in the Gospels.* The "Sarum lectures" have been established to enable other than Anglican theologians to lecture; these are also supported by the Bampton fund. (J. J. PN.)

BAMUM (known also as MUM or MOM), a west African people numbering 75,000 who claim a common origin with the Tikar. Their kingdom, with its capital at Foumban in Cameroun, lies between the Bamileke on the south, the Tikar on the east and the many Tikar peoples of the Bamenda province on the west. It is ruled by the king (*Mfon*), whose position is hereditary within one of the exogamous patrilineal lineages, with the help of his queen mother (*Na*).

The first *Mfon,* Nchare, and his followers are believed to have come from Tikar territory over 250 years ago. Settling among the Bamileke and other Tikar, Nchare proclaimed himself king and established his palace at Foumban. The 11th *Mfon,* Mbuembue, was the first to enlarge the kingdom and, following an attack by the Fulani at the beginning of the 19th century, he fortified Foumban with a surrounding wall and ditch. The 17th *Mfon,* Njoya (1895–1923), became the most celebrated.

Familiar with writing in Arabic script from contact with Fulani and Hausa, Njoya invented a system of writing with 510 pictographic characters about 1895. This he revised six times, the seventh system being a syllabary of 73 characters plus 10 numerals. With the help of his scribes Njoya prepared a book on the history and customs of the Bamum which has been published in a French translation, a map of his country, a religious book and a book on medicine and local pharmacopoeia. In 1912 he established the first of 47 schools to teach reading and writing in his sixth script and in 1913 he commissioned a member of his court to prepare a printing press for it. In 1920, annoyed by his troubles with the French administration, which deposed him in 1923, Njoya destroyed the type, which had been cast by the lost-wax method, and closed his schools. Njoya was converted to Islam in 1918, and it is estimated that more than half of the Bamum are Muslims.

Njoya built a beautiful new palace, established what was really a museum, and was a patron of beadworkers, brass casters, weavers, dyers and other craftsmen. His palace contained 300 looms and six dye pits with different colours, some of which Njoya himself discovered. The arts for which the Tikar in general are noted flourished under his royal patronage.

Men do embroidery, weaving, leatherwork, wood carving, ivory carving, metalwork and blacksmithing, and women make pottery. Both men and women work the land. The Bamum are sedentary farmers who do some fishing but little hunting. Their principal crops are maize, millet, cassava and sweet potatoes.

They believe in a supreme god (*Njinyi, Nnui* or *Yorubang*) who creates children, and they practise ancestor worship. Bamum diviners interpret the manipulation of marked leaves by the earth spider (*ngame*).

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BAN, a title formerly used in Hungary to denote the governors of military districts known as banats and later used to designate the local representative of the Hungarian king in outlying possessions; *e.g.,* Bosnia (*see* BOSNIA-HERCEGOVINA) and Croatia (*q.v.*). (*See* also BANAT for the province specifically so named.) Ban is a Persian word meaning "lord" or "master" and was first introduced into Europe by the Avars (*q.v.*). The office and title were revived in the kingdom of Yugoslavia in Oct. 1929 when the country was divided in *banovine,* or provinces, but the German-Italian invasion of April 1941 did away with them.

BANANA. One of the world's most important fruits, the banana is consumed extensively throughout the tropics, where it is grown, and in the temperate zone, where it is popular because of its flavour, its food value and its availability at all times of the year.

Botany.—The plant is a gigantic herb, springing from an underground stem, or rhizome, to form a false trunk 10 to 20 ft. high, composed of the leaf sheaths and crowned with a rosette of 10 to 20 oblong to elliptic leaves which sometimes attain a length of 10 to 12 ft. and a breadth of 2 ft. The large flower spike, carrying numerous yellowish flowers in half-whorllike clusters, emerges at the top of the false trunk and bends downward to become the bunch of 50 to 150 individual fruits, or fingers, which are grouped in clusters, or hands, of 10 to 20. Once the plants have fruited they die, and are replaced by others (suckers) which arise from the underground stem. The life of one stool or clump thus continues for many years.

Bananas belong to the genus *Musa,* of the family Musaceae (*q.v.*), but the botany of the cultivated forms is confused. Tall-growing varieties of which the fruit is eaten uncooked are commonly listed as forms of *M. sapientum;* the dwarf or Cavendish variety as *M. cavendishii;* and the plantains or forms eaten only when cooked as *M. paradisiaca.* However, *M. paradisiaca* is viewed by some botanists as a subspecies of *M. sapientum,* while others hold the opposite to be the case. There has further been a tendency on the part of modern investigators to consider that many commercial bananas, including the all-important Gros Michel, are not derived from either of these, but wholly or in part from the species *M. acuminata.*

BY COURTESY OF UNITED FRUIT CO.

BANANAS (VARIETY GROS MICHEL) READY FOR HARVEST

There are 100 or more varieties of the banana in cultivation; confusion exists because of diverse names applied to one and the same variety in different parts of the world. As regards the origin and early history of this fruit, Alphonse de Candolle wrote (*Origin of Cultivated Plants* [1883]):

> The antiquity and wild character of the banana in Asia are incontestable facts. There are several Sanskrit names. The Greeks, Latins, and Arabs have mentioned it as a remarkable fruit tree. Pliny speaks of it distinctly. He says the Greeks of the expedition of Alexander saw it in India and he quotes the name *pala* which still persists in Malabar. Sages reposed beneath its shade and ate of its fruit. Hence the botanical name *Musa sapientum.* Musa is from the Arabic *mouz* or *mawoz,* which we find as early as the 13th century in Eba Baithar. . . . There is an immense number of varieties of the banana in the south of Asia, both on the islands and on the continent; the cultivation of these varieties dates in India, in China, and in the Archipelago from an epoch impossible to realize; it even spread formerly into the Islands of the Pacific and to the west coast of Africa; lastly, the varieties bore distinct names in the most separate Asiatic languages, such as Chinese, Sanskrit, and Malay. All this indicates great antiquity of culture, consequently a primitive existence in Asia, and a diffusion contemporary with or even anterior to that of the human race.

Cultivation.—Shortly after the discovery of America, the banana (an African name) was brought from the Canary Islands to the new world, where it was first established in Hispaniola, soon spreading to other islands and the mainland. Its cultiva-

tion increased until it became one of the staple foodstuffs in many regions; then in the 19th century it began to appear in the markets of the United States. Between 1870 and 1880 the present-day banana industry began to develop, mainly through the efforts of two men, Capt. Lorenzo D. Baker and Minor C. Keith.

Bananas thrive naturally on deep, loose, well-drained soils in humid tropical climates, but are grown successfully under irrigation in semiarid regions such as the south side of Jamaica. For the export trade they cannot profitably be cultivated where temperatures often fall below 50° F.; such temperatures result in "chilling" of the fruit, preventing its proper ripening; but for home use they are grown successfully in cooler regions, including the southernmost part of Florida. Suckers and divisions of the pseudobulb are used as planting material; the first crop ripens within 10 to 15 months, and thereafter production is more or less continuous. Frequent pruning is required to remove surplus growth and prevent crowding in the clump, or mat. Mechanical tillage is customary in semiarid regions, but in many countries this is not practised; weedy growth is controlled instead by the shade of the banana plants and through occasional cleaning with the machete. Nitrogenous fertilizers are often used to increase quantity and quality of production.

A good commercial bunch of bananas consists of nine hands or more and weighs from 50 to 125 lb. Three hundred or more such bunches may be produced annually on an acre of land, if the soil is good and cultural attention adequate. When ripe, the fruit contains as much as 22% of carbohydrate, mainly sugar; it is high in ash and a good source of several vitamins. Thus it is an unusually valuable source of human food.

Cooking varieties (plantains), which differ from other bananas in that the ripe fruit is starchy rather than sweet, are extensively cultivated and used in tropical regions, but rarely appear in the markets of the temperate zone.

Interesting features of the banana industry are the sudden and great changes that take place in production as the result of the opening up of new regions, the havoc wrought by floods and windstorms (to which the plant is peculiarly susceptible) and the ravages of Panama disease and of a few other pests.

The industry in the Caribbean is based largely on Gros Michel, which in terms of quantity and cash value of the crop is one of the world's most important fruit varieties. Its origin is almost certainly Asian; it is said to have been brought to the attention of horticulturists in tropical America by Jean Pouyat of Martinique. Jamaica was the first country to undertake its cultivation on an extensive scale; Costa Rica and Panamá were not far behind. In the Canary Islands, on the west coast of Africa and in Brazil the dwarf or Cavendish variety has been of greater commercial importance.

Beginning about 1925, great changes began to take place in banana agriculture, or horticulture as it should more properly be called, through the application of modern cultural practices in the Caribbean area. Careful examination of lands to eliminate unsuitable soils before planting, efficient drainage practices, the selection of proper planting material, overhead irrigation and, especially, the use of fungicides to control the Sigatoka disease (*Cercospora musae*) and other developments put the industry on an intensive basis.

The so-called Panama disease, caused by a fungus of the genus *Fusarium* (which lives in the soil), made necessary the abandonment of large areas from time to time, so far as the cultivation of the Gros Michel banana is concerned. This disease, however, does not affect the value of the land for the production of other crops.

Production.—After mid-20th century annual world exports of bananas were usually in excess of 3,000,000 tons. In 1958, for example, about 3,900,000 tons were exported. While the United States generally imports more bananas than any other country, large quantities also go to Great Britain and continental Europe, especially from the West Indies and the west coast of Africa.

Even for local consumption bananas are not left on the plant until fully ripe. For exportation, the degree of maturity they are allowed to attain before harvesting depends upon distance from market and type of transportation.

Specially designed refrigerated ships operate between numerous tropical countries and centres of consumption in North America and Europe.

Chief sources of production in Middle America include Costa Rica, Honduras, Guatemala, Mexico, Panamá and the Canal Zone, Dominican Republic, Guadeloupe, Jamaica and Martinique; in South America, Brazil, Colombia and Ecuador; in Africa, Canary Islands, Eritrea, the Cameroons region, Guinea and Nigeria and in Asia, Formosa. (W. Po.)

BANAS, the name of four rivers in India: (1) a river of Rajasthan which rises in the Aravalli range about 25 mi. N.W. of Udaipur and after a 330-mi. eastward course flows into the Chambal and so into the Jumna and eventually the Ganges; (2) another river, sometimes called the West Banas, rising in the Aravallis about 35 mi. W.N.W. of Udaipur on the opposite side of the watershed to (1) and flowing southwest across northern Bombay for 170 mi. to the Little Runn of Cutch; (3) a small river in Shahabad district, Bihar, forming the drainage channel between the Arrah canal and the Son canals system and finally falling into the Ganginadi; (4) a small river in Baghelkhand rising in northwestern Surguja district, Madhya Pradesh, and flowing northward to the Son, 15 mi. S.E. of Rewa city. (L. D. S.)

BANASKANTHA, the northernmost district of Gujarat state, India, is named after the Banas river which crosses it. Following Indian independence the district was formed from petty Muslim and Rajput principalities and *jagirs* ("feudal estates"). After boundary adjustments its area is 4,039 sq.mi.; pop. (1961) 995,980. Extending from the Runn of Cutch eastward to the Aravalli range, it is a sandy plain on the south of the Thar desert. One-sixth is barren, but parts are afforested and there are good pastures: millets and wheat are staple crops; maize, potatoes, timber, wool and handwoven cloth are produced for export from the district. There are also quarries for building stone. Communications are in general restricted to unimproved roads; but the district headquarters, Palanpur, the market town of Deesa (pop., 1951, 10,646) and a few other townships are on the Western railway. Palanpur (pop. 22,629) is 80 mi. N.N.W. of Ahmedabad. It is an ancient settlement, mentioned by Gujarat chroniclers as the home of Vanaraja, founder (A.D. 746) of the Chavada dynasty. (V. A. M. J.)

BANAT, a region of Europe lying across the modern frontiers of Hungary, Rumania and Yugoslavia, being bounded by Transylvania and Walachia in the east, by the Tisa river in the west, by the Mureş river in the north and by the Danube in the south. The name means frontier province or province governed by a ban (*q.v.*).

Largely an area of rolling plains, Banat is mountainous in the east with summits reaching from 4,000 to 7,500 ft. Its main rivers are the Timiş (Tamis), the Bega (Begej), the Caraş (Karas) and the Nera. Cattle, horses, sheep and pigs are reared. The main crops are wheat, maize, sugar beet and tobacco. There are also flourishing vineyards and some mineral deposits (coal at Anina, iron ore, zinc and petroleum at Kikinda). The main railway line Belgrade-Timişoara-Bucharest crosses the province.

Banat has been inhabited since prehistoric times and there are Paleolithic remains near Vrsac. The most important discoveries of the Neolithic period are at Starcevo, Srpski Krstur, Novi Knezevac and Crna Bara. Cemeteries with urns have been discovered at Vrsac and Ilandza. There are findings of the Bronze Age at Vatin and Dubovac (Dubova). Under the Romans Banat was either in Moesia Superior or in Dacia. Later the Goths invaded the province and after them there came the Gepidae, the Huns and the Avars. The Slavs began to establish themselves there in the 5th century.

Banat was occupied by the Magyars at the end of the 9th century. In 1233 the Hungarian king Andrew II created the Banat of Severin (Terra de Zevrino) and entrusted its defense to the knights of the Order of St. John of Jerusalem. After the battle of Kosovo (1389) and especially after the occupation of Serbia by the Turks (1459) a large number of Serbs immigrated into Banat. At the beginning of the 16th century four Serb bishoprics were

organized in Banat, and the Serb monasteries Bezdin, Mesic and Hodos were built.

Led by the grand vizier Mohammed Pasha Sokollu (Sokolovic), the Turks conquered the greater part of Banat in autumn 1551. The following summer they took Timişoara (Temesvár), which became the seat of the *il*. In 1594 the Serbs revolted against the Turks, but were suppressed with much bloodshed.

By the peace of Passarowitz (1718) Austria gained Banat and formed the Temeser Banat or Banat of Temesvár under a *Generalkommandant* with his seat at Timişoara. Later the military government in northern Banat was replaced by a civil administration. Maria Theresa and Joseph II brought colonists from the Rhineland, from Lorraine and from Luxembourg into Banat. In 1779 Banat was incorporated into Hungary. After the Hungarian revolution of 1848 Banat was in 1849 detached from Hungary and joined with Srem and Backa to form a "Serbian Vojvodina" (still under Austria), but this unit was abolished in 1860, and under the Austro-Hungarian compromise of 1867 Banat was again incorporated into Hungary. By this time the population of the province had become ethnically mixed. In 1919 its estimated total of 1,582,000 was 40% Rumanian, 20% Serb, 23% German and 14% Hungarian.

At the Paris peace conference of 1919, Rumania claimed the whole Banat, as promised to Rumania by the Allies during World War I in the secret treaty of Aug. 17, 1916. This clashed with Serbian ethnic and historic aspirations, and the treaty of Trianon (June 4, 1920) between Hungary and the Allies divided Banat into three unequal parts. Rumania obtained the eastern area (7,143 sq. mi.); the kingdom of Serbs, Croats and Slovenes, later to be called Yugoslavia, obtained the western part (3,591 sq.mi.); and the district of Szeged was left to Hungary.

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(M. A. P.)

BANBRIDGE, an urban district and market town on the Bann river, County Down, N.Ire., 24 mi. S.W. of Belfast by road. Pop. (1961) 6,115. Area 1.2 sq.mi. To flatten the summit of a steep hill in the main street, the roadway was brought through a cutting 200 yd. long and 15 ft. deep, the terraces on either side being connected by a bridge. All branches of the linen industry are carried on in Banbridge; there is also a considerable manufacture of lighter types of footwear. Banbridge serves as market centre for a wide area of agricultural countryside. (Hu. S.)

BANBURY, a municipal borough in Oxfordshire, Eng., lies on the river Cherwell, 23 mi. N. of Oxford by road or rail. Pop. (1961) 20,996. Area 8 sq.mi. Banbury is the centre of a rich agricultural district and its cattle market is one of the biggest in England, about 420,000 animals being sold annually. Besides a large aluminum works there are factories for agricultural machinery, electrical apparatus, furniture, fabricated and constructional steelwork and surgical supports. A big new industrial estate was developed during the early 1960s. Commerce markets are still held biweekly in the open, and a fair in October. For centuries Banbury was noted for its ale, cheese and cakes. Although beer is still brewed locally, it is the Banbury cakes—a spiced currant pastry—for which the town is chiefly noted. Part of the original cake shop dates from the 16th century and there are some fine timbered and stone houses. The present church replaces a magnificent Gothic one destroyed as unsafe in 1790.

A great battle is said to have been fought at Banbury in 556 between Cynric and Ceawlin and the Britons. Banbury was in the hands of the bishop of Dorchester for about four centuries and then belonged to the bishop of Lincoln from 1073 until the Reformation. Its first charter was granted in 1554 and the offices of high steward and recorder established by the charter of 1608 are still in existence. The original Banbury cross, celebrated in the nursery rhyme beginning "Ride a cockhorse to Banbury cross," was destroyed in 1602 by the zealous Puritans who were frequently satirized by contemporary dramatists, but was replaced in 1859. Banbury castle, built in 1125, was twice besieged by parliamentarians during the Civil War and afterward demolished. Broughton castle (14th–16th century), 2½ mi. S.W., the present seat of Lord Saye and Sele, was used by the parliamentary party, and the battle of Edgehill (1642) was fought 8 mi. N.W. of Banbury. Sulgrave manor, the early home of George Washington's ancestors, lies 8 mi. N.E. (*see* SULGRAVE MANOR). (F. G. E. B.)

BANCA D'ITALIA, the sole bank of issue of the republic of Italy. It was established in 1893 as a joint-stock company by the merging of two Tuscan banks with the National Bank of the Kingdom. The Banca d'Italia became the sole note-issuing bank in 1926, after the right of issue had been taken from the Bank of Naples (Banco di Napoli) and the Bank of Sicily (Banco di Sicilia). In 1936 it was made a public credit institution.

The statute of the bank is approved by decree of the president of the republic. Its capital may be held only by credit and by insurance bodies. Its powers are exercised (1) by an assembly of the shareholders; (2) by its supreme council; (3) by a committee of this council; and (4) by the governor, the director-general and the vice-director-general. Supervision of the bank's work lies with the treasury, in conjunction with a commission of supervision comprising members of parliament and government officials under the presidency of the head of the treasury.

The bank's business is principally with discounting bills up to four months (for the account only of credit concerns) and with advances up to six months. It accepts interest-free deposits from private persons and interest-bearing deposits from the credit and insurance institutions. The rate of interest is fixed by ministerial decree.

Until 1928 there was a ceiling for the issue of bank notes and a compulsory minimum for the reserve in gold or the equivalent amounting to 40% of the circulation; but in that year the limit on the issue was abolished, and in 1935 the reserve of 40% was suspended. The note circulation is therefore not limited, nor is it linked to a definite reserve; but the quantity, the design, the denominations and the particular features of the notes to be printed are laid down by ministerial decree. In Jan. 1960, the money possessed by the Banca d'Italia and estimated on the same basis as 1936 was revalued at the new value of the lira; the resulting balance of 627,000,000,000 lire was, as on preceding occasions, assigned to the state treasury and allotted to the paying-off of part of its debt to the Banca d'Italia. For the lira, *see* ITALY: *Finance*. In order to regulate the volume of credit, the bank exercises control over the work of credit institutions and authorizes the issue of negotiable securities, under the direction of an interministerial committee for credit and saving. Authorization must be obtained from the bank before credit institutions can be established and before they can open branches; permission must also be obtained if loans are made exceeding one-fifth of the resources of the banks concerned. Their accounts are subject to scrutiny, and periodical inspections are made. The credit institutions (other than the savings banks and the rural banks) must place reserves with the Banca d'Italia either in treasury bonds or in cash amounting to 25% of their deposits. Beginning in Sept. 1958, even the savings banks were obliged to form a reserve equal to 20% of the increments from their deposits. Interest is paid on these reserves. The chief instruments of enforcement of the credit policy of the bank are: the compulsory reserves brought into force in Sept. 1947; the submission to the bank of applications for authority to grant credits for all amounts in excess of a prescribed figure; and the power to accept or refuse bills for rediscount, and advances.

As far as the market is concerned, credit institutions must obtain the bank's authorization before increasing their capital. Its permission must also be obtained by the special credit bodies before issuing medium- and long-term bonds (except those secured against land). Also, all issues of negotiable securities, whether to be placed with credit concerns or to be quoted on the stock exchange, require the bank's authorization. The authority of the Banca d'Italia is separate from that of the treasury for the floating of companies, for the increase of cash capital and for the issue of debentures whenever the amount exceeds 500,000,000 lire.

The control of exchange is effected through the banks by the Italian Exchange Control bureau, over which the governor of the Banca d'Italia presides. The bank not only endowed this bureau

with funds but also provides it with the means for its operations.

Finally, the bank administers the clearinghouses and acts as treasurer for the account of the state. In this latter capacity it may make advances to the treasury of up to 15% of the expenditure provided for in the budget. (La. R.)

BANCHIERI, ADRIANO (1567–1634), Italian composer of much sacred and secular music, most famous for his madrigal-comedies. He was also an organist, musical theorist and poet. Born at Bologna in 1567, he spent almost his whole life at the monastery of S. Michele in Bosco near Bologna, becoming abbot in 1620. He was also prominent in Bolognese academies. His numerous madrigal-comedies are second in importance only to those of Orazio Vecchi. *Il festino nella sera del giovedì grasso avanti cena* (1608; mod. Eng. ed., *The Animals Improvise Counterpoint,* 1937) contains some delightful characterization. Although he used the *basso continuo* (*see* Thorough Bass), the style of his music is on the whole backward looking. He died at Bologna in 1634. (N. Fo.)

BANCROFT, GEORGE (1800–1891), U.S. historian, politician and diplomat who wrote a ten-volume *History of the United States,* was born in Worcester, Mass., on Oct. 3, 1800. His father, Aaron Bancroft, was a distinguished Congregational clergyman, author of a *Life of Washington* and one of the founders of the American Unitarian association. George Bancroft was educated at Phillips Exeter academy, Exeter, N.H., and at Harvard university, where he prepared for the ministry. In 1818 he gained a Harvard scholarship to the universities of Göttingen, Heidelberg and Berlin in Germany. He received the Ph.D. degree in history from Göttingen in 1820, and on his return to Harvard in 1822 became tutor in Greek. In 1823 he joined Joseph Green Cogswell in establishing Round Hill school for boys at Northampton, Mass. At Round Hill he became increasingly interested in German poetry and philosophy, writing articles and translations for the *North American Review* and the *American Quarterly Review.*

Bancroft severed connections with Round Hill in 1831. Although a member of a Federalist-Whig family, he began his political activities in the Workingmen's and Anti-Masonic parties in Massachusetts, running unsuccessfully in 1834 as Anti-Masonic candidate for general court. After this he joined the Democratic party and became an influential figure in its inner circles. After Martin Van Buren's election as president of the U.S. in 1836, Bancroft was appointed collector of the port of Boston, an important patronage post. Two of his appointees were Orestes Brownson and Nathaniel Hawthorne. He lost his collectorship in the Whig victory of 1840 and with it much of his influence in the Massachusetts Democratic party. In 1845, with the assistance of Van Buren, he entered Polk's cabinet as secretary of the navy, serving until late 1846. During his brief period in the cabinet he favoured the extension of the Naval academy at Annapolis, Md.; issued the directive that led to the occupation of California; and as acting secretary of war, sent Gen. Zachary Taylor into the disputed territory between Texas and Mexico, thus precipitating the Mexican War. Bancroft in 1846 asked for and received appointment as minister to England, where he remained until 1849.

On his return to the U.S., Bancroft took up residence in New York city and resumed work on his *History of the United States,* the first volume of which had appeared in 1834, the second in 1837 and the third in 1840. In evolving his theory of history, Bancroft derived much from the nationalistic German school of historians. In his view the office of the historian was twofold: first, to examine the past as a record of man's attempts to perceive and act upon divinely inspired concepts of truth, morality, beauty, justice and freedom; second, to find in the past evidences of man's progress, and to recognize and explain the significance of God's plan for the liberation of the human race. He believed the political and social system of the U.S. represented the highest point yet reached in mankind's quest for the perfect state. Bancroft placed great emphasis on the use of original sources, building a vast personal collection of documents and hiring copyists to transcribe materials from archives in Great Britain, France, Spain and the Netherlands. Only in his failure to make full use of newspapers, periodicals and journals did he fail to approximate modern research methods.

Though one critic complained that the early volumes of the history "voted for Jackson," they sold well and Bancroft's reputation as the leading U.S. historian was firmly established by 1850. Volumes iv and v appeared in 1852, vi in 1854 and vii and viii in 1858 and 1860, carrying his narrative to 1776. With the rise of the slavery and secession controversy and the outbreak of the American Civil War, he gave less time to historical writing and more to support of the Republican party and Lincoln, although he never entered actively into the antislavery or other reform movements. During the war he spoke and wrote for the Union cause, and published volume ix of the history in 1866. Bancroft supported Andrew Johnson, and was appointed minister to Prussia in 1867. During the Franco-German War he followed a consistently pro-German policy, and in 1871, on its conclusion, became minister to the German empire. He was responsible for the successful settlement of the Oregon boundary dispute between the U.S. and Great Britain, which was arbitrated before the emperor of Germany in 1872, and he negotiated important naturalization and trade treaties with Germany.

The tenth and final volume of the history, covering the last year of the American Revolution, appeared shortly after his return to the United States in 1874, and Bancroft immediately began preparing a revision for the centenary edition, which appeared in 1876. By removing digressions and pruning his style, he reduced the original ten volumes to six, although his approach to American history remained unchanged. A two-volume study, *The History of the Formation of the Federal Constitution,* was published in 1882, and in 1886 he combined it with the centenary edition to form the author's last revision in six volumes. He also published a pamphlet on the paper money controversy in congress in 1884 and a life of Martin Van Buren in 1889, and he contributed several historical sketches to the *New York Ledger.* He died in Washington, D.C., on Jan. 17, 1891.

Though Bancroft's career as politician and diplomat deserves recognition, it was as the pioneer historian of the U.S. that he wished to be judged. With a few exceptions, historians before him had been collectors or annalists, concerned chiefly with state or Revolutionary War histories. Bancroft was the first to plan a comprehensive study of U.S. history from its beginning, a task that eventually required 40 years to complete. He approached history as a philosopher, molding it to fit his preconceived thesis, which rested on a deeply held, intuitive faith in mankind's perfectibility. He neglected economic and social factors in historical development in favour of political, military and religious viewpoints. However, he was one of the first to recognize the importance of the colonial period, of foreign relations and of the frontier as factors in U.S. history.

See M. A. de Wolfe Howe, *The Life and Letters of George Bancroft,* 2 vol. (1908); Russel B. Nye, *George Bancroft: Brahmin Rebel* (1944). (R. B. N.)

BANCROFT, HUBERT HOWE (1832–1918), U.S. historian of western North America, was born in Granville, O., May 5, 1832. He arrived in California in 1852 and in 1856 opened a bookstore in San Francisco which became the largest bookselling and publishing house west of Chicago. In 1859 he began to collect California materials, soon expanding his interest to include all of western America from Panamá to Alaska. This was the nucleus of the 60,000 volume library he sold and in part gave to the University of California in 1905.

In the 1860s utilizing his own holdings, he began a comprehensive and exhaustive history of the area of his collecting. His *Native Races of the Pacific States* (5 vol., 1874–75) was followed by 34 volumes of history (1882–90), including *Chronicles of the Builders* (8 vol., 1891–92), *Book of the Fair* (5 vol., 1893), *Book of Wealth* (10 vol., 1896–1908), and half a dozen miscellaneous volumes (1887–1917). Acting as his own publisher he sold his books by subscription, marketing about 250,000.

For his ambitious task as historian Bancroft employed numerous assistants, all but one of them as inexperienced as he was in research and writing. He put them to work indexing his library, taking notes, writing drafts, and whenever possible producing copy

for the printer. His own writing, revising and supervising gave the volumes essential unity of design and execution. But he made the great mistake of not explicitly identifying his helpers and their contributions. His works took and held rank as the basic reference on the history of the United States and his library as its principal research centre. He died in Walnut Creek, Calif., March 2, 1918.

See his own *Literary Industries* (1890) and *Retrospection, Political and Personal* (1912); W. A. Morris, "The Origin and Authorship of the Bancroft Pacific States Publications," *Oregon Historical Quarterly*, vol. iv, pp. 287–364 (1903); John W. Caughey, "Hubert Howe Bancroft," *American Historical Review*, 1:461–470 (1945), *Hubert Howe Bancroft, Historian of the West* (1946). (J. W. CA.)

BANCROFT, RICHARD (1544–1610), archbishop of Canterbury, noted for his anti-Puritan zeal, was born in Sept. 1544 at Farnworth, Lancashire, and educated at Christ's college, Cambridge. He received important preferments—his great-uncle was archbishop of Dublin—and was chaplain successively to the vice-chamberlain Christopher Hatton and Archbishop Whitgift. He was appointed in 1587 as a member of the high commission, and among the more noteworthy cases which he directed were proceedings against "Martin Marprelate" (*see* MARPRELATE CONTROVERSY), Thomas Cartwright and his friends and John Penry. Bancroft's scathing sermon against the Puritans preached at Paul's Cross on Feb. 9, 1589, brought him into prominence. In June 1597 he was consecrated bishop of London, and in consequence of the advanced age of Whitgift was virtually invested with the power of primate. In 1600 he headed a diplomatic mission to Denmark. He took a prominent part in the famous conference of prelates and Presbyterian leaders held at Hampton Court in 1604, and in the framing and passing by convocation of the canons of that year. By his orders Puritan ministers were required to conform to these canons or suffer deprivation. In March 1604 Bancroft, on Whitgift's death, was appointed president of convocation, and in Nov. 1604 he was elected to the see of Canterbury. In 1608 he became chancellor of Oxford university. Bancroft was "chief overseer" of the Authorized Version of the Bible. One of his last acts was to assist in the re-establishment of episcopacy in Scotland. He died in London on Nov. 2, 1610.

See R. G. Usher, *The Reconstruction of the English Church*, 2 vol. (1910); A. Peel (ed.), *Tracts Ascribed to Richard Bancroft* (1953). (G. HU.)

BANCROFT, SIR SQUIRE (1841–1926), English actor and manager, who did much to build the tradition of the modern theatre, was born in London on May 14, 1841. He first appeared in Birmingham in 1861 and played in the provinces for several years. His first London appearance was in 1865, in *A Winning Hazard* at the Prince of Wales's theatre under the management of Marie Effie Wilton (b. 1839) whom he married in 1867. At the old Prince of Wales's theatre (now Scala) the Bancrofts produced all the better-known comedies of Thomas William Robertson—*Society* (1865), *Ours* (1866), *Caste* (1867), *Play* (1868), *School* (1869), *M.P.* (1870)—and caused a revolution in theatrical production, sweeping away the old crude methods of writing and staging. Later, at the same theatre, they produced new plays and revivals, such as Edward Lytton's *Money*, Dion Boucicault's *London Assurance* and an adaptation of V. Sardou's *Théodora*, entitled *Diplomacy*. In 1880 they moved to the Haymarket theatre and continued a brilliant career until their retirement in 1885. Bancroft joined Henry Irving in 1889 to play Latour in a revival of *The Dead Heart*. Lady Bancroft died in 1921, Sir Squire Bancroft (he was knighted in 1897) in London on April 19, 1926. Bancroft was a good, polished actor but never a great one, his wife being the more talented. But their management was outstanding, and it was his policy and judgment which directed it. The Bancrofts also gave a start to many actors and actresses who subsequently became famous.

See *Mr. and Mrs. Bancroft, on and off the Stage* (1888) and *The Bancrofts: Recollections of Sixty Years* (1909), by themselves; also *Empty Chairs* (1925), a volume of reminiscences, by Sir Squire Bancroft. (W. J. M.-P.)

BAND, a term used in music to describe a group of instruments played together. The instruments are generally of one family or type and in the United States the term has been restricted more specifically to groups of wind instruments. Colloquially it may be synonymous with orchestra.

Derived from the French *bande* ("group"), the term was first applied in England to the "king's band" of 24 violins at the court of Charles II. This was modeled on Louis XIV's group of violins, a development of the practice of employing musicians at court and in noble households that was widespread throughout Europe in the 16th and 17th centuries. The string band remained popular, and composers from Bach and Handel to Benjamin Britten wrote music for small groups of stringed instruments. The string band is also a feature of 20th-century musical life.

The term has also been more generally applied to wind bands, especially military bands and brass and silver bands, and to jazz bands and percussion bands.

The formation of wind bands began in Germany, where military bands, later consisting chiefly of oboes and bassoons, developed from the 15th century onward. German musicians joined foreign groups and the wind bands spread to England via France. In the 18th century a variety of percussion instruments, known as "Turkish music" (cymbals, triangles, the military glockenspiel and the crescent), was introduced, and at this period, too, Negro drummers appeared in European bands, brandishing their drumsticks in the manner of the later drum major. By the end of the 19th century the number of wind instruments had greatly increased, and the marches of Haydn written for the Derbyshire yeomanry were scored for trumpet, two horns, two clarinets, two bassoons and serpent. In Berlin, in 1838, 1,000 wind instruments and 200 drummers were assembled by the organizer of Prussian military music to perform in honour of the Russian emperor. In England the standard of playing was raised when instruction was begun in military music at Kneller hall, Twickenham, London, in 1857. In the United States both P. S. Gilmore (*q.v.*), bandmaster during the Civil War, and J. P. Sousa (*q.v.*), leader of the U.S. marine band, developed the standard of military bands to a virtuoso level and undertook tours in Europe. (*See* MILITARY MUSIC.)

Wind band is the name given to a small group of brass and woodwind instruments used by composers in works destined for concert performance. Serenades for wind band were written by Mozart and, in modern times, by Hindemith and Schönberg. The Italian word *banda* signifies the brass band on the stage or, in opera, behind the scenes, notably in Berlioz' *Requiem* and in Verdi's *Rigoletto* and *La Traviata*.

In England the brass band, sometimes called silver band when the instruments are made of an alloy, began to replace the earlier bands of the town "waits" and of the village churches at the end of the 18th century, when their formation was encouraged particularly by employers in industrial areas. The development of the cornopean, a predecessor of the cornet, and of a family of brass instruments, invented by Adolphe Sax (*q.v.*), on all of which the fingering was similar, made the adoption of these instruments by amateurs a possibility. Among the earliest of these bands was the Stalybridge Old band (1814) and the famous Besses o' the Barn, an all-brass band by 1853. The movement attained national popularity with the institution of contests, notably at Bellevue, Manchester and the Alexandra palace, London. After the first National Brass Band festival (1900), a high standard of playing by bands representing towns, factories, the Salvation army and numerous other religious and social bodies was maintained and composers such as Sullivan, Ireland, Elgar and Holst wrote works for brass band, usually scored for cornets, flugelhorns, horns, baritones in B flat, euphoniums and basses. The brass band also has a wide popularity in the United States.

In schools the percussion band is a term used for a children's orchestra of percussion instruments, its purpose being to develop a sense of rhythm. Britten introduced a children's percussion band in his setting of the Chester miracle play *Noye's Fludde*. Dance bands or jazz bands originated in the U.S. at the end of the 19th century and assumed a large variety of forms (*see* JAZZ).

See J. F. Russell and J. H. Elliot, *The Brass Band Movement* (1936).

BANDA, a town and headquarters of a district of the same name in Uttar Pradesh, India. The town (pop. 1961, 37,744) is

situated 95 mi. W. of Allahabad on the right bank of the Ken river, a tributary of the Jumna. It is accessible by road from Allahabad and is a market town and cotton mart, and well known for its moss agates, which are exported throughout the world.

BANDA DISTRICT (pop. [1961] 954,642) has an area of 2,950 sq.mi. and lies between the Jumna on the north and the escarpment of the Vindhya hills on the south. Most of the population is engaged in agriculture, cultivating the richer alluvial soil of the plains, and pasturing cattle and other animals on the hills. The crops grown include cotton, oilseeds, millet, rice, pulses and other food grains.

Banda and the neighbouring fort of Kalinjar (*q.v.*) changed hands many times in the wars between the Muslims, Marathas, French and British, as they command the northern end of one of the main routes from the Ganges-Jumna Doab across the hills of central India to the Deccan. The road leading south from Banda is no longer maintained, and Banda has declined as a centre of trade. Chitrakuta hill, 35 mi. E. of Banda, near the town of Karwi, is a famous place of pilgrimage connected with the Ramayana story. The district is also rich in remains of the Stone Age.

(M. N. K.)

BANDAGES AND BANDAGING. A bandage is a strip or piece of woven material used to bind up wounds. Its general use is to retain dressings or splints in position; to give support to a part of the body; and to exert pressure to stop or prevent bleeding.

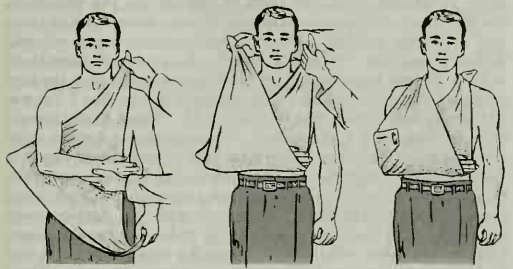

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FIG. 1.—TRIANGULAR BANDAGE AS ARM SLING

Triangle is tied behind neck at side of spine and pinned at elbow. In injury of forearm, the hand is elevated slightly above level of elbow

There are four kinds of bandages: the triangle, roller or pleated gauze, four-tailed and many-tailed. In medical usage each method of bandage application is given a distinctive name. For example, a roller bandage applied in spiral form to cover each finger and the hand is called a gauntlet.

The triangle is the most useful bandage for emergencies as it fulfills every need in bandaging: it is easily made, is easy to apply, will stay on, will cover any part of the body, and little danger of injury to flesh or blood vessels results from its application. The triangle bandage is usually made by cutting diagonally muslin or gauze 36 to 40 in. square. As an open triangle it is used as a sling for the arm, as a bandage to cover the head, the hand or the foot. It is folded to make various widths in order to adapt it best for use on the various parts of the body. When folded repeatedly it becomes a cravat bandage, in which form it may be used for a sling or to cover the palm of the hand, the eyes or the ears. When made of surgical gauze and kept sterile it is suitable to use directly on a wound the same as any surgical dressing, either with or without the addition of solutions or ointments. The cotton or muslin bandage is stronger than the gauze and therefore more suitable for the application of pressure or to give support.

Another common type of bandage is the roller bandage, from 1 to 5 in. or more in width, averaging 10 yd. in length and rolled longitudinally. It is usually applied spirally. The material of this bandage is usually muslin, flannel, gauze or cheesecloth, gauze or cheesecloth being preferred for elasticity. The four-tailed bandage, for which 5 to 8 in. wide by 2 to 3 ft. long is a representa-

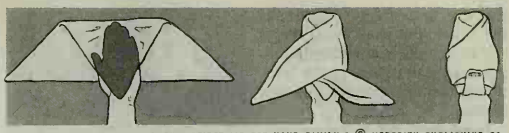

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FIG. 2.—TRIANGULAR BANDAGE FOR HAND OR FOOT

Hand is placed injured side up, bandage is folded back, ends crossed around wrist and pinned

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FIG. 3.—HEAD BANDAGES

(A) Triangular bandage for scalp or forehead: hem is folded along edge, the two ends crossed at base of skull and tied over forehead. The point is turned up and pinned. (B) Cravat bandage to hold compress on wound of head or to protect eye

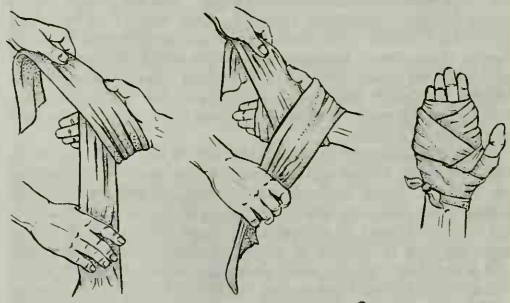

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FIG. 4.—CRAVAT BANDAGE FOR INJURED PALM

Cravat is wrapped around hand, leaving thumb out. Lower end is carried back of hand and around base of thumb. Remaining ends are wrapped around hand and tied

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FIG. 5.—ROLLER OR SPIRAL BANDAGES

(A) Spiral is begun on small part of injured limb and wrapped as far up as needed. (B) End of gauze is anchored at wrist and spiral wrapped down finger, back to wrist and tied

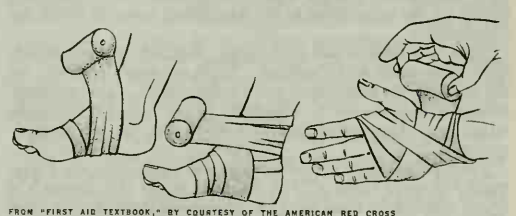

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FIG. 6.—FIGURE-EIGHT BANDAGE FOR ANKLE OR WRIST

Bandage is anchored with several turns around instep (or palm), carried diagonally upward around ankle (or wrist), and downward around foot (or hand)

tive size, is useful for injuries of the lower jaw and head, elbow and knee. The many-tailed bandage is an elaboration of the four-tailed bandage and its uses are similar.

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FIG. 7.—FOUR-TAILED BANDAGE FOR WOUNDS OF CHIN OR NOSE

Bandage is centred over dressing and upper tails carried downward, lower tails upward

Bandages applied to meet various needs and positions of the body have special names. Among them are: Johannes Esmarch's figure-eight bandage, in which the turns cross each other like a figure 8; the circular bandage applied to a part in circular turns; the gauntlet and demigauntlet hand bandages; Desault's bandage for a fractured clavicle; the oblique, pressure, suspensory, reversed, spiral and spiral reverse bandages; the T-bandage; the Spica, which is a spiral folded regularly on itself like the letter V for use at the junction of a limb to the body. Some bandages are made of special materials to meet specific needs; *e.g.*, the roller bandage of crinoline filled with plaster of Paris or splints; starch, silica and dextrin bandages for stiff and immobile dressings; the rubber bandage for flexible support as in varicose veins; and numerous other highly specialized bandages. (W. R. R.)

BANDA ISLANDS, in the Banda sea, Indon., lie 130 mi. S.E. of Amboina and 66 mi. S. of Ceram. The ten islands, which are in Maluku (Moluccas) province, cover only 72 sq.mi. Pop. (1956 est.) 13,686. The three largest are Bandalontar or Great Banda (6 mi. long), Bandanaira and Gunungapi, grouped around an inland sea which forms Banda harbour; Bandalontar, sickle-shaped, lies south and east, Bandanaira to the north, with Gunungapi to the west. Undoubtedly these three islands form part of the rim of a crater.

West and southwest of Gunungapi are Ai and Run, and north and northwest, Pisang and Suwangi. Channels on either side in the south of Banda harbour enable vessels to enter with safety during either monsoon, while a northern passage, between Gunungapi and Bandanaira, is navigable for small vessels. Bandalontar has coral rock to a height of 400 ft., with lava and basalt above, and is certainly volcanic, while Gunungapi (2,152 ft.) is an active volcano which caused destruction in 1820 and 1852. It is covered with bushes to within 700 ft. of the summit, which exhibits various shallow and extinct crater basins and a hot, smoking plain, sending forth sulfurous vapours and covered with split lava blocks. The volcanic soil, however, is admirably adapted to the growth of the nutmeg, which is indigenous. Other products are cloves, coconuts, tapioca and various tropical fruits and vegetables. Of the islands' total population, about 6,000 live in Bandanaira, the capital, on the island of that name, the port for the group.

The people are a mixed race, mostly descendants of Javanese, Macassarese and people from neighbouring islands brought in by the Dutch as slaves to work the nutmeg plantations in the place of the Bandanese, who refused to do so and were either killed or banished. A colony of exiled Bandanese continued to exist on one of the neighbouring islands of the Kai group. They, alone, use the old Bandanese language. On Gunungapi there is a small colony of Butonese. On Bandanaira there are many Arab and Chinese traders and some Malays, with a few Europeans and Eurasians, officials and persons engaged in business. Agriculture and fishing are the occupations of the inhabitants, many of whom are Christians.

Trade is in Chinese and Arab hands. Regular ship service connects Bandanaira with Amboina. There are roads sufficient for the needs of the population, and a radio station. The approach, especially from the north, is beautiful, as is the scenery about the inland sea. The marine gardens beneath this sea are probably unrivaled.

The Banda Islands were discovered and annexed by the Portuguese Antonio d'Abreu in 1512, but early in the 17th century the Dutch expelled the Portuguese and established themselves, in spite of native opposition, on Bandanaira and built a fort there. The Dutch East India company allotted the nutmeg plantations (Dutch *perken*) to deserving former servants, the so-called "perkeniers," but kept the monopoly on the nutmeg trade. For 300 years the perkeniers, who gradually became of mixed blood, were the aristocracy of the islands. The English tried to establish themselves in the islands at the same time as the Dutch. After some unsuccessful attempts—among them that of Capt. David Middleton—English influence made headway on Bandalontar, Run and Ai, and in 1621 the Dutch, anxious to make an end of native rule, proposed a joint Anglo-Dutch conquest of the islands. The English declined to co-operate, whereupon the Dutch crushed Bandanese resistance and ruled the islands under a governor, soon eliminating the English element. Alleged English participation against the Dutch in a native revolt on the island of Run led to the Amboina massacre (*see* AMBOINA). As a result, in 1654, under pressure from Cromwell, Run was awarded to the descendants of those who perished in Amboina. It was held until 1664, when the Dutch captured it. In 1796 the islands were taken by a British naval force, restored to the Dutch in 1800, retaken during the Napoleonic War and restored finally by the treaty of Paris of 1814. Japan occupied the islands in World War II. (J. O. M. B.)

BANDAR ABBAS, a port of Iran on the strait of Hormuz, seat of the Oman Sea general governorship and the main maritime outlet for a large part of southern Iran, stands on the barren northern beach of Hormuz bay opposite the islands of Qeshm (*q.v.*), Larak and Hormuz (Hormoz). Pop. (1956) 17,710, mainly Arabs and Negroes. The climate is oppressive by reason of heat and humidity in summer, but pleasant from October to April. Many inhabitants leave the town in summer for the villages at the foot of the mountains, especially Minab where some of them own date palm gardens. The roadstead is shallow and not well sheltered from the southeastern winds. Large vessels have to lie as much as four miles out. Port facilities are very poor; the port served as a base for British-Indian troops in World War I but was completely neglected during World War II. Water supply is good and plentiful from a rich source 12 mi. distant. Annual trade averages about 20,000 to 30,000 tons, exclusive of the oil products from Abadan. Imports, mainly manufactured goods, generally exceed exports, which include Kerman rugs and raw wool, dried fruits, pistachios and dates. Exchanges with the Arabian coast are small. The town has a cotton mill and a fish canning plant. Development plans after 1960 included the construction of a new harbour to the west of the town and road improvements. There are also agricultural possibilities in the district and iron deposits on the islands of Hormuz and Qeshm. The general governorship of the gulf ports includes the districts of Bandar Lengeh (added after the 1956 census), Minab and Jask. Its area in 1961 was 23,228 sq.mi., and population 266,547.

Bandar Abbas (Persian for "port of Abbas") was established in 1623 by Shah Abbas I at the site of the village of Gumrun, or Gombrun, to replace the ancient and famous city of Hormuz (*q.v.*) which had fallen into the hands of the Portuguese (1507). The English were permitted to build a factory there (as later were the Dutch and French) and assisted in the seizure of Hormuz which was destroyed and completely abandoned. During the 17th century Bandar Abbas was the chief maritime city of Persia, claiming a population of 40,000. In the 18th century the rival port of Bushire (*q.v.*), founded by Nadir Shah, obtained commercial supremacy in the gulf when, after the destruction of the English factory by the French in 1759, the East India company transferred its activities to Bushire. From about 1780 Bandar Abbas and its surrounding district were in the hands of the rulers of Muscat (Masqat), but in 1868 the Persian government regained possession of the area. (H. Bo.)

BANDARANAIKE, SOLOMON WEST RIDGEWAY DIAS (1899–1959), Ceylonese statesman whose electoral victory in 1956 was revolutionary in its effect, was born in Colombo on Jan. 8, 1899, the son of a rich landowner. Educated at Christ Church, Oxford, Eng., he was called to the bar at the Inner Temple in 1925. Soon afterward he returned home. Entering politics, he renounced Christianity to become a Buddhist. In 1931 he entered the newly formed state council. In 1947, as a prominent member of the United National party (U.N.P.), he was elected to the new house of representatives and appointed minister

of health and local government. Having resigned from the government and from the U.N.P. in 1951, he was returned in 1952 as founder of the Sri Lanka (Blessed Ceylon) Freedom party. He became the leader of the opposition. Four years later he formed the People's United front (P.U.F.), a political alliance of four leftist parties which swept the election, and he was sworn in as prime minister on April 12, 1956. The P.U.F. advocated a neutralist foreign policy and a Sinhalese Buddhist nationalism at home. By amicable agreement the British bases on the island were relinquished in 1957 and Ceylon remained a realm of the Commonwealth of Nations. The attempt to introduce Sinhalese as the country's official language led to serious riots. In 1959 the country's economy began to falter and in May a split occurred in the P.U.F., depriving Bandaranaike of a parliamentary majority. Steering a complicated course to retain power, he alienated some of his former supporters. A Buddhist monk, Talduwe Somarama Thero, shot him on Sept. 25 and Bandaranaike died the following day.

BANDELIER, ADOLPH FRANCIS ALPHONSE (1840–1914), U.S. archaeologist and anthropologist, a pioneer student of Indian cultures of the southwestern United States, Mexico and Peru-Bolivia, was born in Bern, Switz., on Aug. 6, 1840. When eight years old he emigrated with his family to the United States. Originally forced to pursue an uncongenial business career, he found solace in historical-ethnographic library studies, his "life's life." Between 1873 and 1879, under the intellectual dominance of Lewis H. Morgan (*q.v.*), he endeavoured to prove, in support of the latter's evolutionary theories, that Aztec socio-political structure had been entirely kin-based, democratic and substantially similar to the Iroquois system. The results of his investigations were published in three classic studies: *On the Art of War . . . of the Ancient Mexicans* (1877), *On the Distribution and Tenure of Lands . . . Among the Ancient Mexicans* (1878) and *On the Social Organization . . . of the Ancient Mexicans* (1879).

After 1880 Bandelier was able to devote full time to research and during the next decade undertook archaeological, ethnographic and documentary studies in the southwest and Mexico. His best-known works on the former area are *Final Report of Investigations Among the Indians of the Southwestern United States . . .* (1890–92) and a fictionized Pueblo ethnography, *The Delight Makers* (1890). After 1892 he turned to Peru and Bolivia; the most important publication resulting was *The Islands of Titicaca and Koati* (1910). Returning to the United States in 1903, he held various museum, teaching and research posts until 1913, when he embarked for Spain to pursue archival investigations. He died on March 18, 1914.

Bandelier's works, particularly those relating to the southwest and Peru-Bolivia, are still of considerable value. His Mexican studies suffer seriously from his constant forcing of the facts to fit Morgan's scheme, which he had adopted with enthusiasm. Recent scholarship has largely rejected Bandelier's principal conclusions regarding the fundamental nature of Aztec society and government.

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BANDELLO, MATTEO (1485–1561), Italian novelist who had a wide influence in England, France and Spain, was born in 1485 at Castelnuovo Scrivia in Tortona, Lombardy. Bandello, who was a monk, a diplomat and a soldier as well as a writer, was educated at Milan and the University of Pavia. He frequented the courts of Ferrara and Mantua and knew Niccolò Machiavelli.

At the age of 50 he was entrusted with the education of Lucrezia Gonzaga to whom he was greatly attracted and to whom he dedicated a long poem. After the battle of Pavia he fled to France with his protector, Gen. Cesare Fregoso, and later lived at Bassens near Bordeaux. In 1550 he was made bishop of Agen and spent the remainder of his life in France writing the stories on which his reputation rests. Bandello died at Agen in 1561.

Bandello's *Novelle* (4 vol., 1554–73) are frequently daring in the manner of Boccaccio's *Decameron*, and provide a valuable insight into the social intrigues of the Italian Renaissance. They were translated into French under the title *Histoires tragiques* (1559), and in Spain they were greatly admired by Lope de Vega. Shakespeare's *Romeo and Juliet* derives from a tale of Bandello. In France his influence persisted until the 19th century.

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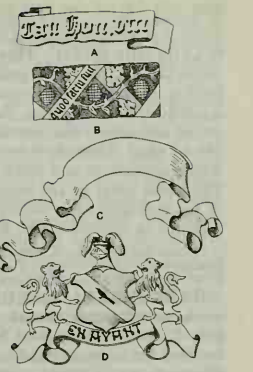

BANDEROLES

(A) English Gothic, Norwich cathedral; (B) English Gothic rood screen, Trunch, 15th century; (C) German Renaissance by Albrecht Dürer, 16th century; (D) Gothic revivel by Augustus Pugin, 19th century

BANDEROLE, a small flag or streamer carried on the lance of a knight or flying from the masthead of a ship. In architecture, it is a sculptured band for bearing an inscription, etc.

BANDICOOT, any of about 20 species of 7 genera of the marsupial family Peramelidae, occurring in Australia and neighbouring islands. They resemble mouse- to cat-sized kangaroos. Some species are uniformly grayish or buffy; others have conspicuous dark bars across the lower back and hips. Most bandicoots are omnivorous, eating a wide variety of plant and animal foods; a few are strictly vegetarian. They are most active at night, digging characteristic conical pits in search of food. Only the bilbies (*Thylacomys*) expertly dig burrows for dens; the daytime retreat of the others is an artfully concealed shallow pit or hollow log. Bandicoots are intolerant of each other and prone to fight. They do so by leaping at each other, striking out with the hind feet and, if successful, tearing out hair and sometimes flesh with the strong claws. Two to eight young comprise a litter, according to the species. They are usually considered pests.

JOHN WARHAM

SHORT-NOSED BANDICOOT (THYLACIS FOROSUS)

See MARSUPIAL. (K. R. KN.)

BANDICOOT RAT, a large ratlike rodent (*Bandicota indica*) of India and Ceylon, with a body 12 to 15 in. long and a tail an additional 11 to 13 in.; it weighs 2½ to 3 lb. The colour is variable but generally blackish-brown above, grayish-brown below. It has a short head, a broad muzzle and a scaly and almost hairless tail. The bandicoot, a burrower inhabiting forest, cultivated land, villages and towns, is destructive to crops, grain and poultry. The litter number is probably large, for the female has 12 teats. The lesser bandicoot rat or Indian mole rat and the short-tailed bandicoot rat or mole rat are smaller allied species. The animal is said to grunt like a pig and a native (Telegu) name *Pandi-koku* (meaning "pig-rat") has been corrupted into "bandicoot." The name has since been applied to a family (Peramelidae) of Australian marsupial mammals zoologically very distant from the original bandicoot of India. *See* also RODENT. (L. H. M.)

BANDIERA, ATTILIO (1810–1844) and **EMILIO** (1819–1844), Italian patriots, who lost their lives in an abortive revolt against Austrian rule. The sons of Baron Francesco Bandiera, an admiral in the Austrian navy, they were born in Venice, Attilio on May 24, 1810, and Emilio on June 20, 1819. They themselves entered the Austrian navy, but were won over to the cause of Italian independence and unity and corresponded with Giuseppe Mazzini and members of the revolutionary organization Giovine Italia

("Young Italy"). They planned to foment a rebellion in the navy, which was largely composed of Italians, but were betrayed and fled to Corfu early in 1844. They then resolved to undertake an expedition to Calabria, where groups of insurgents were believed to be holding out against the Neapolitan government at Cosenza. With a small band of adherents they set sail on June 12, 1844, landing on the Calabrian coast four days later. Through the treachery of one of their followers they were captured, and on July 25 the Bandiera brothers and seven of their companions were executed. The moral effect of the execution was considerable. The action of the authorities was widely condemned, and the brothers were regarded as martyrs of the Risorgimento.

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BANDINELLI, BACCIO (1493?–1560), Italian sculptor, was born in Florence, probably on Nov. 12, 1493, and died there on Feb. 7, 1560. The son of Michele di Viviano de' Brandini, he assumed the surname Bandinelli in 1530. Trained as a goldsmith, Bandinelli later worked under the sculptor Giovanni Francesco Rustici, and became one of the principal artists at the court of Cosimo I de' Medici, grand duke of Tuscany. Accounts of Bandinelli and his work given in Giorgio Vasari's *Lives* and in the *Autobiography* of Benvenuto Cellini represent him as jealous, malignant and untalented.

Bandinelli's surviving works prove him to have been a more distinguished sculptor than his contemporaries allowed, and his copy of the Laocoön (commissioned by Pope Clement VII for Francis I of France and now in the Uffizi, Florence), his statue of Hercules and Cacus (completed in 1534 for a position outside the Palazzo Vecchio, Florence, and carved from a block of marble destined for a group of this subject by Michelangelo) and his reliefs on the choir screen of Florence cathedral explain the vogue which his austere, rather arid work enjoyed at the Medici court. In later life he was supplanted in favour by Cellini and Bartolomeo Ammanati, but shortly before his death he secured the grant of a site for his own tomb in the church of the SS. Annunziata, Florence, where he set up his last work, a group of "The Lamentation Over the Dead Christ," executed jointly with his son Clemente. (J. W. P.-H.)

BANDIRMA (formerly PANDERMA), a town and seaport of northwestern Turkey, lies on the southern shore of the Sea of Marmara within the *il* of Balikesir, of which it is administratively a *kaza*. Pop. (1960) 28,858. It is an active transit port on the shortest route between Istanbul and Izmir and is linked by rail with the latter. There are regular shipping services to and from Istanbul. It is connected by road with both the above cities and with Balikesir, Eskişehir and Ankara. The town is also a trading centre for the rich agricultural plains which border it on the south. (S. ER.; N. TU.; E. TU.)

BANDITRY. The bandit is a robber who generally disdains the commoner forms of theft such as the picking of locks or pockets in favour of face-to-face contact with his victim. By ambush, skirmish, kidnapping or false pretense the bandit secures control over the hapless traveler on the highway or trail. The isolated farm or lonely village may also attract his attention. He is the pirate of the dry land, preying on solitary rider, express coachman or truck driver. After robbing his victim, the bandit may hold him for ransom and all too often commits murder to preserve his anonymity or to gratify an antisocial obsession.

Most bandits appear to have chosen the vocation more as a means of revenge for some real or imaginary wrong done by society than for the promise of booty. Yet the handit is not without social fame, even grudging admiration. The very daring of a Jesse James, the good-natured roguishness and camaraderie of a Robin Hood, the genius of a John A. Murrel and the operettalike colourfulness of a Ned Kelly must always strike a responsive chord even when applied in the most reprehensible of pursuits.

Thus, in India the villagers have devised a whole lore of songs celebrating the exploits of the dacoit. Generations of English children are reared on the legends of the Merry Men of Sherwood forest. The peasants of Macedonia and Albania still cherish the Horatio Algerlike image of success afforded by the tales of their brigand kings. In Italy the bandits are the subject of popular verse.

To those of a romantic proclivity, the bandit or brigand is the dashing, devil-may-care lover portrayed in Alfred Noyes' celebrated poem "The Highwayman" who defies the noose to court the maid. Or he may be Benedetto Mangone, the 16th-century Italian bandit whose delicate sensibilities compelled him to give safe conduct to Torquato Tasso, because he could not bring himself to rob a poet.

To people suffering from oppression, the bandit, however selfish and shoddy his motives, may become a heroic symbol of revolt. The Sicilian mafia (*q.v.*) was originally such a symbol of protest against Neapolitan misrule. This phenomenon was very apparent in the attitude of many California Mexicans toward Joaquín Murrieta who from 1850 to 1853 robbed and killed the hated gringos and defied their law. Murrieta, who was only 23 years old when he was decapitated, became something of an avenging angel to his people.

It is, moreover, sometimes difficult to distinguish between the bandit and the patriot. Even in the worst of bandits there may be a spark or façade of idealism. John A. Murrel linked his fantastic plan for a pirate empire in the southern United States to an uprising and freeing of the slaves, and many a northern abolitionist unwittingly gave aid to Murrel's bandits before the plot was uncovered in 1834. Conversely, genuinely patriotic or chauvinistic movements may, perforce, resort to tactics indistinguishable from those of the bandits. In 1901 a Bulgarian band fighting Turkish persecution captured a U.S. missionary, Ellen Marie Stone, and used the ransom of $72,000 to purchase arms and ammunition. In the 20th century, the Sinn Feiners in Ireland, the Haganah in Israel, the *maquis* in France, the partisans of World War II and the EOKA in Cyprus sometimes resorted to bandit means to achieve other ends. The Mau Mau in Kenya represented a particularly striking merger of banditry and nationalism in the 1950s.

Sometimes the line between banditry and nationalism is deliberately obscured by those fighting to suppress a popular uprising. The so-called Brigands War of 1795–1803 in the Caribbean was nothing less than a war fought by the slaves of the British and French West Indies to secure the freedom promised them by the French Revolution. Yet, because Great Britain and later Napoleon chose to regard the Negroes as bandits rather than as insurgents they were not, technically, compelled by international law to accord to captured slave-soldiers the humane status of prisoners, and hundreds were executed. The last thousand of Gen. Louis Delgres's Negro army refreated into Matouba fortress on Guadeloupe, set fire to the arsenal and blew themselves up.

Banditry flourishes almost as a by-product of dissolute public behaviour in wars and in times of grave economic, political and administrative injustice. The medieval *écorcheurs* ("skinners") of the Hundred Years' War roamed, robbed and terrorized France after being discharged from the armies. The *chaufeurs* ("stokers") of the French post-revolutionary period forced their victims to secure ransom by holding their feet in fires. Banditry flourished in the north of Spain when government was weak and after foreign invasion and civil wars. It reached its climax in 18th-century Catalonia, where it began in the strife of the peasants against the feudal landlords. Yet it has always been put down readily by a just and capable administration.

In the United States, the Civil War bred Frank and Jesse James (*q.v.*), Cole Younger and the "border bandits," men trained to guerrilla warfare for service as Confederate irregulars in Kansas and Missouri. Under the leadership of William C. Quantrill, Bill Anderson and Arch Clements and in the service of the "Black Flag" brigade, these irregulars developed a taste for the violent life. On Aug. 21, 1863, Frank James and Cole Younger participated in a Quantrill raid on Lawrence, Kan., during which some 150 to 182 residents were put to death and much of the town was burned. Before commencing his career as a Confederate irregular leader, Quantrill himself is alleged to have been a horse thief, professional gambler and murderer.

After the war, the freebooters of the border states continued their new way of life. The James gang was hunted by sheriffs, posses and Pinkerton detectives in over 100 counties of 12 states for bank, train, railway and stagecoach robberies as well as for incidental murders. The assassination of Jesse James in 1882, the growth of law and order exemplified by "hanging judges" such as Isaac C. Parker of the Fort Smith, Ark., federal bench, and the fading of the war memory finally brought about the demise of middle western brigandage.

Banditry has traditionally flourished in the isolated rough terrain and rougher morality of the frontier. Indeed, the term *maquis,* applied to French refugees from German labour conscription who formed the nucleus of French partisan resistance to the German occupation in World War II, refers to the bush of Corsica. Together with the equally favourable terrain of southern Italy, Spain and Greece, this wild terrain affords the European bandits their best hiding places.

The term bushranger similarly describes such Australian bandits as Ben Hall, Frank Gardiner and Ned and Dan Kelly who, in the latter half of the 19th century, held sway in the badlands of New South Wales and Victoria. Ned Kelly was perhaps the most colourful of frontier brigands, dressed in a suit of homemade armour like a mock-medieval knight, riding down the main streets of terrorized villages brandishing revolvers and howling outlandish songs. He was shot in the leg—the chink in his armour—on June 28, 1880, and hanged on Nov. 11.

The greatest frontier bandits, however, were the products of the American south and west. River pirates fattening on the Mississippi migrant and commercial trade benefited by the divided jurisdiction that made one bank of the lower river Spanish and the other American.

Diamond Island on the southern border of Illinois became a nest of brigands, and from headquarters on nearby Cave-in-Rock on the Ohio river Philip Aston, dressed in ruffles and lace, went about scuttling river boats and murdering their crews. A few miles down the river, James Ford rounded out his career as justice of peace with the avocation of ferryman and bandit chieftain. His ferry carried the traders, his bandits robbed them and his court protected the offenders: a memorable example of pioneering self-sufficiency.

The great land trails into the south, Daniel Boone's Wilderness road and the Natchez trace, ran through ideal bandit country of dense thicket, wilderness and dark swamp. There such men as Joseph Thompson Hare, Samuel Mason and Murrel had their domain. Micajah and Wiley Harpe, who first plundered the trace in 1797, were unquestionably mad; they dismembered their victims' corpses. Micajah ("Big Harpe") killed Maj. John Love "because he snored so," and thought nothing of murdering women and infants. At the end, the anguished husband of one of his victims cut off Micajah's head and nailed it to a tree on the trace.

Banditry is by no means unique to Europe and America. Indeed, it appears to have found its last sanctuary in parts of Africa and Asia. Early in the 20th century kidnappings of British subjects and U.S. citizens by the Moroccan Ahmed ibn Muhammed Raisuli led to several international incidents. Raisuli's kidnapping in 1904 of the American Ion Perdicaris led to Pres. Theodore Roosevelt's famous demand, "Perdicaris alive or Raisuli dead." On Oct. 8, 1927, two French children were kidnapped and their parents murdered by Moroccan brigands. In India, the proud and wealthy chieftain Mansingh was the law's most brilliant and successful antagonist until, on Aug. 25, 1955, he was killed near Agra by a specially trained company of Gurkha police. The equally famous Bhupat was in the second half of the 20th century still at large, presumably in Pakistan. In Iran, the murder by Dadshah's bandits on March 24, 1957, of three Americans, Kevin Carroll and his wife and Brewster A. Wilson, who were touring southeastern Iran on behalf of the U.S. government, led to the fall of the Hussein Ala government and the suspension of United States aid activity in the area.

Bandits may be hunted either by militia or by the population at large. To arouse the citizenry, a reward for a bandit's capture may be offered or he may be declared an outlaw—that is, a man deprived of all legal protection, who may be hunted and even killed with impunity by anyone. The common law of England and the constitution of the United States forbid the outlawing of persons except by judicial process. *See* also GUERRILLA WARFARE.

BIBLIOGRAPHY.—McFarlane's *Lives and Exploits of Banditti and Robbers* (1837) is a useful introduction to the subject. A good survey of some American banditry is found in Robert M. Coates, *The Outlaw Years* (1930). For additional background *see* Henry F. Lutz, *The Alleged Robbers' Guild in Ancient Egypt* (1937). (T. M. FK.)

BANDJERMASIN (BANJERMASIN), a town of Indonesia, the centre of a district of the same name and capital of South Kalimantan province, is situated on the south coast of Borneo. Pop. (1961) 214,096. The town lies among the swampy mouths of deep, swift-flowing rivers which drain the largest plain in Kalimantan; during the rainy season torrential waters pour down from the mountains of the interior, flooding the surrounding plains and the swamps. To the east a mountain range sweeps down from the north, but the hills are not easily accessible because of the lack of roads. Bandjermasin is built on an island between the Barito and Martapura rivers, both of which are navigable well beyond the town by large vessels. The houses are raised on piles; gardens are walled and drained; and rivers and streams are used in place of roads. There is a good harbour and Bandjermasin port carries most of the import and export trade for the extensive valley region. Exports from the port include rubber, pepper, timber, rattan, cordage fibres, gold and diamonds. In the vicinity are sawmills at Alalak and Tjerutjuk; kilns for bricks and earthenware goods are at Sungri Tabok. Coal comes from Pengaron, about 40 mi. away. Bandjermasin district had an estimated population in 1950 of 415,000.

A sultanate was formerly centred on Bandjermasin, covering the entire southerly region of the Barito basin. In the 18th century a treaty was made with the Dutch East India company. There followed a long period of conflict between various claimants to the sultanate until the area was brought under the direct control of the Dutch. This led to a revolt in 1859, which smouldered as guerrilla warfare in the hills for about 30 years. The town was captured by the Japanese in 1942 and was liberated in 1945.

BANDON (DROICHEAD NA BANNDAN), a town of County Cork, Republic of Ireland, 17 mi. S.W. of Cork by road and situated in a broad, open valley on both sides of the Bandon river. Pop. (1961) 2,308. It is an agricultural centre and there are distilleries, breweries and flour mills. There are many archaeological remains in the district. Bandon was founded about 1608 by the earl of Cork, who planted English and Scottish settlers.

Kilbrogan church (1610), the first Protestant church built in Ireland, contains the town stocks. Fragments remain of the old town wall which was destroyed by the Irish in 1688–89, after which there was a long resistance against the admission of Roman Catholic inhabitants.

There is good salmon and trout fishing in the Bandon; two miles down-river is Inishannon, the head of navigation.

BAND SAW: *see* MACHINE TOOLS; WOODWORKING MACHINERY.

BANDUNG (BANDOENG), the capital of the province of West Java, Indon. It is situated on the northern edge of a plateau nearly 2,400 ft. above sea level, surrounded by beautiful mountain scenery, with several waterfalls, terraced rice fields and heights rising to nearly 7,000 ft. The climate is mild and pleasant with cool nights. Pop. (1961) 972,566.

Bandung is a modern city with wide tree-lined streets and shops, banks and private residences, many of them built in European style. The chief shopping centre is Braga, and there are several street markets, the best being Pasar Baru. Entertainment is provided by motion picture houses, a theatre and a racecourse. There are several churches and a large mosque. Among notable public buildings are the Merdeka and the Dwiwarna, where the Asian-African conference, attended by representatives of more than 20 Asian and African countries, was held in April 1955. (*See* BANDUNG CONFERENCE.) Bandung has three large parks, the finest of which is the Taman Sari, or Jubilee park, adjoining the zoological garden.

WAAGENAAR-PIX FROM PUBLIX

MATHEMATICS AND PHYSICS BUILDING OF THE UNIVERSITY OF INDONESIA AT BANDUNG

The town is the acknowledged centre of Sundanese cultural life and learning. Music, usually of flutes or bamboo instruments, and the puppet theatre are popular. The faculties of pure and technical science of the University of Indonesia are in Bandung. A teachers training college was opened in 1954 and there are academies for plastic art, physical education and military affairs. The geological museum contains an interesting collection of minerals and fossils. There is a Pasteur institute, and in the Lembang highlands, to the north, is the Bosscha astronomical observatory. The Tangkubanprahu volcano, 8 mi. beyond, is reached by way of a large area devoted to the experimental cultivation of vegetables and flowers, especially roses.

Improved communications are making Bandung increasingly a commercial city. The chief industry is the manufacture of textiles and there are many factories and weaving mills in the town, most of them owned by Chinese. The government-administered Textile institute supplies advice on the industry and facilities for research in the technical field of yarn analysis and the use of dyes and chemicals.

There is a large quinine factory that produced 80% of the world's quinine before World War II. A ceramic institute is maintained by the ministry of economic affairs to promote research into ceramic raw materials and to provide technical information and assistance to the ceramic industry. Manufactures include rubber goods and machinery. Bandung is connected with the chief towns on the island by the state railway. There is an airport at Andir, 5 mi. W. of the city.

Bandung was founded by Marshal H. W. Daendels, Dutch governor general, in 1810, but was little more than a village until, in 1884, the government railway was brought to it from Bogor. It was then regarded as the capital of the whole of the Sundanese country and as a health resort for the coastal people.

The town was of great strategic value during the Japanese invasion of World War II, and its fall on March 7, 1942, practically sealed the fate of Java.

BANDUNG CONFERENCE, known officially as the Asian-African conference and held April 18–24, 1955, at Bandung, Indon., was organized on the initiative of Indonesia supported by Burma, Ceylon, India and Pakistan. They and 24 other Asian and African countries sent delegations. The conference reflected the five sponsors' dissatisfaction with what they regarded as a reluctance of the western powers to consult with them sufficiently on decisions affecting Asia; their concern over tension between China and the United States; their desire to lay firmer foundations for China's peaceful relations both with the west and themselves; their opposition to continuance of colonialism—especially France's in north Africa; and Indonesia's desire to promote its case in the dispute with the Netherlands over western New Guinea.

Major debate centred around the question of whether Soviet policies in eastern Europe and central Asia should be censured along with western colonialism. A consensus was reached wherein "colonialism in all of its manifestations" was condemned, implicitly censuring the U.S.S.R. as well as the west. Communist China's prime minister, Chou En-lai, displayed an unexpectedly moderate and conciliatory attitude which tended to quiet fears of some anti-Communist delegates concerning China's possible aggressive intentions. He was applauded for his statement that China wished to avoid war with the United States and was "willing to sit down and enter into negotiations with the United States government to discuss the question of relaxing tension in the Far East and especially the question of relaxing tension in the Taiwan area."

A ten-point "declaration on the promotion of world peace and co-operation," incorporating the principles of the UN charter and the Indian *panch shila* (Nehru's five principles) was unanimously adopted. Agreements concerning economic and cultural co-operation lacked real substance and led to little.

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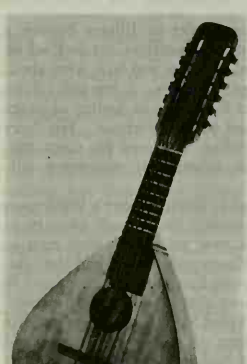
BANDURRIA, a short-necked, pear-shaped stringed instrument with a flat back, peculiar to Spain, where it is often used for the performance of outdoor music. It is strung with six paired courses of strings of gut and metal-spun silk, tuned in fourths as follows: G sharp (below middle C), C sharp, F sharp, B, E, A. There are 12 fixed metal frets on the finger board, and the instrument is played with a short, hard plectrum. The regular tuning in fourths throughout gives great facility and uniformity of fingering in chromatic passages. (E. Ha.)



BY COURTESY OF THE SMITHSONIAN INSTITUTION

SPANISH BANDURRIA, ABOUT 18TH CENTURY

BANEBERRY (HERB CHRISTOPHER), popular name for *Actaea spicata* (family Ranunculaceae; *q.v.*), an herb with long-stalked compound leaves, small white flowers and black berries, found wild in thickets in limestone districts in the north of England. It is widely distributed in the north temperate zone. *Actaea alba*, with white fruits, and *A. rubra*, with red fruits, are common in eastern and midwestern North America. The rootstocks and berries of baneberry contain irritant resins that have a cathartic action and produce vomiting.

BANÉR, JOHAN (1596–1641), Swedish field marshal, was born at Djursholm castle on July 3 (new style; June 23, old style), 1596, of an old Swedish noble family. His father, Gustaf Banér, a member of the king's council, was executed in 1600 after the defeat of Sigismund III of Poland (*see* CHARLES IX, king of Sweden). Entering the Swedish army in 1615, Johan Banér was greatly influenced by the military ideas of the young king Gustavus Adolphus: he served with distinction in Russia, in Livonia and in Poland and early attained the rank of general.

In Germany from 1630 (*see* THIRTY YEARS' WAR), he led the victorious right wing of Swedish horse at the first battle of Breitenfeld (*q.v.*) in 1631. Thereafter he served as the king's

chief of staff at headquarters. In 1632, wounded in the fighting around Nürnberg, he did not take part in the battle of Lützen, where Gustavus Adolphus was killed. In 1634 he was appointed field marshal, with command of an army corps in Silesia and Bohemia; and when the main Swedish army had been crushed at Nordlingen he was asked to take command of the whole Swedish army in Germany. Having restored discipline by forceful action against mutineers, he resolved on an offensive strategy, despite the enemy's numerical superiority.

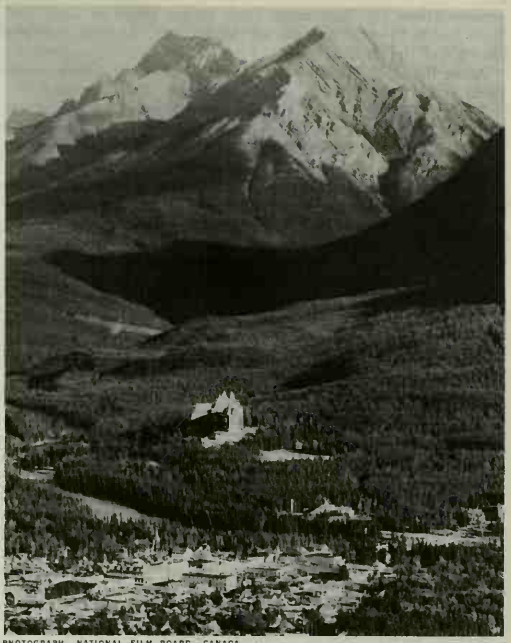
In 1636 his great victory at Wittstock restored for some time Sweden's paramount influence in central Germany. In 1637, hard pressed by the enemy's armies and almost surrounded, he made a strategic retreat into northern Germany that provoked the contemporary comment that "the enemy had put him in the sack but had forgotten to tie it." By the end of 1638, however, Banér had collected reinforcements, with which he began a new offensive toward central and southern Germany. At Chemnitz (April 1639), he defeated the emperor's army. Reinforced by French troops under the comte de Guébriant, he advanced toward southern Germany during the summer and autumn of 1640, but could not force the enemy to a battle. After a dangerous march through Bohemia in the winter, when Banér for the last time gave proofs of his courage and ability, he died at Halberstadt, Ger., on May 20 (N.S.; 10, O.S.), 1641, of a pulmonary disease contracted during the winter campaign.

Banér's lucid intellect and military genius made him one of the foremost soldiers of the Thirty Years' War. His strategy was characterized by great mobility, by readiness to take the initiative and by the swiftness of his advances. His tactics were distinguished by his daring and unconventional methods and by rude energy. The battle of Wittstock is a classic example of masterly leadership. A tall man with a commanding glance, he enjoyed the complete confidence of his troops despite his stringent rule ("he carried lightning and thunder on his tongue"). He was a generous host to the officers in his staff. His letters to Axel Oxenstierna were published in 1893.

See G. Björlin, *Johan Banér,* 3 vol. (1908–10); B. Steckzen, *Johan Banér* (1939). (B. S.)

BANERJEA, SIR SURENDRANATH (1848–1925), Indian nationalist leader, was born in Calcutta, of a distinguished Kulin Brahman family, on Nov. 10, 1848. Educated at Doveton college, Calcutta, he passed the examination for the Indian civil service (1869). When the civil service commissioners tried to exclude him on the ground that at Calcutta university he had wrongly stated his age (which he had reckoned from the date of conception, in accordance with Hindu custom), he successfully appealed to the court of queen's bench against their decision. He was posted to Sylhet but in 1874 was found guilty of procedural irregularities and dismissed (he considered himself a victim of racial discrimination). He turned to teaching and journalism and took a leading part in the foundation of the Indian association in 1876. As editor of the *Bengalee* and as an effective speaker at the annual sessions of the Indian national congress, which first met in 1885, he exercised a powerful influence over Indian nationalist opinion. He was a firm believer in representative government and in the efficacy of "constitutional" methods of agitation for it—such as the making of speeches at political meetings and the drawing up of petitions. He opposed the extreme methods advocated by B. G. Tilak and the non-co-operation advocated by M. K. Gandhi. He welcomed the Montagu-Chelmsford reforms (1919) as a step toward responsible government, accepted office as minister for local self-government in Bengal and was knighted (1921). He held office from 1921 to 1924, but was bitterly attacked by extreme nationalists as a turncoat and was defeated at the polls by a Swarajist (Independence) candidate. In his autobiography, *A Nation in Making* (1925), he criticized non-co-operation as a sterile policy. He died at Barrackpore on Aug. 6, 1925. (Ke. A. B.)

BANFF, a popular resort in the Rocky mountains of Alberta, Canada. Pop. 2,518 (1956). On the main line of the Canadian Pacific railway and on the Trans-Canada highway, it is the principal centre for the Banff National park of Canada, which has an



PHOTOGRAPH, NATIONAL FILM BOARD, CANADA

THE VILLAGE OF BANFF. BEHIND THE LARGE RESORT HOTEL RISES GOAT MOUNTAIN

area of 2,585 sq.mi. The town stands at an altitude of 4,538 ft. It is 84 mi. W. of Calgary and 40 mi. E. of Lake Louise, with which it shares a large tourist patronage. Besides the scenic beauty of the region the town's chief attractions are its two government-controlled hot sulfur springs. Its annual winter sports carnival and ski tournament draw visitors and competitors from other parts of Canada and from the United States. In summer the Banff School of Fine Arts, operated by the extension department of the University of Alberta, conducts its classes there. (Jn. H. W.)

BANFF, royal and small burgh, seaport and capital of Banffshire, Scotland. Pop. (1961) 3,329. It is a seaside resort situated on rising ground on the west bank of the mouth of the river Deveron, about 46 mi. N.W. of Aberdeen by road. A road bridge connects it with the town of Macduff on the east bank. The fishing trade is important and local industries include a distillery, a brewery, an iron foundry and boatbuilding.

The first charter was granted to Banff by Malcolm IV in 1163 and further privileges were conferred by Robert Bruce in 1324 and Robert II in 1372. On a hill near the sea a castle was built (1750) on the site of an old one which had been a royal residence and where, in 1613, James Sharp (*q.v.*), the archbishop, was born. Duff house, immediately adjoining the town, was a seat of the duke of Fife. It was built in 1740–45 after designs by Robert Adam. In 1906 the duke presented the whole estate to the towns of Banff and Macduff.

BANFF NATIONAL PARK, in southwestern Alberta, Canada, was established as that country's first national park in 1885 when an area of 10 sq.mi. surrounding the newly discovered hot mineral springs at Banff (*q.v.*) was set apart for public use.

The park, which includes some of the finest alpine scenery in the Canadian rockies, has been enlarged to more than 2,500 sq.mi. It is noted for its wildlife; game animals protected there include bighorn sheep, Rocky mountain goats, elk, moose, deer, and black and grizzly bears.

More than 750,000 tourists visit Banff park annually, and ac-

commodations for them range from luxury hotels at Banff and Lake Louise to camp grounds and trailer parks at various points throughout the park.

Along the scenic highway connecting Banff and Jasper national parks is the Columbia ice field, the largest in North America.

BANFFSHIRE, a county of northeastern Scotland, is bounded on the north by Moray firth, on the east and south by Aberdeenshire and on the west by Moray and Inverness-shire. Its land area is 630 sq.mi.

Physical Features.—The county forms a long, narrow triangle, based in the north on the 30 mi. of coast and tapering southwestward to a point near Cairngorm (4,084 ft.). The southern, Highland half of Banffshire is roughly the basin of the Avon, along with part of the catchment area of the upper Deveron. The northern half is broadly the rolling lowland between the lower Spey and the lower Deveron rivers.

In the extreme south is part of the granitic Cairngorm plateau reaching more than 4,000 ft., with an annual rainfall exceeding 60 in. and distinctive arctic-alpine vegetation. Great ice-carved corries, with cliffs of more than 1,000 ft., cut into the mountain sides, which drop within a mile from 4,000 ft. to the glaciated ribbon lake of Loch Avon at 2,400 ft. The granite runs east into the Ben Avon massif at 3,600–3,800 ft. The steep face of these high tablelands look across a series of lower, dissected plateaus planed mainly across rocks tightly folded and metamorphosed in the Caledonian orogenesis. Very marked belts of quartzite and limestone strata run northeast-southwest among the slates, phyllites and mica schists of the Moine and Dalradian formations. There are further granite intrusions, and also younger, unaltered sediments of Old Red Sandstone in the northeastern and northwestern corners and in pockets inland around Cabrach and Tomintoul (the highest village in the Highlands at 1,160 ft.).

The lower plateau surfaces form very broadly a series of east to west steps descending toward the firth and dissected by southwest-northeast longitudinal valleys like Glenrinnes and Glenfiddich, though there are also transverse valleys. The hills, with summit planes of 2,000 to 2,400 ft., have a mean annual rainfall of about 40–45 in. and are dominated by heather moorland. Intermediate, upland plateau surfaces give green rolling hills with summit planes at about 800 ft. and 1,500 ft. The lowest and most recent surfaces are the post-glacial raised beaches, giving important stretches of well-drained, readily warmed and easily cultivated soils. Mean annual rainfall is about 30 in. The spring tends to be dry with cold easterly winds, and sea fogs are not uncommon; from July the rainfall increases; sunshine remains adequate (August mean more than 4 hours) and harvests are usually successful. There are cliffs at Troup Head, in schists amid an Old Red Sandstone belt. Fulmar petrels breed there, while in the Cairngorms there are red deer, wildcats, golden eagles, snow buntings and dotterels. (A. T. A. L.)

History.—Banffshire has many relics of early man. In several parishes are remains of stone circles; stone cists and urns, sometimes ornamented, have been found. Stone axes, three of which are reputed the finest of their kind in Scotland, have been unearthed, also flint arrowheads, scrapers, saws and borers.

There were many conflicts with the Danes. A sculptured stone near St. Moluogs' church, Mortlach, is believed to mark the site of Malcolm II's victory in 1010. Malcolm III established a bishop's see at Mortlach about 1063, whence it was translated to Aberdeen by David I.

Of medieval relics, the ruined castles of Findlater, Auchindown and Balvenie are noteworthy, both in setting and story. The ruined churches of Gamrie, which dates from the 12th century, and of Deskford, with its large sacrament house, deserve mention. The most impressive ecclesiastical structure in Banffshire is Cullen church, which is still used; it was made collegiate about 1543 by Alexander Ogilvy of Deskford and Findlater, whose monument is in the church. Robert Bruce's second queen died at Cullen in 1327; he gave five pounds annually "for the support of a chaplain for ever to serve in the parish church of the Blessed Mary of our burgh of Cullen, for the weal of the soul of the whilom most august Princess Elizabeth." Of the Carmelite friars, established in the royal burgh of Banff by Bruce, only slender documentary records remain.

After the Reformation parts of Banffshire clung to their Catholic traditions. The Enzie, with its centre at Preshome, was long the stronghold of Scottish Catholicism. In Glenlivet was established at Scalan in 1717 a seminary which until its removal to Aberdeenshire in 1799 trained more than 100 priests during the penal times. Scalan was purchased in 1946 by Scots Catholics for preservation as a valued memorial.

In 1594 the "Popish earls" Huntly and Errol defeated a royal force under the earl of Argyll in Glenlivet. Viscount Dundee maneuvered in Banffshire before the battle of Killiecrankie (1689), receiving valuable aid from John Grant of Ballindalloch. The shire was strongly Jacobite; many lairds who rebelled in 1715 had sons who supported Prince Charles Edward in 1745.

(W. R. Hu.)

Population and Administration.—In 1961 the population was 46,400. The chief burghs, all small ones, are Banff (3,357), the county town, Buckie (7,666), Keith (4,208) and Macduff (3,479), the others being Cullen, Dufftown (*qq.v.*), Aberchirder, Aberlour, Findochty, Portknockie and Portsoy. Banff and Cullen are royal burghs. Banffshire together with the shires of Aberdeen and Kincardine, forms a sheriffdom, and there is a resident sheriff substitute at Banff who sits also at Keith. The county returns one member to parliament.

Industries and Communications.—Farming, fishing, boatbuilding, distilling and limestone quarrying are the main industries of Banffshire. Breeding and fattening of cattle, particularly of the Aberdeen Angus variety, is carried on throughout the county and there is extensive dairy farming. The earls of Fife and the earls of Findlater, afterward earls of Seafield, did much to reclaim lands for farming. It was a Seafield who, in 1846, received the honorary gold medal of the Highland and Agricultural Society of Scotland for his great plantations of useful trees in this and neighbouring counties.

The cod and herring fisheries are important at Buckie, while fishing is also carried on from the harbours of Macduff, Gardenstown and Whitehills. There are valuable salmon fisheries along the coast and on the Spey and Deveron, while trout fishing in most of the streams is among the tourist attractions. Distilleries are numerous throughout the county; the one at Glenlivet is particularly well known. Near Keith there are woolen mills reputed for quality but there was need in the early 1960s for more light industries to absorb labour released by the mechanization of farming and the decline in fishing. Limestone is extensively quarried for crushing, while slates (for roofing) and granite have also been worked in the past. A variety of veined serpentine is known as Portsoy marble.

Bus and restricted rail services connect the chief towns and villages and provide communication with Aberdeen, Elgin, Nairn and Inverness. (R. J. Cu.)

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BANG, BERNHARD LAURITS FREDERIK (1848–1932), Danish veterinarian, whose most noted work was the discovery in 1897 of *Brucella abortus*, the germ responsible for contagious abortion in cattle, was born at Sorö, Sjaelland, on June 7, 1848. He studied at the University of Copenhagen and at the Royal Veterinary and Agricultural college there, graduating from the latter in 1873. Having obtained his M.D. in 1880, he began teaching in the same year at the Royal Veterinary school, of which he eventually became director. He was also for many years veterinary adviser to the Danish government.

Bang brought to veterinary medicine a wide knowledge of general pathology and bacteriology, and he and his pupils made the Danish school a model for the whole world. By his own researches he probably contributed more than any of his contemporaries to the advancement of veterinary science, and much of his work was

of the highest importance for preventive medicine. Bang's discovery of *Brucella abortus* (Bang's bacillus) assumed even greater importance when it became known that the organism was a not uncommon cause of brucellosis (*q.v.*) in man. Equally important were Bang's work on bovine tuberculosis and his method of control of the disease by isolating affected cows and removing their newborn calves and feeding them milk of healthy animals. His name is also associated with important researches on smallpox vaccination, actinomycosis, bacillary necrosis, swine fever and swine erysipelas, and Johne's disease. He died at Copenhagen on June 22, 1932. (W. J. Bp.)

BANG, NINA HENRIETTE WENDELINE (1866–1928), Danish economist and political writer, the first woman cabinet minister, was born in Copenhagen on Oct. 6, 1866. Graduating M.A. at Copenhagen in 1894, she married, in 1895, an outstanding Danish Socialist, Gustav Bang (d. 1915). Devoting herself not only to Social Democratic politics and journalism but also to economic studies, she began, with the support of Danish and foreign scientific funds, to produce a comprehensive work on dues in the Sound, finally published as *Tables of Shipping and Goods Transport on the Sound, 1497–1660,* 3 vol. (1906–33). She became a member of the *landsting* (upper house) in 1918. In 1924, when Thorvald Stauning formed the first Danish Social Democratic government, she was appointed minister of education. Nina Bang died in Copenhagen on March 25, 1928.

BANGALORE, the capital city of Mysore state, India, and headquarters of Bangalore district, lies 3,113 ft. above sea level, 183 mi. W. of Madras (219 mi. by rail). Pop. (1961) 905,134. It consists of the closely built old town, with modern suburbs laid out on a gridiron pattern north and south, and to the east a sprawl of military cantonments, the largest in India south of the Krishna river.

Bangalore is one of the two centres of the University of Mysore and the seat of 17 of its constituent and affiliated colleges, conducting the work of the science, medical, engineering, veterinary, agriculture and commerce faculties. There also are the Indian Institute of Science (1911), the Raman Research institute (1943; named after the Indian Nobel prize physicist), the National Aeronautical Research laboratory (1960) and a division of the National Power Research institute (1960). Among other prominent buildings are the Vidhana Soudha or legislature (1956), the maharaja of Mysore's palace and the museum. The city is well provided with open spaces, among them a botanical garden, the Lalbagh.

Bangalore is at the focus of south India's road system: it lies on the Varanasi-Cape Comorin national highway and is connected by main roads with Bombay and Madras, and with Kerala via Mysore city, the Nilgiris and Palghat gap. It is a busy junction on the Southern railway, linking the broad-gauge line from Madras with an extensive metre-gauge system to the north and west. Hindustan airport, 5 mi. E. of the city centre, is served by scheduled flights to and from Bombay, Madras, Mangalore and Colombo.

Beside the large aircraft, railway coach and machine tool installations run by the central government, Bangalore has state-owned electrical, telephone, porcelain and soap factories; and commercially operated concerns producing pharmaceuticals, textiles, radio parts, glassware, leather and footwear, agricultural implements and paper.

Bangalore's warm, subhumid climate, giving pleasant winters and tolerable summers, make it a popular place of residence. But water supply for its increasing industrial and domestic needs presents a problem, as its 36 in. annual average rainfall is inadequate and there are no rivers nearby.

The nucleus of modern Bangalore was "hele Bangaluru" (old Bangalore), the settlement around a mud fort built in 1537 by a petty chief, Kempe Gowda. Early in the 17th century it was captured by Shahji (Sahu) Bhonsla, father of Sivaji (*q.v.*), founder of the Maratha dynasty. Sivaji sold it to the Hindu rajah of Mysore in 1687. In 1758 it was granted as a *jagir* or fief to Haidar Ali (*q.v.*), afterward usurper of Mysore. During his reign the fort was rebuilt in stone. It was captured in 1791 by the British under Lord Cornwallis, but restored the next year to Haidar's son Tipu Sahib (*q.v.*). He dismantled the fort; but following his final defeat in 1799 and the restoration of the old Hindu dynasty, it was rebuilt by Purnaiya, the state minister. Bangalore was the headquarters of the British caretaker administration from 1831 to 1881; and from 1881, when the rajah was again restored, to 1947, when India became independent, the British retained the city's administrative and military quarters.

Bangalore District abuts the southwestern (Madras) border of Mysore state. Pop. (1961) 2,504,462. Area 3,081 sq.mi. The main crops are millets and oilseeds. (G. K. Gh.)

BANGKA (Banka), an island of Indonesia off the east coast of Sumatra across Bangka strait which is only 9 mi. wide at its narrowest point. On the east, Gaspar strait, wider and island-studded, separates Bangka from the island of Billiton. Bangka, with its dependencies, is a division of the province of south Sumatra. It is 136 mi. long and 69 mi. wide and its area, with a few adjacent islands, is 4,611 sq.mi. The soil is somewhat dry and stony, but the greater part of the surface is covered with tropical vegetation. The virgin forest has almost disappeared because of mining and agricultural operations. The hills, of which Maras in the north is the highest (2,293 ft.), are covered with vegetation to their summits. Bangka resembles the Malay peninsula geologically, with formations of granite, Silurian and Devonian slate, frequently covered with sandstone, laterite (of small fertility) and alluvium. The granite runs from west-northwest to south-southeast in short, irregular hill chains. These are generally near the east coast; hence the rivers of the west coast are longer. There are no volcanoes and the number of anchorages along the coast is small. The rivers run in deep valleys; in their upper courses, and some in their lower courses, the rivers form extensive marshes. Nevertheless, many are navigable for nearly 20 mi. because they were once inlets of the sea, and are tidal for some distance. The Selan and the Jarin rivers are the largest. The climate is hot, especially from May to August (southeast monsoon), but at night in the hills it is quite cool. The mean annual rainfall is 118 in. and the average number of rainy days is 159. The wet and cooler season is from November to February (northwest monsoon).

Bangka is one of the chief tin-producing centres of the world. Tin mining is a government monopoly. The ore is found in many river alluvial deposits and in the alluvial strata on the slopes of small hills; it is worked in open cuts and by dredgers that work in the sea just off the coast. The labour ordinarily is supplied by about 15,000 contract coolies, mainly Chinese, who work under government supervision, and electrical power is used extensively. The tin for consumption in Indonesia is smelted on Bangka and the remainder in the U.S. and the Netherlands.

The population was (1961) 251,639 including foreign Asians, mostly Chinese. The inhabitants (Muslims) are mainly immigrant Malayan peoples. The aborigines are represented by only a few primitive hill tribes, probably of mixed Malay origin and akin to the Bataks of Sumatra, who live by hunting, fishing and the collection of forest products. Rice, pepper (grown by Chinese), gambier (for dyeing and tanning), coffee and coconut palms are cultivated. There are more than 1,000 mi. of roads fit for wheeled traffic, but no railways. The island has radio connection with Java and frequent air and steamship communication with Java and Sumatra and with Singapore and Penang. The chief town is Pangkalpinang (pop. [1961] 60,283), on the east coast, and the chief port is Muntok (pop. [1957 est.] 25,883), at the northern end of Bangka strait. The sultan of Palembang, in Sumatra, ceded Bangka to the British in 1812, but in 1814 it was exchanged with the Dutch for Cochin in India. Japan occupied Bangka in 1942; it was reoccupied by the Dutch in March 1946 and became part of the independent Republic of Indonesia in 1949. (J. O. M. B.)

BANGKOK (Krungthep), the capital, sole metropolis and chief port of Thailand (Siam), is situated on the Maenam Chao Phraya, 25 mi. upriver from the Gulf of Siam. Bangkok proper, the municipality of Krungthep, lies on the east bank of the river, in the province of Phra-nakhorn (*q.v.*). Pop. (1957

est.) 1,204,894. The municipality of Thonburi (*q.v.*), across the river on the west bank and connected with Krungthep by three modern bridges, is in effect part of metropolitan Bangkok.

The climate of Bangkok is hot throughout the year, the average temperature being 83.8° F. during the hot, dry months of March and April, and 79.3° F. during the cool season from November through February. Most of the annual rainfall, averaging about 60 in., occurs during the rainy season from May through October. Monthly mean relative humidity seldom falls below 60%.

Prior to 1767, Bangkok was merely a fortified outpost guarding the approaches to Ayutthaya (*q.v.*). In that year the old capital was destroyed by Burmese invaders, and Taksin, a popular general of Chinese extraction who became king after driving out the Burmese, established the national capital at Thonburi. During his reign (1767–82), a large Chinese settlement and market serving the capital grew up on the east bank of the river. When Taksin was succeeded as king by Rama I, the founder of the Chakkri dynasty, the present royal city was established on the site of the Chinese trading centre, which was removed to Sampheng, a quarter which is still the Chinese centre of Bangkok. The position of the new royal city in a loop of the river afforded natural protection on three sides, and a wall and moat were constructed on the exposed eastern flank.

Throughout the 19th century, Bangkok was an eastern Venice, for most of the populace lived in houses on stilts at the edges of canals and the river, and trade was carried on in sampans, floating shop houses, and junks anchored in the river. The first major street outside the royal city, New road, was built in 1864 to connect the palace with the foreign consulates down the river. From 1880 to 1910 most of the city's population gradually shifted from the waterways to live by newly planned roads. Several of the remaining canals still carry considerable commercial traffic.

The Chinese, whose immigration was deliberately encouraged by the 19th-century Thai kings, formed at least half of Bangkok's population until the late 1930s. In the late 1950s approximately 40% of the population of Krungthep was of immediate Chinese descent, 20% being China born, and the corresponding proportions for Thonburi municipality were 28% and 16%. Ethnic Chinese dominate both commerce and industry.

Bangkok is the communications hub of Thailand. All railways radiate from the capital, and most roads either begin there or start from one of the rail lines beginning there. The city lies at the centre of the extensive canal network linking the three main rivers of the central plain, and much of the rice produced there is milled in the Bangkok area prior to shipment. Teak logs from the forests of northern Thailand are floated down-river to the city for milling and export. About 50 rice mills and 130 sawmills line the river and the larger canals of metropolitan Bangkok, which is also Thailand's chief centre for light manufacturing industry. Bangkok handles most of the nation's foreign trade, and dredging operations completed in 1954 make the city docks directly accessible to large ocean-going vessels. The government-owned port of Bangkok has modern installations which can handle ten 10,000-ton vessels simultaneously. Don Muang airport, 12½ mi. N. of the city, is the starting point of all internal routes, and its international traffic is the heaviest in southeast Asia.

One of the most colourful cities of the east, Bangkok attracts about 10,000 tourists annually, and offers television, night clubs, air-conditioned theatres and several excellent hotels. There are three big parks where the many fairs and festivals are held, and where kite fighting, one of Thailand's national sports, takes place. Bangkok's national theatre, the Silpakorn, presents traditional Thai dancing, drama and music. The exhibits of the national museum nearby include archaeological finds from earlier civilizations in Thailand, *objets d'art* of all kinds and historical lore.

Overshadowing Bangkok's other attractions are the several hundred Buddhist temples, with their glittering tile roofs and flashing spires. Among the finest are Wat Pho, which houses a huge gilded reclining Buddha and, along the gallery around the inner sanctuary, a fabulous array of early bronze Buddhas; Wat Suthat, noted for its carved and inlaid doors, early frescoes, and the giant swing, a survival of Brahmanic state ceremonies; and Wat Benchamabopit, an exquisitely detailed marble temple, whose central Buddha is a reproduction of the famous Phitsanulok image. The Grand palace, covering more than a square mile, provides an architectural feast, with its castellated walls and profusion of halls built at different periods. It includes the Dusit throne hall and Wat Phra Kaeo, both built by Rama I. The former ranks among the finest examples of traditional architecture, while the latter serves as the king's chapel and contains a sacred jasper image of the Buddha.

PHOTOGRAPH, C. R. SIEGEL, JR.

LARGE CHINA FIGURE STANDING IN FRONT OF THE "PORCELAIN" PAGODA, BANGKOK

Thailand's facilities for higher education are almost all centred in Bangkok. University instruction is offered in liberal arts at Chulalongkorn university; in law and applied social science at Thammasat university; in agriculture, forestry and fisheries at Kasetsart university; and in medicine at the University of Medical Sciences. The capital also has a college of education, a modern technical institute, an academy of fine arts with university status, and the national service academies. Bangkok is the home of the Siam society, founded in 1904 for the study of Thai culture, history and science. Over 25 daily newspapers are published in the city, including several in Chinese and English.

Bangkok is the permanent home of the United Nations Economic Commission for Asia and the Far East (ECAFE), regional headquarters of several UN specialized agencies, and a centre for international conferences. In 1955 it became headquarters of the Southeast Asia Treaty organization (SEATO). In addition to the Chinese, the foreign community includes about 10,000 Indians and Pakistanis, approximately 2,000 Europeans, over 1,500 Americans, and representatives of every east Asian country. If not the most cosmopolitan city of Asia, it is at least an uncommonly diverse meeting ground of east and west. (G. W. Sk.)

BANGOR, a municipal borough in County Down, N.Ire., lies on the southern side of Belfast lough, 12 mi. E.N.E. of Belfast by road or rail. Pop. (1961) 23,865. Area 3.7 sq.mi. Bangor is a seaside resort with a small harbour and rapidly expanding light industries. It is the headquarters of the Royal Ulster Yacht club. Its history began about 555 when St. Comgall founded a monastery. This was to become the most celebrated seat of learning of its time and two of Comgall's pupils, St. Columban and St. Gall, between them founded a number of monasteries on the continent of Europe. (St. Gall gave his name to one of the cantons of Switzerland.) Repeated incursions by Danes from the 9th century laid waste the settlement. It was partially rebuilt by St. Malachy in the 12th century and part of his stone church still stands. David Bailie Warden, a native of Bangor, fled after the rebellion of 1798 and later became U.S. ambassador to France and a member of the French Academy. (T. B. G.)

BANGOR, cathedral city and municipal borough (1883) of Caernarvonshire, Wales, is located at the northern entrance to the Menai strait, at the junction of the coast road with that from Capel Curig and Bettws-y-Coed. Pop. (1961) 13,977. Area 2.5 sq.mi. It is a notable educational centre. The University College of North Wales, founded there in 1884, became a constituent college of the University of Wales in 1893. Other educational facilities include a North Wales Counties' Training college which had an unusually distinguished succession of students in its early days, Church of England training college and a school for divinity, an Independent college and a Baptist college and a museum of Welsh antiquities. The boys' county school was founded in 1557 as the Friars' grammar school.

A depression running northeast-southwest divides the town into

two parts, Upper and Lower Bangor. Upper Bangor, on the northwest ridge, contains the buildings of the University college (1911, with later additions) and the residential quarter. On the southeast side of the valley, in Lower Bangor, are the chief shopping centre and the cathedral, small and low, inheriting traditions dating from the days of Celtic Christianity. St. Deiniol—to whom the cathedral is dedicated—founded a religious house there in the early 6th century. Successive structures were restored or rebuilt after destruction by Normans, by King John and by Owain Glyn Dwr (Owen Glendower, *q.v.*). In 1866 Sir George Gilber Scott undertook the restoration of the cathedral. The building, cruciform in design, comprises an aisleless choir, transepts and nave with aisles. A central tower projected by Scott was abandoned because of the danger of overloading the foundations. Early settlement in the neighbourhood is indicated by a British camp supposedly of Roman date on a height overlooking the town. Slight traces of a Norman moat and bailey castle can be found on a rock near the Friars' school. Bangor showed markedly conservative tendencies during the civil wars and was the centre of the Bangorian controversy (*q.v.*) in the early 18th century. The Congregationalist influence of the slate quarry workers of the neighbourhood during the 19th century made the town a centre of religious and educational movements.

Port Penrhyn nearby exports slates from the Penrhyn quarries near Bethesda. Penrhyn castle, the seat of Lord Penrhyn, stands in a large park northeast of Bangor. It is a modern copy, in Penmon marble, of a Norman castle.

BANGOR, a city of Maine, U.S., 76 mi. N.E. of Augusta; port of entry situated on the Penobscot river, 60 mi. from the ocean, and seat of Penobscot county. (For comparative population figures *see* table in MAINE: *Population.*) In 1604 Samuel de Champlain, the French explorer, was the first white man in the Bangor vicinity. The first permanent settler, Jacob Buswell, came from Massachusetts in 1769. Originally called Kenduskeag Plantation (1776) and later Sunbury (1787), the place was incorporated as a town in 1791; and was probably named Bangor by the Rev. Seth Noble after the tune name for one of his favourite hymns. Bangor received a city charter in 1834 and adopted a council-manager form of government under a charter of 1931.

The town was captured and briefly occupied by the British in the War of 1812 and made its greatest economic strides after the treaty of Ghent, which ended that war. Lumbering and shipping were the main industries, and the city became one of the leading lumber ports in the world before the American Civil War. In the last half of the 19th century, Bangor became an important commercial, manufacturing and trade centre. The city's varied manufactures include pulp and paper, lumber products, footwear, tools, extracts, caskets, canoes and sporting goods.

Bangor supports a symphony orchestra and a community concert association. The Bangor Theological seminary (Congregational, incorporated 1814) was established there in 1819. At Orono, nine miles up the river, is the University of Maine (founded 1865). (G. A. BI.)

BANGORIAN CONTROVERSY, a theological-political dispute in the Church of England arising from the publication in 1717 of *A Preservative Against the Principles and Practices of the Non-Jurors* by Benjamin Hoadly, bishop of Bangor. Hoadly contended that the civil government had jurisdiction over ecclesiastical affairs only when these endangered national peace, as when it deposed clergymen who refused allegiance to William and Mary. Later, in a sermon, he identified the church with the Kingdom of Christ, which is not of this world, and denied that officers of the earthly institution act literally with Christ's authority.

The lower house of convocation, already antagonistic to Hoadly's latitudinarian principles, received its committee report on the *Preservative* and sermon charging that the bishop had subverted all government and discipline in the church and had impugned the authority of the government in church affairs. But before further action could be taken, the government prorogued the convocation, which was not to meet again for over a century (*see* also CONVOCATIONS OF CANTERBURY AND YORK).

Over 60 writers, including the later famous William Law, joined in the controversy that raged for three years over such issues as permitting religious dissent, excluding thousands of English Christians from the national church, and using the sacraments as a test for political office.

BIBLIOGRAPHY.—*The Works of Benjamin Hoadly, D.D.* (1773) contains a bibliography of the pamphlets of the controversy. *See* also John Overton and Frederic Relton, *The English Church From the Accession of George I to the End of the Eighteenth Century* (1906); John Stoughton, *Religion in England Under Queen Anne and the Georges* (1878); Norman Sykes, *Church and State in England in the Eighteenth Century* (1934). (PA. H.)

BANG'S DISEASE: *see* BRUCELLOSIS.

BANGUI, the capital town of the Central African Republic, lies on the west bank of the Ubangi river at its bend southward where the Chad routes enter the Congo basin. Pop. (1959 est.) 79,634 of whom 2,790 were Europeans. The town is built below wooded hills which extend from the dense forest where the river widens below the Mission rapids. In its new African quarters, to the west in the marshy plain, the inhabitants are grouped by race and religion. The European town began among the mango trees on the bank, but has spread up the slopes. Development has been in three directions: along the river, where are the port and industrial quarter; westward along the Mbaiki road, where European plantations were established; and at the junction of hill and plain, where are the administrative buildings, modern residences, mission, hospital and civil aviation quarters. Industries include soap making, breweries and workshops, but the town is mainly commercial. The river port developments include a quay 1,300 ft. long and an oil port downstream. Exports include cotton, timber, coffee, sisal and cabbage palm (*Oreodoxa*); imports are building and industrial materials. Bangui is a hub of communications, being connected to the waterway and the roads to Cameroun, Chad and upper Ubangi. After 1960 these were supplemented by a railway to Chad and an airport. (J. D.)

BANGWEULU, the African name, meaning "large water," for a lake and extensive swamps in Northern Rhodesia which are part of the Congo river system. They lie at an altitude of 3,760 ft. above sea level and cover a triangular shaped area of about 3,800 sq.mi. The lake, at the northwest corner, is 45 mi. long by 24 mi. broad. It is shallow and has two inhabited islands, Chisi and Mbabala. A much larger island, Chilubi, at the edge of the swamp, has 6,000 inhabitants of the Babisa tribe.

The swamp is the result of excessive vegetation growth over a section of low gradient along the course of the Chambezi river, where it acts as a check to the annual flooding, releasing the flood waters slowly through a myriad of channels and lagoons, to issue as the Luapula river where the slope increases again.

There are many low islands in the swamp and a very large area known as the Lunga bank which used to support about 5,000 of the Unga tribe until they were flooded out about 1940. A survey showed that the disaster was the result of the choking of a main channel and a new channel, now known as the Debenham cut, was dug in 1949 and has resulted in the emergence of the Lunga bank once more and improved facilities for navigation by power launches.

For a long time, fishing in the lagoons of the swamp has been a native industry, and dried fish (valued at more than £100,000 or $280,000 annually) is exported to the industrial centre of the copper belt about 100 mi. to the west.

The vegetation responsible for the swamp consists of a high *Phragmites* reed growing just above mean water level, a zone of the well-known papyrus at water level and a floating grass, known as hippo-grass, in deeper water.

David Livingstone was the first white man to visit the lake in 1868 and he died on its southern border in 1873. Since then its history has been a peaceful one and the swamps are still rarely visited except by government officials and missionaries.

See F. Debenham, *Study of an African Swamp* (1952) and *The Way to Ilala* (1955). (F. DE.)

BANHA (BENHA), a market town of lower Egypt and capital of Al Qalyubiyah governorate, lies 29 mi. N. of Cairo by rail. Pop. (1957) 46,834. It has profited by its position at the bridging point of the Damietta branch of the Nile on the direct route from Cairo to Alexandria through the central delta

provinces, and has become an important road and railway junction, with rail connections to Az Zaqaziq and the canal zone, Zifta, Tanta and the northern delta, Minuf and Shibin al Kawm in the west. It stands between the Nile and the Tawfiqi canal in the heart of a highly fertile cotton-growing region. Unlike many other provincial capitals in the delta it has not attracted industries and those established relate to the surrounding agricultural produce: cotton ginning, some small cotton and flax mills, vegetable dehydrating and canning. Close by are mounds indicating the site of the ancient town of Athribis. (A. B. M.)

BANIA (Sans. *vanijya*, "trade") is an Indian caste designation generally used for any Indian moneylender or trader throughout northern and western India though, strictly speaking, many trading communities are not banias and, conversely, some banias are not traders.

Banias are supposedly descended from the twice-born "clean" Vaisyas of the fourfold division of Vedic society, with Brahmans and Kshatriyas above them and Sudras below. The innumerable bania subcastes are based on place of origin, special customs, ancestral claims and local gods.

In religion banias are Vaishnavas or Jains. They are strict vegetarians, teetotalers and orthodox in observing ceremonial purity. They are noted for ostentatious display. Trained as small boys in the family business to be skilful calculators of compound interest, they early acquire the acquisitive personality—hoarding, multiplying money by charging high rates on distress loans to the ignorant and impecunious, and worshiping their account ledgers. Gujarat has produced many famous bania bankers (seths), as has Rajasthan, original home of the omnipresent Marwari businessmen. India's great leader Mohandas Gandhi belonged to a Gujarati bania caste.

See D. R. Gadgil, *Origins of the Modern Indian Business Class*, an Interim Report, Institute of Pacific Relations (1959); H. B. Lamb, "Business Organization and Leadership in India Today," *Leadership and Political Institutions in India*, ed. by R. Park and I. Tinker, pp. 251–265 (1959). (H. B. L.)

BANIM, JOHN (1798–1842) and **MICHAEL** (1796–1874), two brothers, Irish novelists of peasant life. Sons of a small trader and farmer, both were born in Kilkenny, John on April 3, 1798, Michael on Aug. 5, 1796. John studied drawing in Dublin for a while and subsequently taught it in Kilkenny. Shortly afterward he went to Dublin where he earned a living by journalism. In 1821 his blank verse tragedy, *Damon and Pythias*, was produced at Covent Garden; John married, moved to London, and continued to live by journalism. In 1825 there appeared *Tales, by the O'Hara Family*, written in collaboration with Michael, who had studied for the bar but had had to take over his father's business. All three *Tales*—two by John, *The Fetches* and *John Doe*, and one by Michael, *Crohoore of the Bill Hook*—are remarkable for their intensity of imagination and melodramatic invention and were immediately successful, John being dubbed "the Scott of Ireland." He followed them with *The Boyne Water* (1826), a novel about the Jacobite wars in Ireland, and in 1826 a second series of *Tales* appeared, containing *The Nowlans*, a story of passion, guilt and religious fervour displaying a degree of insight which makes it possibly John's best novel. *The Croppy* (1828) is mainly by Michael, then an active supporter of Roman Catholic emancipation. The plot is conventional melodrama but the background, the Wexford rebellion of 1798, is memorably handled. Despite an intensely painful spinal malady, John continued to produce novels, including *The Denounced* (1830), *The Mayor of Windgap* (1835) and *The Smuggler* (1831), in which he attempted an English theme with some success. Ill-health eventually led to poverty, however, and in 1833 subscriptions were opened for him in England and Ireland. He returned to Kilkenny in 1835, was awarded a civil list pension, and died on Aug. 13, 1842. *Father Connell*, the Banims' happiest book, published the same year, was almost entirely by Michael, who continued to write but in 1873 retired to Booterstown, near Dublin, where he died, Aug. 30, 1874.

The Banims, primarily storytellers, delighted in complication, mystery, coincidence and dramatic confrontation. Their plots are often lurid to a degree and their dialogue preposterous, but in spite of this the romantic imagination that informs their work is sombre and powerful. As delineators of Irish life in their time they cannot compare, however, with William Carleton (*q.v.*).

See P. J. Murray, *The Life of John Banim* (1857). (A. Cr.)

BANISTER, JOHN (*c.* 1630–1679), English violinist and composer, the first organizer of public concerts in England, was born in London, *c.* 1630. He learned the violin from his father, and in 1660 joined the king's band of 24 violinists. After further training in France he became leader of a select group of 12 court violinists, and, later, of the 24. In Dec. 1666 he was ordered to submit to instruction from Louis Grabu, the French musician, who had become master of the king's music, and in March 1667 Grabu replaced him as leader of the king's band. Pepys records Banister's fury at this eclipse by foreign musicians, from which he never completely recovered, although he continued in the royal service.

Banister made musical history on Dec. 30, 1672, when he gave at his own home the first public concert for which admission was charged (one shilling). His reputation as a composer rests on his songs for plays by Dryden, Wycherley, Shadwell and other Restoration dramatists and especially on his settings of four of Ariel's songs for Shadwell's adaptation of *The Tempest* (1673). He died in London, Oct. 3, 1679, and was succeeded at court by his son John (d. 1735), who continued in the service of James II, William and Mary and Queen Anne, and was also principal violinist at the Italian Opera in Drury lane. (B. P.)

BANI SUWAYF (Beni Suef), a town of upper Egypt 77 mi. S. of Cairo by rail and capital of a governorate of the same name, stands on the west bank of the Nile, which there hugs the bluffs marking the edge of the Eastern desert. West of the town the valley is nearly 12 mi. wide and intensively cultivated. Pop. (1957) 70,100. The town is connected by a branch line with Al Fayyum to the northwest. Ten miles to the south is the site of ancient Heracleopolis Magna. The principal industry is cotton weaving.

Bani Suwayf Governorate consists of the flood plain of the Nile and extends about 45 mi. north to south in the Nile valley and averages 12 mi. in width, most of this being west of the Nile. To the east, between the Nile embankment and the foothills are stretches of barren gravel. It is bounded north by Giza governorate and south by Al Minya governorate, with the desert edge of the valley to the east and west. Pop. (1960) 859,000. Area 510 sq.mi. Famous antiquities include the 4th-dynasty pyramid of Seneferu at Maydum, 12th-dynasty pyramids of El Lahun and Hawara (Senusret II and Amenemhet III) and the ruins of Heracleopolis Magna, capital of middle Egypt during the 22nd dynasty. The river flood plain there is densely settled and among the most effectively irrigated parts of the Nile valley. About 67% of the occupied population is engaged in agriculture and the principal crops grown (in order of importance) are: cotton, maize (corn), wheat, millet, onions and dates. Perennial irrigation water is supplied from the Al Ibrahimiyah canal, Egypt's largest irrigation canal which parallels the Nile between Asyut and Giza. Industrial activities are limited to the processing of agricultural commodities, principally flour milling and cotton ginning. Alabaster is quarried near Bani Suwayf, the capital, which is the only large town.

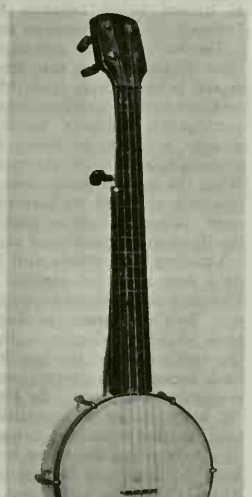
(A. B. M.)

BANJAK ISLANDS (Banyak Islands), a group of more than 60 small isles north of Nias and west of Sumatra, Indon. The largest island is Great Banjak, or Pulau Tuangku (meaning "chief's residence"), about 20 mi. long. The population is a mixture of settlers from north and central Sumatra (Achinese and Menangkabau) and from Nias. Most of them are Muslims. Agriculture (rice and root crops) is largely for subsistence, but copra is exported. (J. O. M. B.)

BANJA LUKA, a town in the people's republic of Bosnia-Hercegovina, Yugos., lies on the Vrbas river, a tributary of the Sava. Pop. (1961) 50,463. A railway line links the town with Belgrade, Zagreb and Sarajevo and a good road connects it with the Trieste-Ljubljana-Zagreb-Belgrade highway. The name is derived from ban, the title of the head of the Bosnian medieval state, and from the fact that the town is built at the head of a valley. The town was first mentioned by this name in connection with the Bosnian Ban Radislav (1295). Under the Turks Banja

Luka was an important military centre. They built many mosques, of which Ferhadiya is the most beautiful. The town is the seat of a Roman Catholic and also an Orthodox bishop. There is an important annual stock and produce fair, at which horse racing is a popular feature. In the town there exist the remains of Roman forts as well as of the Roman baths. In the 19th century Banja Luka played an important part in the uprisings of the Bosnian feudal lords against Istanbul as well as in the rebellions of the Serbs against the Turks (*see* BOSNIA-HERCEGOVINA: *History*). In 1941 Banja Luka—the town and the province—were made a part of the axis-created kingdom of Croatia, and during the course of World War II partisans liberated Banja Luka three times. The town, which has an industrial section built after World War II, has a machine tool factory, a steel mill, a power station, cloth, cereal and tobacco factories, a brewery and corn mills. (V. DE.)

BANJO, a stringed instrument originating in North America, apparently associated in the first place with the Negro population, who may have given it its name from the *bandju* of the Congo region. It is the only modern stringed instrument of western origin that employs a stretched skin membrane as the soundboard or belly. The circular body consisted originally of a wooden drumlike shell, open at the back, to which the skin, or vellum, was nailed. Later a "flesh-hoop" was introduced, with screw stretchers for varying the tension of the "head." The long neck, or handle, is "stepped in" to the body, its shank fitting into mortices at the top and bottom. Here again, the banjo is unique among western instruments in using this primitive stick-and-resonator construction, where all resistance to the pull of the strings is taken by this central member.

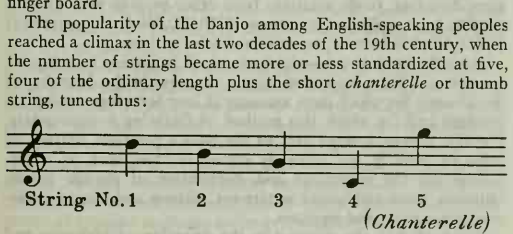


BY COURTESY OF THE METROPOLITAN MUSEUM OF ART, THE CROSBY BROWN COLLECTION OF MUSICAL INSTRUMENTS, 1889

AMERICAN BANJO, 19TH CENTURY

The first banjos had either nine or seven strings; six of the full-speaking length of the neck (about 24 in.), and from one to three shorter strings, about 16 in. long, the tuning pegs and nut being mounted on a thickening of the neck on the bass, or thumb, side nearest the player. These short high-pitched strings were played only by the thumb and were intended to complete the contour of melodies or upper parts of chords without awkward shifting of the hand. The strings were of gut, and passed from the pegs over a pressure bridge to a violin-type tailpiece or string holder at the bottom end. The neck was unfretted, like a violin finger board.

The popularity of the banjo among English-speaking peoples reached a climax in the last two decades of the 19th century, when the number of strings became more or less standardized at five, four of the ordinary length plus the short *chanterelle* or thumb string, tuned thus:



but sounding an octave lower than the written notes. Of these, the fourth (C) string was of silk, covered with fine copper wire, and the others usually of gut (later sometimes replaced by silk, with an occasional first string of steel). Tuning was by means of violin-type pegs mounted in the flat head. Later a screw adjustment was used to keep the pegs bearing properly without either jamming or slipping.

About 1890 the more sophisticated zither-banjo was introduced. The chief difference was in the body, the vellum being of smaller diameter and mounted in a frame suspended within a hollow-box resonator with a closed back, which threw the sound forward. The finger board was fitted with fixed metal frets, like the guitar, the number eventually reaching as many as 24. Metal frets began to be used on the ordinary banjo at about the same time. Since zithers use steel wire for strings 1, 2 and 5, they were fitted with "machine heads"; *i.e.,* screw-and-wheel adjusters for the pegs. A peculiarity of these machines was that they included a sixth peg for symmetry, although it was permanently useless. The *chanterelle* was tuned from the head, the unused part of the string passing beneath the finger board, to emerge at the fifth fret. This enabled the old excrescence and peg to be done away with, and the neck became streamlined for greater technical facility.

Other sizes of the banjo have included at various times the piccolo banjo, tuned an octave higher, the *banjeaurine,* a fifth higher, and bass and contrabass instruments. Banjo-type instruments have also been adapted to the pitch and tuning of the mandolin, with four pairs of steel strings; and, in miniature form, to the ukulele (*q.v.*), with four single gut strings. The tenor banjo is common. It is rather shorter than the standard instrument, with four strings only, tuned in fifths at viola pitch. The traditional technique is plucking with the fingers, but with modern instruments the plectrum is also used. (E. HA.)

BANK, SAVINGS: *see* SAVINGS BANK.

BANKER MARKS (MASONS' MARKS) cut upon the dressed stones of a building (though rarely seen on tracery or carved work), were apparently the personal trade-marks of masons working the stone at the banker (Ital. *banco*), or stonecutters' bench. They are to be seen widely in Europe from Roman times to the present, but most frequently on medieval work, when they were cut on the exposed face; since then they have been cut on the bed to avoid disfigurement. In Germany the same marks were also used by important masons as personal badges. These personal marks were often passed from father to son. From the 16th century, when others besides working masons were admitted to masonic guild lodges, they too were allocated banker marks, which were entered in the lodge register.

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BANK FOR INTERNATIONAL SETTLEMENTS. The Bank for International Settlements (B.I.S.) at Basel, Switz., was created with two purposes in mind: (1) to provide an agency to handle the payment of reparations by Germany after World War I (*see* REPARATIONS); and (2) to establish an institution for co-operation among the central banks of different countries (*see* CENTRAL BANK). The objects of the bank were stated as follows in its statutes:

> to promote the co-operation of central banks and to provide additional facilities for international financial operations; and to act as trustee or agent in regard to international financial settlements entrusted to it under agreements with the parties concerned.

A committee drew up the basic documents creating the bank in 1929; the Hague conference of 1930 confirmed them, and the bank started business on May 17, 1930. The bank's capital was fixed at 500,000,000 gold francs, but of this amount only 25% had been paid up by 1961. Subscription of the capital was originally guaranteed in equal parts by the central banks of Belgium, France, Germany, Great Britain and Italy and by two banking groups, one Japanese and the other from the United States. The shares issued to the Japanese banking group were repurchased in 1952 by those of the European central banks which originally guaranteed the subscription of the bank's capital, the Japanese government having renounced in 1951 all its rights concerning the bank. In the early 1960s most of the U.S. shares were in European hands and

the membership of the *B.I.S.* extended to all European central banks except that of the U.S.S.R.

At the outset the bank was to receive reparations payments from Germany and allocate the proper share to each creditor nation. Under the impact of financial crisis, however, Germany's payments of the reparations provided for in the Young plan (*see* YOUNG, OWEN D.) were suspended by the Hoover moratorium of July 1931. The bank was active in attempts to counteract the crisis and participated in the granting of international credits. Within the framework of the Young plan, it had made certain investments in Germany the total of which has remained, from 1932, unchanged at about 300,000,000 gold francs. An agreement was concluded in 1953 with the Federal Republic of Germany for the settlement of these investments.

Excluding the amount of long-term government deposits of 228,909,375 gold francs and corresponding investments under the Hague agreements of 1930, the total of the bank's balance sheet on March 31, 1961, was 3,973,433,539 gold francs. The bank's own funds, consisting principally of the paid-up capital, the reserves and the major part of the provisions for contingencies, amounted to about 342,000,000 gold francs. These funds were held in gold, both to provide the high degree of liquidity necessary for an institution in receipt of central-bank funds and as a basis for the bank's manifold transactions in terms of gold. Under its statutes the bank may undertake only operations that are in conformity with the monetary policy of the countries concerned. Its operations have been short term, both as regards its granting of credits and its purchases and sales of gold and foreign exchange. The bank showed a profit every year, except for 1945. Dividend payments were suspended in that year but resumed in 1951.

In 1947 the bank was appointed agent for the execution of the first intra-European compensation agreement initiated under the Marshall plan (*q.v.*), and in 1950 it became agent for the Organization for European Economic Cooperation in respect of the European Payments Union (*q.v.*). After the liquidation of the latter at the end of 1958, the bank was appointed agent of the Organization for European Economic Cooperation (later of the Organization for Economic Cooperation and Development) in respect of the European monetary agreement.

In 1954 the bank was invited to undertake certain functions as depositary under the terms of an act of pledge concluded with the high authority of the European Coal and Steel Community (*q.v.*).

The monetary and economic department of the bank is responsible for the preparation of the bank's annual report. It has also made special studies, at the request of the central bank concerned, of the economic and financial position of a number of special areas, including Austria, France, Italy and the sterling area.

The B.I.S. is thus an international bank which makes its services available to the European central banks, a centre for economic and monetary research and consultation and a technical agent for the execution of certain specific agreements. The founders of the bank attached great importance to the permanent contacts which the bank would make possible between officials of different central banks. Apart from the war years, the central-bank governors who are members of the board of directors have held regular monthly meetings in Basel, and the governors of other central banks have attended annual meetings and made other occasional visits. *See* also INTERNATIONAL PAYMENTS; MONETARY AGREEMENT.

(P. J.)

BANK FOR RECONSTRUCTION AND DEVELOPMENT, INTERNATIONAL. This bank was established as an international organization, designed to help finance sound projects for reconstruction and development—reconstruction in war-devastated countries and development of world economic resources, particularly in underdeveloped regions. Commonly known as the World bank, it had its origin in preparations for postwar international financial and economic co-operation which culminated in the United Nations Monetary and Financial conference held in July 1944 at Bretton Woods, N.H. Out of this conference, at which 44 nations were represented, grew two complementary, but separate, organizations: the International bank and the International Monetary fund.

The principal purposes of the bank, set forth in its articles of agreement (charter), may be summarized as follows:

1. To assist in the reconstruction and development of its member countries by facilitating the investment of capital for productive purposes, thereby promoting the long-range growth of international trade and improvement of standards of living.
2. To promote private foreign investment by guarantees of and participations in loans and other investments made by private investors.
3. When private capital is not available on reasonable terms, to make loans for productive purposes out of its own resources or funds borrowed by it.

The bank came into existence on Dec. 27, 1945, when its articles of agreement were signed by 29 governments. The bank officially began operations at its headquarters in Washington, D.C., in June 1946. By June 30, 1961, the bank had 68 member countries. The largest of these, in terms of capital subscribed, were the United States, the United Kingdom, France, Germany, India, Japan, Canada, China (Formosa) and the Netherlands. Also among the bank's members were many smaller or less wealthy countries such as Iceland, Israel, Lebanon, Luxembourg, Afghanistan, Libya, Denmark, Ghana, Yugoslavia and the Latin American republics.

The bank's charter authorized it to engage in the following types of financing: it may lend funds directly, either from its capital funds or from funds which it borrows in private investment markets; it may guarantee loans made by others; or it may participate in such loans. Loans may be made to member countries directly, or to any of their political subdivisions, or to private business or agricultural enterprises in the territories of members. When the member government in whose territory the project is located is not itself the borrower, however, this member government, its central bank or some comparable agency acceptable to the International bank must guarantee the loan.

Lending Operations and Policies.—The first loans by the bank were made for urgently needed reconstruction in several European countries whose economies had been damaged by the war. By 1949, however, emphasis in the bank's lending had shifted to developing productive facilities and resources, particularly of the bank's economically less developed member countries. The bank became an important source of long-term capital for this economic development. By June 30, 1961, the bank had granted 292 loans totaling the equivalent of $15,790,000,000 (net of cancellations and refundings through subsequent loan operations) to 57 countries and dependent territories. The distribution of the loans is indicated by the fact that 35 loans were made to Africa, 85 to Asia and the middle east, 6 to Australia, 60 to Europe and 106 to Latin America.

The bank obtains its funds for loans from paid-in capital subscription, from borrowings in the capital markets of the world and from net earnings. Sales to investors of portions of the bank's loan portfolio and repayments of loans to the bank, while representing only a recovery of funds originally derived from one of the above sources, have the same effect as new capital in that they reduce the amount the bank would otherwise have to obtain from other sources. The capital markets of the world provide the largest amount of funds for loans. By June 30, 1961, the bank's outstanding funded debt amounted to $2,228,500,000. On the same date loan funds available from other sources were $1,651,000,000 from capital subscriptions; $379,000,000 from operations; $1,451,500,000 from repayments and sales of loans.

Since the bank is primarily a source of long-term loan capital, its resources have been used largely to assist in the financing of investments for which large amounts of long-term loan capital are required and for which this method of financing is appropriate. For this reason, a large part of the bank's portfolio consists of loans to publicly and privately owned utilities, such as undertakings for the generation and distribution of electric power, railroads, ports and inland waterways, airlines and airports, telecommunications, and pipelines.

The bank has also assisted in the financing of highways and roads. It has made loans to industrial enterprises, to development banks which in turn finance industrial activities, for the expansion of agricultural production through farm mechanization, irrigation and flood control, and land clearance and improvement, crop

processing and storage, livestock development and forestry.

Loan Procedure.—Among the conditions that must be met before the bank can consider a loan are the following, derived from the articles of agreement: (1) the project for which the loan is sought must be for a productive purpose; (2) the borrower must be unable to obtain the loan elsewhere on reasonable terms; (3) there must be a reasonable prospect that the borrower, and the guarantor also, if there is one, will be able to meet the obligations contracted under the loan; (4) if a member government is not the borrower, the loan must be guaranteed by the member in whose territory the project is located. The bank established the procedure, before making a loan, of sending bank representatives to the prospective borrowing country to make an investigation on the spot. This investigation ordinarily covers the country's economic and financial position generally, as well as the specific project for which the loan is sought.

As a matter of general policy the bank lends only for specific projects, and only for the cost of imported material and equipment and services obtained from abroad. Disbursements are usually made directly to the supplier. But, if special circumstances warrant, it departs from this general policy and makes loans to finance the foreign exchange expenditures of a broad general development program, or, alternatively, it agrees to the use of loan proceeds to cover investment expenditures incurred in the borrowing country itself.

As contemplated in its charter, one of the important aspects of the bank's lending operations is that in general the proceeds of its loans can be used for purchases in all member countries and certain other countries and not only in the country whose currency is used in a particular loan operation.

In the early years of its operations, bank loans were used almost exclusively for purchases in the United States because other countries did not have available significant amounts of capital goods for export. As productive capacity recovered throughout the world, this situation changed radically and borrowers from the bank obtained a great deal more of the goods they needed from sources outside the United States. The bank obtains the particular currency needed by the borrower either out of its own holdings in that currency or by purchasing it with other currency that it holds. In the first case the loan is repayable in the currency provided to the borrower; in the second case the loan is repayable in the currency used by the bank to buy the currency furnished to the borrower. By June 30, 1961, total disbursements amounted to the equivalent of $4,319,500,000, of which $2,709,500,000 was repayable in U.S. dollars and the remainder in 31 other currencies.

Technical Assistance.—In addition to financial assistance, the bank, as a service to its member countries, furnishes them with technical assistance, partly in connection with its loan operations and partly independently of them.

Between 1949 and 1961 the bank organized 20 survey missions to 8 countries in the western hemisphere, 6 countries in Asia, 5 countries in Africa and 1 European country. The purposes of these missions were to survey the development potentialities and problems of the countries and to make recommendations designed to assist the governments in formulating long-term development programs. The reports of these missions were published by the bank and, in most instances, by the government of the country that had invited the mission.

The bank also provides technical assistance to its member countries in different forms and with more limited objectives. It has stationed special representatives in several countries in Latin America and Asia to assist the authorities in the preparation of development or public investment programs. It has organized, in co-operation with the Food and Agriculture Organization of the United Nations, missions to survey the possibilities of agricultural development in four countries, and co-operated with the governments of member countries in the preparation of special surveys.

Economic Development Institute.—As a further extension of its technical assistance activities, the bank established, in 1955, the Economic Development institute, a training centre for government officials of underdeveloped countries and territories concerned with the formulation and execution of development policies and programs. The institute offers an intensive six-months seminar course in which economic problems of underdeveloped countries are analyzed, to a large extent on the basis of the bank's experience with its member countries, and in which the participating officials who come from government departments, central banks and public development institutions have an opportunity to exchange their own views and experiences.

International Development Association.—In Sept. 1960 the bank established the International Development association (IDA) as an affiliate. Its purpose is to provide loans to less-developed countries on more flexible terms than those of conventional loans. IDA and the bank are administered jointly to assure effective co-ordination.

Capital Structure.—The bank's capital is derived from subscriptions by its member countries to shares of capital stock. Members' subscriptions in general are in proportion to their economic resources. When the bank was established, its authorized capital was $10,000,000,000. Of this amount, only 20% was paid in by member countries, partly in gold and partly in their national currencies; 80% remained on call and served to support the bank in its borrowing operations in the money markets of the world. By mid-1959, with the funded debt of the bank approaching $2,000,000,000, it was clear that the continued high rate of demand on the bank for development loans meant that it would frequently be in the market to borrow funds for its operations. Therefore on Sept. 15, 1959, as a result of action by the bank's board of governors, the authorized capital was increased to $21,000,000,000, and each member was asked to double its subscription, the additional capital to remain on call. The effect was to provide massive additional guarantee resources to serve as backing for the bank's sales of bonds and notes to investors. In addition, several members of the bank made further increases in their capital subscriptions and 10% of these increases were paid in cash. As a result, subscribed capital rose from $9,500,000,000 to $20,093,000,000 by June 30, 1961. Of this amount, roughly $1,651,000,000 was available to the bank for its operations.

Marketing Operations.—The bank began its borrowing operations in 1947 when two bond issues totaling $250,000,000 were publicly sold in the United States. In the bank's earlier years, the U.S. investment market was the principal source of borrowed funds. Progressively, however, the bank succeeded in broadening the market for its issues on an international scale. There were 46 issues of bonds and notes outstanding by June 30, 1961, aggregating $2,228,500,000; they were held by investors in about 40 countries. The outstanding bonds and notes were denominated in U.S. dollars, Belgian francs, Canadian dollars, deutschemarks, Netherlands guldens, pounds sterling and Swiss francs. In the United States the bulk of trading in the bank's bonds is on the over-the-counter market, but they are also quoted on the New York Stock exchange and on all major exchanges in Europe. The maturities and other terms affecting the bank's issues are determined by market conditions and the requirements of the bank.

In addition to direct borrowing, the bank sells to financial institutions securities it receives from borrowers in connection with its loans. In this way, as well as by its own borrowings, the bank acts as a channel for the flow of private capital into international investment. By June 30, 1961, the bank had sold or had agreed to sell to investors the equivalent of $1,013,000,000 from its loan portfolio.

Interest Charges and Financial Results.—Interest and other charges are on a nondiscriminatory basis without distinction among borrowers. The total interest rate charged on loans consists of three components: the estimated cost of borrowing to the bank; a 1% commission which the bank levies for the purpose of creating a special reserve against losses; and a small fraction out of which administrative costs are met. Between 1953 and 1960 the interest rate varied between 4% and 6¼%.

In the fiscal year 1960–61, the bank's net income amounted to $63,000,000. This income was placed in the supplemental reserve against losses on loans and guarantees bringing that reserve to $408,000,000; loan commissions were credited to the bank's special reserve, increasing that reserve to $193,500,000. By June 30,

1961, the total of their reserves had risen to $601,500,000.

Administrative Organization.—The bank's charter provided for an administration composed of a board of governors, executive directors, a president and staff. All powers of the bank are vested in the board of governors consisting of a representative appointed by each member. This board meets normally once a year.

The board of governors delegated most of its powers to a board of executive directors. Five executive directors are appointed by the five largest stockholders. The other executive directors are elected by the governors of the remaining member nations for two-year terms. Each executive director is entitled to cast the number of votes of the member or members by which he was appointed or elected. Each member country is entitled to 250 votes plus 1 vote for each share of capital stock held.

The president of the bank is ex officio chairman of the executive directors. He is selected by the executive directors, and is the chief executive officer of the bank. Subject to their general direction on questions of policy, he is responsible for the conduct of the business of the bank and for the organization of its staff. In June 1961 the bank's operating staff consisted of approximately 700 persons representing about 50 different nationalities.

The first president of the bank was Eugene Meyer, who held office from June to Dec. 1946. He was succeeded by John J. McCloy, who took office in March 1947 and held the presidency until June 1949. Eugene R. Black became president of the bank on July 1, 1949.

See INTERNATIONAL MONETARY FUND; UNITED NATIONS: *Economic and Social Co-operation;* FREE TRADE: *Later Methods of Trade Regulation;* PAN-AMERICAN CONFERENCES: *Ninth International Conference of American States: Economic Matters;* MONETARY AGREEMENT; INTERNATIONAL FINANCE CORPORATION; *see* also references under "Bank for Reconstruction and Development, International" in the Index.

See International Bank for Reconstruction and Development, *Annual Reports* and *The World Bank, Policies and Operations* (June 1957).

(JN. H. A.; X.)

BANK HOLIDAYS, in the United Kingdom, are those days which by the Bank Holidays act of 1871 and by a supplementary act of 1875 are observed as holidays in all banks in England, Wales, Northern Ireland and Scotland. They are not statutory public holidays; their observance, however, is no longer limited to banks. Before 1830, the Bank of England closed on approximately 40 saints' days and anniversaries, but in that year the number was reduced to 18 days. In 1834 they were further reduced to four—Good Friday, May 1, Nov. 1 and Christmas day. By the act of 1871, the following were constituted bank holidays in England, Wales and Ireland: Easter Monday, the Monday in Whitweek, the first Monday of August, Dec. 26 if a weekday and, by the act of 1875, Dec. 27 when Dec. 26 falls on a Sunday; and by the Bank Holiday (Ireland) act, 1903, March 17, St. Patrick's day (or, if that is a Sunday, the next following day) as a bank holiday for Ireland. In England, Wales and Northern Ireland, Christmas day and Good Friday are bank holidays under common law. In Scotland, New Year's day, Christmas day, Good Friday, the first Monday of May, the first Monday of August or, if Christmas day and New Year's day fall on a Sunday, the next Monday following are bank holidays under the act of 1871. By the same act it was made lawful for the sovereign to appoint by proclamation, any day to be observed as a bank holiday throughout the United Kingdom or any part of it, or to substitute another day. These powers may be exercised in Northern Ireland by the governor in council and it has become customary for July 12 (the anniversary of the battle of the Boyne, 1690) to be appointed a bank holiday in Northern Ireland. Bank holidays are observed in customs and excise establishments under the Customs and Excise act, 1952. (E. E. Bs.)

BANKING. In this general survey of banking several aspects of the subject are examined in separate sections, as the following outline indicates:

I. History of Banking
  A. Ancient and Medieval World
  B. Modern Europe
  C. Great Britain and the Commonwealth of Nations
  D. The United States
II. Principles of Banking
  A. Creation of Deposits
  B. Reserves and the Limitation of Deposit Creation
  C. Central Banking in Relation to Commercial Bank Reserves
  D. Theory of the Banking Firm
  E. Development of Banking Principles
III. Practice of Banking
  A. Deposits
  B. Lending Operations
  C. Investment Practices
  D. Relations With Other Financial Institutions

In a discussion of banking it is essential at the outset to distinguish between commercial banks and central banks. Central banks may be viewed as "bankers' banks." They are lenders of last resort to the commercial banks; they regulate the monetary and credit conditions of the countries in which they operate; they act as banks and fiscal agents to governments; and, usually, they have a monopoly of the note issue. In the exercise of their function as lenders to banks and to governments, they create credit and thus fulfill the essential function of a bank. In many countries they serve both as central banks and as commercial banks. (*See* also CENTRAL BANK.)

A modern commercial bank provides a wide variety of services to its customers. It usually accepts savings deposits. It may maintain a vault with individual safe-deposit boxes available to its customers on a rental basis, and it may serve as an administrator of trust funds. A commercial bank may also offer a broad range of other services such as the purchase of travel tickets, the disbursement of dividend payments for corporations and the payment of amounts due on behalf of its customers. These activities impose great responsibilities on banks and require highly developed skills; but they involve relatively little theoretical analysis.

The commercial bank, in its characteristic role, makes loans, accepts deposits and provides a means of payment by the transfer of deposits from one account to another. Its most distinctive feature, however, is its power to create credit and thus add to the money supply by lending sums larger than the sums deposited with it in actual cash. To describe and define a commercial bank as a bank that has the distinctive power to create money and credit excludes from this category a number of institutions frequently referred to as banks. Such a definition excludes savings banks (*q.v.*), investment banks (*see* INVESTMENT BANKING), trust companies (*see* TRUST COMPANY) and other institutions in the financial field that lack the power to create credit. Institutions of this latter type are not discussed here apart from incidental reference.

I. HISTORY OF BANKING

There exists little historical evidence as to the nature of banking operations before the 13th century. For the earlier period, the distinction between commercial banks and other types of banks is difficult to make with certainty. As A. P. Usher points out, it is very difficult in this early period to differentiate between the activities of dealers in coin and in bullion from the activities of banks. Money-changers and bankers were often viewed as one and the same. Although there are very early records of loans and of deposits it does not follow that they constitute evidence of banking activity in the sense in which we have defined it. Such early transactions may not have involved the creation of credit but may well have been limited to the acceptance of deposits and the making of loans. Thus what follows must be read in the light of these views and in the light of the commonly held opinion that commercial banking evolved only in the later medieval period from the much older functions of moneylending and money-changing. Central banking, of course, is of comparatively recent origin and development.

A. Ancient and Medieval World

There are records of loans by the temples of Babylon as early as 2000 B.C. As temples were considered sacred places under the special protection of the gods, they were not likely to be robbed, and thus were considered safe depositories. Companies of traders

also carried on banking functions connected with the buying and selling of goods. A notable example in ancient Babylon was the Igibi bank that flourished in the 6th century B.C. In Greece by the 4th century B.C. financial activities were being performed by the temples, by public bodies and by private firms. The latter accepted deposits, made loans, tested and changed coins and arranged credit transactions between cities to avoid the movement of specie. The Greek system was imported into Hellenistic Egypt and also influenced Rome. Roman law recognized payment in bank in discharge of a debt, and in the 2nd century A.D. public notaries were appointed to register such transactions.

The decline of trade after the breakup of the Roman empire made banking facilities less necessary, and at the same time usury laws imposed restraints on lending. Records from Genoa and other Italian cities go back to the 12th century, but it is not until the 14th century that a large volume of evidence is available. By this time the trade of Europe had developed along two main lines: (1) the Italian cities and, later, Bruges, Antwerp and the towns of the Hanseatic league became centres of warehouse trade and developed local banking systems; and (2) at certain centres of communications there grew up the great international fairs, of which those of Champagne (an ancient province of France) are the most famous, with their own system of finance through ambulatory bankers and also their function as centres for international clearings. Distinct from both these systems were the international financiers who were concerned, among other things, with the finance of the international wool trade, the collection and transmission of papal revenues and making loans to kings and princes.

When deposit banking re-emerged in medieval Europe, the only way of transferring bank credit was through oral instruction by the debtor and acceptance by the creditor in the presence of witnesses. Holograph documents (written in the hand of the principal) came into use in the 13th and 14th centuries, and by the second half of the 14th the nonnegotiable bill of exchange (*q.v.*) was firmly established. But the use of any document serving the purpose of the modern check was only occasional before 1500, and the legal doctrine of negotiability evolved only gradually from the 16th to the 18th centuries.

At the Champagne fairs the value of purchases appears to have been recorded in the books of a fair banker as they were made. At the end of the fair the various book debts were offset, so far as possible, against one another, and balances settled either in cash or by drawing a bill payable at the next fair. By the 15th century the fairs were also serving as clearinghouses for payments arising in other forms of trade; for example, the Cely family in England was taking bills payable at the fairs in payment for wool exported through the Calais staple; and similar methods seem to have been used at the other important fairs. The system, though ingenious and highly important in its day, involved neither deposits nor credit creation, so that it did not contribute much to the evolution of modern banking.

The same might be said of the great merchant bankers who dominated high finance during the middle ages and the Renaissance. The men of Piacenza were the first Christian bankers to challenge the monopoly of the Jews in this field. They were soon displaced by others from Siena, Lucca and Florence, but the name of Lombard clung to them all and was adopted for the street in London where money-lenders carried on their business. The Bardi and Peruzzi of Florence and the Frescobaldi of Lucca played a big part in the state finances both of England and France, but their power was broken by Edward III's repudiation of his debts in 1339 followed by the confiscation of their property in France and by a revolution in Florence. Native financiers such as William de la Pole in England and Jacques Coeur in France were unable for long to meet the growing needs of their governments, and the 15th century saw a second period of Florentine financial power. This time the outstanding family was that of the Medici, who laid the foundations of their immense fortune as financial agents for the papacy. The Florentines suffered again from defaults and confiscations and gradually lost ground to Genoese and Germans. One other name must be mentioned, that of Fugger, the family who were the greatest moneylenders of the 16th century: they played a vital part in the election of Charles V as emperor and supported him through all the vicissitudes of his reign and also had extensive dealings in Germany, Italy, Hungary, Spain, the Netherlands and England. However, they too suffered the common fate of their kind, meeting their ruin in the crash of the Spanish state finances at the end of the 16th century. These and other smaller firms dealt to some extent in borrowed money, though they relied largely upon their own capital; they had little interest in ordinary commercial finance and were agents for the raising of government loans and the management of the resulting exchange transactions rather than bankers in the modern sense.

The sedentary bankers of the Mediterranean cities, especially Venice, Genoa and Barcelona, were the direct ancestors of modern commercial bankers. They accepted deposits which were regularly transferred from one account to another in payment for commercial debts; the normal method of transfer was by an entry inscribed by the banker in his books in the presence of both debtor and creditor. In the 14th and 15th centuries Venetian bankers allowed customers to overdraw their accounts, but this was regarded as an abuse. Failures among them were common, and as early as 1356 there were proposals for the establishment of a public bank. It was not until 1587, however, that the Banco della Piazza di Rialto was founded in Venice. It was to receive deposits in coin, to transfer them from one account to another and to pay bills of exchange, but it was not to make loans nor, since it had no legal source of revenue, did it pay interest on deposits. Its services were performed free, expenses being a charge to the state. The constitution was not strictly observed, and the bank did make loans, especially to the government, and got into difficulties as a result. It was to meet the difficulties of the state that the Banco Giro was formed in Venice in 1619, the creditors of the government agreeing to accept payment in the form of credits with the new bank. The two public banks were fused in 1638 and continued to operate until 1806. Other important public banks dating from the middle ages were the Casa di San Giorgio in Genoa (1407) and the Bank of Deposit in Barcelona (1401).

The Bank of Amsterdam, founded in 1609, was similar in constitution to the Banco della Piazza di Rialto. Its original functions were to accept and transfer deposits, to exchange coins, to purchase specie and uncurrent coin for the mint and to act as a clearinghouse for bills of exchange. All bills of more than 600 florins were to be made payable at the bank, but this law was not strictly enforced. The overdrawing of accounts was prohibited, but the bank did give credit to certain institutions, including the city of Amsterdam and the Dutch East India company. By the beginning of the 18th century bank deposits had become inconvertible, but for many years they circulated freely and the bank maintained their value by prudent management. However, it suffered severely in the French wars at the end of the 18th century and was liquidated in 1819. Similar banks were founded in other Dutch cities and, in 1619, at Hamburg.

B. Modern Europe

France.—At the beginning of the 18th century, when banking in England was making rapid progress, France suffered from the failure of the financial system of John Law (*q.v.*). The Banque Générale was founded in 1716 as a bank of deposit and also of note issue, but its constitution provided that notes were to be issued only against the deposit of coin and that no credit was to be given to private customers. However, the bank soon became involved with the rest of the system and these principles were disregarded. In 1717 the Compagnie d'Occident was formed to trade with Louisiana, and two years later it was transformed into the Compagnie des Indes, with a monopoly of foreign trade and the right to farm the customs. Law now proposed to repay the public debt by making the creditors of the state shareholders in the company. In 1718 the bank, then known as the Banque Royale, had its notes made legal tender. It became more and more involved with the company, issuing a great volume of notes in order to support the value of the company's shares in the market. These reckless issues helped to produce a violent inflation and to bring

about the collapse of the system in 1720. The holders of Law's notes lost heavily and the idea of a note-issuing bank was discredited in France for many years to come.

A number of banks doing discount and deposit business were founded during the 18th century, but there was no bank of issue until 1776. Then Blanchaud (a Swiss) and Clouard (a Scot) formed the Caisse d'Escompte, which made overgenerous advances to the government and was liquidated in 1793. In 1796 a syndicate of private bankers in Paris founded the Caisse des Comptes Courants, and shortly afterward the Caisse d'Escompte de Commerce was formed by a commercial group. Both were taken over by the Bank of France in 1800 and 1803, respectively. (*See* BANQUE DE FRANCE.)

The Bank of France was founded in 1800 and received its basic constitution in laws of 1800, 1803, 1806 and 1808. The management was entrusted to a governor and 2 deputy governors appointed by the head of the state and a council of 15 regents and 3 auditors elected by the general assembly of the 200 largest shareholders. The business of the bank was to be note issue, receipt of deposits on current account, collection and discount of bills of exchange and dealing in precious metals. It also acted as banker to state and was at times called upon to make large advances to the government. In 1803 the bank was given a monopoly of note issue in Paris. A number of provincial banks of issue were founded under the July monarchy, but all their notes were discredited during the 1848 revolution, and the Bank of France arranged amalgamations with them. Thenceforward (apart from a brief interval in which other notes circulated in Savoy after its cession to France) the Bank of France was the sole issuing body. There was no legal requirement of a reserve. A maximum issue was fixed by law, but the restriction had little meaning: in times of difficulty the bank always asked for and obtained an increased issue. Notes were made legal tender and inconvertible in 1870, but full convertibility was restored in 1878. The law of 1808 empowered the bank to establish branches, and several were set up between 1830 and 1840. Under a law of 1857 the bank could be compelled to set up at least one branch in each *département,* and at the end of the century about 120 branches had been established.

For many years the Bank of France was practically the only institution offering facilities for the transfer of current-account balances. The check was little used and was not fully recognized in French law until 1865. Hence, the circulation both of notes and of bills of exchange was much greater than in England. The bank discounted very small bills, but normally insisted on three signatures and so remained predominantly a bankers' bank. It always maintained a very large reserve. The law of 1803 placed France on a bimetallic standard, and the bank commonly cashed its notes in silver. After 1875, however, gold was the only metal suitable for export, and the bank strove to build up its gold reserve, which, by 1907, accounted for about four-fifths of the total reserves.

The Bank of France always came freely to the assistance of other banks in time of crisis but appears to have made little effort toward credit control during the first half of the 19th century. The private banks and later the joint-stock banks did chiefly a discount business and, in the absence of an organized discount market, rediscounted directly with the central bank. The Bank of France had neither the powers nor the opportunities for open-market operations of the type being developed by the Bank of England, and it was not until 1857 that its discount rate was freed from the restriction of the usury laws. Under these circumstances the bank could vary only the time allowed for payment of the bills which it would discount, and this was done on occasions. After 1857 discount rate was used as an instrument of policy, but only sparingly. In an effort to minimize fluctuations the bank bought gold at a premium, sold at a premium (until 1897) or availed itself of the bimetallic law to refuse gold for export when it thought such action expedient. On the other hand the bank gave assistance to foreign institutions on a number of occasions when it appeared that this course would minimize the ultimate pressure on France; the transactions with the Bank of England in 1839, 1890 and 1907 are outstanding examples of this practice.

The only other banking development before 1848 was the foundation of a large number of small banks doing discount (lending) and deposit business. These banks remained numerous throughout the century, but their importance declined greatly in face of competition from the big joint-stock banks. The first of these, the Comptoir National d'Escompte de Paris, was founded as an emergency measure in 1848 and was followed by the Crédit Industriel et Commercial (1859), the Crédit Lyonnais (1863) and the Société Générale de Crédit (1864). These banks set out to develop the check system and attracted deposits by opening a nationwide network of branches and offering attractive rates of interest. They participated to some extent in the issue of industrial shares, but their advances to industry were very limited; by far the most important part of their business with industry and commerce was in the form of discounts.

A few institutions on the periphery of the banking world deserve mention. The Crédit Foncier and the Crédit Mobilier were both formed in 1852; both did a limited deposit business, but the former was chiefly an agricultural mortgage company and the latter an investment bank. The Crédit Mobilier, after a spectacular career, was liquidated in 1867, but the Crédit Foncier remained an important part of the French financial system. The successors of the Crédit Mobilier were the *banques d'affaires,* or business banks, of which the first was the Banque de Paris et des Pays Bas (1872). These firms were chiefly concerned with the marketing of industrial securities and, although they accepted deposits from firms with which they had dealings, they did not seek deposits from the general public.

Germany.—There were few banks of any significance in Germany before the middle of the 19th century. The Bank of Prussia, forerunner of the Reichsbank, did only a small and old-fashioned business until 1846, when it received a new constitution and began to grow rapidly. The old Hamburg *Giro* bank continued its business until absorbed by the Reichsbank in 1875. The Seehandlung, formed as a state-owned trading company by Frederick the Great, acted as banker to the Prussian government and did a limited general business. There were wealthy merchant bankers engaged in international finance, and the Rothschilds were extending their activities from Frankfurt am Main over the whole of Europe; but the local private banker was still doing only a small and primitive business. Banks of issue were subject to regulation by the various states; the first was formed in Bavaria in 1834, and there were 33 in existence in 1875.

The Bank of Prussia was transformed into the Reichsbank in 1875. The capital was privately owned, but the representatives of the shareholders had mainly advisory functions; the bank was managed by a president, vice-president and directorate appointed by the emperor on the nomination of the Bundesrat and was subject to the supervision of a state-appointed curatorium.

The act of 1875 regulated the issue of bank notes. Each bank received an "indirect contingent" of notes not covered by cash (the Reichsbank received 250,000,000 marks out of a total of 360,000,000), and there was a tax of 5% on uncovered issues in excess of this. It was further provided that all notes must be covered by a reserve of one-third in gold, current coin or imperial notes (an issue fixed in 1874 at 120,000,000 marks). By 1905 only four banks besides the Reichsbank retained their issues, and these accounted for only 6% of the total bank-note circulation. Reichsbank notes were made legal tender in 1909.

The Reichsbank was required to provide banking facilities for the whole empire, and no other central bank used the branch system so extensively. Within 30 years from its foundation the bank established about 100 main branches and more than 4,000 sub-offices. With the development of the branches went that of the transfer system. Even persons without an account might, for a small fee, pay money in for transfer to anyone holding an account anywhere in Germany and this service was very widely used.

The Reichsbank was obliged by its charter to act as banker to the empire and the states free of charge. Most of its private lending was by way of discount. The official rate was usually

higher than that of the other banks, but in 1880 the Reichsbank began to make discounts at a lower "private" rate in times of easy money; it handled a much larger proportion of the total discount business of the country than did most central banks.

The bank, like the Bank of England, was obliged to buy gold at a fixed minimum price and to pay its notes in gold; and it acted from the first as keeper of the central gold reserve and lender of last resort. These obligations of a central bank imply a general regulation of credit; and the chief instrument for this was discount policy, involving both variations in the official rate and in the bank's readiness to discount at the "private" rate. At times the bank also tried to protect its reserve by making interest-free advances to importers of gold and by buying gold at more than the statutory price.

The first great German joint-stock bank was A. Schaaffhausenscher Bankverein, founded in Cologne in 1848. The Discontogesellschaft was founded in 1851; the Bank für Handel und Industrie (Darmstädter und Nationalbank), in 1853; the Berliner Handelsgessellschaft and the Mitteldeutsche Kreditbank, in 1856. Another spate of promotions from 1870 to 1872 produced, among others, the Deutsche bank, the Dresdner bank and the Commerz- und Discontobank. The expansion of industry after 1870 was accompanied by rapid development in banking. The large provincial banks established offices in Berlin and opened branches, though they did not try to penetrate directly into the smaller towns. There were some amalgamations, but the chief way in which the big banks both extended and consolidated their influence was by obtaining a share in the capital and representation on the boards of provincial banks. By these means nine large Berlin banks, those already mentioned together with the Nationalbank für Deutschland, came to dominate the banking system.

The main differences in the business of the English and German joint-stock banks were the lower cash ratio and larger bill holdings of the German banks and their closer association with industry. Contrary to a widely held opinion, the German banks did not deliberately hold long-term industrial stock; but they did take a very big part in the issue of such stock and, when an issue miscarried, might be left with substantial holdings which they would have to retain for some time. The banks were frequently represented on the boards of firms which they assisted in this way, and their control over industry was increased by the widespread practice of voting stock deposited with them by customers. The banks were also most energetic in forming subsidiaries and establishing agencies abroad, and their activities in this way were conspicuous in Italy, Rumania and Bulgaria, in the near and far east and in South America.

Other European Countries.—The other countries of Europe showed wide variety in their banking systems. In general, those of northwestern Europe were the most mature; those of southeastern Europe, the least. In most countries savings banks and mortgage companies were important parts of the financial system, and in the Austrian empire, Italy and Poland it is difficult to draw a line between them and the commercial banks. The commercial banks of Scandinavia and the Netherlands tended to confine themselves to deposit banking on the English model; those of Austria, Italy, Switzerland and, to a lesser extent, Belgium followed the German pattern in associating closely with industry; and those of eastern Europe were chiefly concerned with agricultural finance. All the major countries set up central banks, sometimes in private hands, sometimes with state participation; in some there was no special commercial banking legislation, while in others the powers of the banks were carefully regulated.

The oldest joint-stock commercial bank in Europe, the Société Générale pour favoriser l'Industrie Nationale (later Société Générale de Belgique) of Belgium, was founded in 1822. In 1850 the National Bank of Belgium was formed, taking over the note issues of the older joint-stock banks and acting as fiscal agent for the state. Other banks were formed during the second half of the 19th century, and by 1913 there were 70 of them, but the Société Générale was by far the most important. In the Netherlands the Bank of the Netherlands was founded in 1814. There was a flourishing private banking system; but joint-stock banking did not begin until after 1860, and growth was comparatively slow.

In Scandinavia the Bank of Sweden (oldest surviving bank in the world at mid-20th century) dates from 1668, but Swedish private banking did not begin until about 1830 and joint-stock commercial banking until 1864. Joint-stock banks were not allowed to issue notes, but private banks could do so until 1897, when all issues were centralized with the Bank of Sweden. Thereafter no new private banks were formed; altogether there were about 80 banks in 1913. The system in Finland closely resembled that of Sweden, private banking beginning in the 1860s and joint-stock banking in the 1880s. The first Norwegian bank, other than the Bank of Norway (1814), was not founded until 1848; thereafter progress was gradual, and the system remained highly decentralized with many small local banks. In Denmark joint-stock banking began in 1846, and there were no less than 144 banks in 1913, though 7 of them accounted for two-thirds of total deposits.

The Austro-Hungarian system comprised three parts, centred on Vienna, Budapest and Prague, of which the last was the least important. The Austrian section was dominated, in 1913, by ten big Viennese banks, which had grown up on the German model with extraordinarily close relations with industry and trade, while in Hungary there were a few large and very many small banks concerned largely with agricultural finance.

Switzerland had a tradition of private banking, and Swiss joint-stock banking began with the local "discount banks" formed between 1820 and 1840. Several bigger banks were founded after 1860 to finance railway and industrial development, and these grew into the most important element in the system. The cantonal banks were formed in the third quarter of the 19th century, primarily to assist agriculture, but some also did a general banking business. The central bank, the Swiss National bank, was not founded until 1905.

In Italy a number of note-issuing banks were formed in the separate states during the 1840s, and there was a rapid development of the banks closely associated with industry after the unification of the country. The National Bank of the Sardinian States, formed in 1849 by merging two banks of Genoa (1844) and Turin (1847), became the National Bank of the Kingdom of Italy. A crisis in 1893 provided the opportunity for a syndicate headed by the Discontogesellschaft and other big German banks to form the Banca Commerciale Italiana (1894), which grew into one of the most important banks in the country. In 1913 five large banks controlled two-thirds of all deposits; of these the Credito Italiano as well as the Banca Commerciale had some German participation.

Modern Spanish banking began with the formation of the Bank of St. Charles in 1782. In 1844 the Bank of Isabella II was formed; and in 1847 the two banks merged. In 1856 the combined bank was reorganized as the Bank of Spain with a monopoly of banking activity throughout the country. The bank issued notes, operated current accounts and did some discount business but was heavily involved in the unsatisfactory Spanish state finances and was in difficulties throughout the century.

Banking in Russia dates from 1768, when Catherine II set up two banks of issue in Moscow. The Russian State bank was founded in 1860, and the first joint-stock commercial bank in 1865. The banking system was not, however, highly developed and depended considerably on French and German capital. The immature banking systems of other eastern European countries also relied largely on foreign capital, German in Rumania and Bulgaria, French and British in Greece.

The 20th Century.—World War I brought a general increase in bank deposits and involved most banks in large purchases of government securities. Its aftermath included great territorial and political changes in many countries and currency disturbances in almost all. The period 1919–29 was mainly occupied with these problems.

Central banks were set up in the new countries (Poland, Czechoslovakia, Hungary, Yugoslavia, Estonia, Latvia and Lithuania); and the Bank of Spain was reorganized as a true central bank in 1921. The new countries all endeavoured to build national banking systems. In the former Austro-Hungarian empire, the Hun-

garian system grew up from the big Budapest banks. A central corporation of banking companies was formed in 1916 and remained after the war, with powers of inspection over member banks. Branches of Austrian banks in Czechoslovakia were either liquidated, taken over by Prague banks or formed into new Czech companies, while Yugoslavia made some progress in building a national system on the much more primitive foundations existing there. The sphere of influence of the Austrian banks was thus greatly restricted, and there were several amalgamations, as a result of which the big Viennese banks were reduced to four by 1929. In former Russian Poland there had been eight Polish commercial banks and three state institutions doing some banking business. These continued after liberation and a number of new banks were formed.

The timing of inflation and deflation varied considerably between countries. In the inflationary period new banks were formed and the nominal though not the real value of deposits increased, while deflation and stabilization brought liquidations and further concentration in banking systems. Deflation was first felt in Scandinavia in 1921; both in Norway and Sweden the state gave emergency assistance, and there were a large number of closures. In France, Belgium and the Netherlands there was less change in banking structure, but some concentration took place in France through the big banks extending their branches and, in Belgium and the Netherlands, gaining control of smaller provincial banks. The German system underwent great change. In 1924 the Reichsbank was reconstituted under a general council (half of which was foreign), with its discount policy restricted and without the power to buy long-term securities. A subsidiary, the Gold Discount bank, was established to assist foreign trade and was later used for a wide variety of purposes. The big commercial banks suffered heavy losses in the inflation and had to face competition from new banks formed for particular industrial groups and from public institutions (one of which, the Reichskreditgesellschaft, formed in 1922, was a full-fledged commercial bank). A series of amalgamations between 1914 and 1929 reduced the big Berlin banks from nine to five.

In Italy the Banco di Sconto was in difficulties in 1921 and was replaced by the Banca Nazionale di Credito, which amalgamated with the Credito Italiano in 1930. A comprehensive banking law of 1926 provided for registration of all banks, state approval for all new banks or branches and inspection by the Bank of Italy; and in 1930 all note issues were placed in the hands of the Bank of Italy. (*See* BANCA D'ITALIA.)

The depression which began at the end of 1929 hit the banks of many countries. The failure of the Austrian Credit-Anstalt in May 1931 had repercussions throughout central Europe, and before the depression was ended the state had to take special measures in Austria, Germany, Hungary, Czechoslovakia, Sweden, Italy and Belgium. The German crisis was the most acute; the Deutsche, Commerz-, Dresdner and Darmstädter banks were all assisted by the state; the two last were amalgamated, and at one time the Gold Discount bank held 90% of the capital of the combined bank. Later, however, the special advances were repaid and the capital returned to private hands.

The crisis was followed by legal changes affecting both central and commercial banks. Central banks were given more freedom of action in Austria, Poland, Czechoslovakia, Sweden, Hungary, Denmark and Yugoslavia by reducing the amount of reserve required by law and in Germany, France, Poland, the Netherlands, Hungary and Lithuania by extending their powers in respect of open-market dealings. The constitution of the Reichsbank was changed in 1933, when the general council was abolished and the appointment of the president placed in the hands of the chancellor. In 1936 the Bank of Denmark was nationalized and the Bank of Italy was reorganized.

In commercial banking the tendency was toward more stringent control. The German law of 1934 set up the office of banking commissioner with the power to fix cash ratios and to limit the amount of credit that might be given to a single customer. The Italian law of 1936 gave the governmental office of inspection wide powers over the type of credit that a bank might give and over the direction of lending; and laws creating or strengthening controls were also passed in Sweden, Switzerland, Belgium and Rumania.

The Russian banking system developed on distinctive lines as part of the machinery of central economic planning. All banks were nationalized in Dec. 1917, but they practically ceased to operate in the chaos which followed. The new system began with the foundation of the State Bank of the Russian Soviet Federated Socialist Republic, later the State Bank of the Union of Soviet Socialist Republics (U.S.S.R.) (Gosbank), in 1921. Several other banks were set up and, under the New Economic Policy, received deposits and discounted bills both for state institutions and private firms. By decrees of 1927 and 1928, however, Gosbank became the sole source of short-term credit. Five other banks provide long-term credit for different sections of the economy, but only one, the Savings bank, accepts deposits from individuals; this bank will transfer deposits from one account to another, but its main function is to mobilize personal savings for investment in state loans. With the abolition of private trade and the introduction of the five-year plans, Gosbank assumed the responsibility of seeing that state enterprises kept within the "ration" of credit allocated to them in the plan. Each enterprise was compelled to keep its spare funds with Gosbank (which had opened a large number of branches); bills of exchange were no longer discounted and, instead, the bank gave credit to the purchaser, which was then transferred to the account of the seller on delivery of the goods, thus greatly easing the problem of supervision.

World War II produced new inflationary pressures everywhere, besides leading to great territorial and political changes. The German banks had penetrated deeply into the financial systems of the occupied countries, but the Allies declared all share purchases by Germans to be void, and foreign affiliates of German banks were liquidated. Currency reform was necessary in many countries after the war. Belgium, Yugoslavia, Denmark, France, the Netherlands, Czechoslovakia, Austria and Finland made new note issues, and in some of those countries part of the holding of old notes was placed in blocked bank accounts. In the U.S.S.R., at the beginning of 1948, old rubles were exchanged for new at the rate of one new for ten old, and bank deposits and the value of government bonds were also scaled down. German currency reform of June 1948 also involved drastic cancellations of the old currency.

The banking systems of Estonia, Latvia and Lithuania were incorporated with that of the U.S.S.R. when those states lost their independence; and those of the countries which passed under Communist control (Poland, Hungary, Czechoslovakia, Bulgaria, Rumania and Yugoslavia) were nationalized. In eastern Germany the old banks were abolished and a new system, resembling that of the U.S.S.R., was created. In the western zones the three large commercial banks (Deutsche, Dresdner and Commerz-) were divided in 1945–46 into 30 small units, each of which was allowed to operate in only one of the 11 *Länder*. New central banks were set up for each state and, as part of the currency reform, there was created the Bank of the German States (Bank Deutscher Länder) at Frankfurt am Main with a monopoly of note issue and limited powers over the state central banks. The 30 commercial banks created in 1945–46 proved too small for efficient operation and, in 1952, the law was amended. The country was divided into three banking regions and the banks consolidated into nine new firms, each of which could operate throughout the whole of one region. To prevent any further concentration, interlocking shareholdings and directorates were prohibited. The central banks of Norway and the Netherlands were nationalized and that of Belgium was brought under state control.

In France the nationalization movement went much further; the law of Dec. 1945 nationalized the Bank of France and the four largest commercial banks; in 1946 the two principal *banques d'affaires* were nationalized; and the smaller banks, of both kinds, were brought under stringent control. In the late 1950s various policies looking to economic and financial rehabilitation were made effective with the result that the substantial inflationary pressures were abated. On Jan. 1, 1960, the French franc was

revalued at .18 gram of fine gold or 20.25 U.S. cents per franc.

The war in Korea in 1950 aggravated the inflation which had been a chronic feature of the European economy since World War II, and caused most western European countries to abandon the low and stable interest rates which had survived from the 1930s and to adopt more orthodox monetary policies. There was a general rise in interest rates in 1950–51 and, thereafter, central banks varied their rates according to the economic circumstances of their respective countries. In most cases the new policy involved only the more active use of powers already possessed by central banks, but in some countries (*e.g.*, the Netherlands in 1954) central banking powers were substantially increased.

C. Great Britain and the Commonwealth of Nations

England.—In the middle ages, English finance was not as fully developed as that of the great commercial centres on the continent and much of it was in the hands of foreigners. Financiers were mainly concerned with loans to the crown, with the collection and transmission of papal revenues, and with the finance of foreign trade. Bills of exchange were widely used but did not circulate as money and bank notes were unknown. The type of loan that might be made was severely restricted by the usury laws, though the Reformation substantially altered prevailing views on this point and after 1545 the state confined itself to the establishment of a maximum rate of interest.

The Tudor period was one of expanding trade, capital accumulation and increasing need for financial agencies and instruments. Merchants like Sir Thomas Gresham (*q.v.*) played a growing role in the financing of foreign trade and London scriveners began to lend money, both their own and that which they had borrowed for the purpose. It is generally held, however, that the direct ancestors of modern banks were neither the merchants nor the scriveners but the goldsmiths. At first the goldsmiths accepted deposits for safekeeping only; but early in the 17th century their deposit receipts were circulating as money and thus became the prototypes of the first English bank notes. Soon the goldsmiths began to issue notes not only against the deposit of coin or of bullion but also by way of loan. This may be viewed as the beginning of fractional reserve banking in England. Some of the goldsmiths lost heavily on their loans to the crown in the reign of Charles II. Some went into bankruptcy but others survived and came to be leaders among the London private banks in the 18th and 19th centuries. Two notable examples of the latter group are Child's and Hoare's.

The financial difficulties of the crown continued after the revolution of 1689 and led to the foundation of the Bank of England (*q.v.*) in 1694. Establishment of the Bank of England marked the beginning, in a sense, of the development of a banking system consisting of a central bank and of a number of private banking firms. At the time of its founding the Bank of England made an initial loan to the government of £1,200,000 in return for a charter of incorporation. In 1697 it was granted a monopoly of joint-stock banking in England and Wales. In 1707 it became the principal agent for the circulation of exchequer bills and in 1715 it acted for the first time as agent for the issue and management of a government loan. Gradually, during the next 40 years, it became banker to the exchequer and the principal government departments, holding their deposits and paying their drafts as any bank does for its customers.

The Bank of England also did ordinary banking business, issuing notes, receiving deposits and discounting bills of exchange. But its role as banker to the state and its monopoly of joint-stock banking placed it in a unique position; and in its relations with the private banks it soon became much more than just a privileged competitor. About 1770 the London private bankers (survivors of the old goldsmith bankers reinforced by a number of new firms) practically ceased to issue their own notes and used Bank of England notes instead. Most of them opened drawing accounts with the Bank of England, as also did the Royal Bank of Scotland. The country banks managed their business in the capital through a correspondent, generally one of the private bankers. The Bank of England's reserve of gold could thus be drawn upon in time of crisis by these London banks and, through them, by all the multitude of small banks which were springing up all over England in the second half of the 18th century. To meet this obligation the Bank of England had to accumulate a large reserve, and most of the country's gold stock not in actual circulation came to be concentrated in its vaults.

Thus by the end of the 18th century the Bank of England was performing, though not yet fully, several of the recognized functions of a central bank; it acted as banker to the government, manager of the public debt, bankers' bank and custodian of most of the country's gold reserve. It did not yet, however, recognize the responsibility of acting as "lender of last resort" or accept the supreme duty of a central bank; namely, that of exercising a general direction and control over monetary affairs.

There were very few private banks outside London until after 1750, but subsequent development was rapid; there were about 150 in 1776, 350 in 1800 and 430 in 1833. They enjoyed, of course, no corporate status and could not comprise more than six partners. They varied greatly in size and stability from wealthy and well-managed firms, such as Gurney's of Norwich and Stuckey's of Somerset, to tiny and evanescent enterprises started by small tradesmen in market towns. Many failed in the commercial crises of the period; their activities often embarrassed the Bank of England; and they were blamed for many of the monetary troubles of the time. Nevertheless, they played a vital part in the finance of the Industrial Revolution. At first nearly all these banks issued notes, and the country bank note was the chief form of paper currency in circulation outside London and Lancashire. By 1830 the bank deposit transferred by check was becoming important; and the banks made an increasing proportion of their loans by means of overdrafts, rather than by issuing notes. Indeed one of the distinguishing characteristics of the history of banking in Great Britain and the commonwealth is the early development and use of the check. The treatment of the check in England, where under the common law it was defined as a bill of exchange and hence at all times negotiable, greatly facilitated the circulation of deposit credit. This stood in sharp contrast to developments on the continent where the limitations of the nonnegotiable check made extensive use of deposit credit impossible until well into the 19th century.

Cash reserves of the private banks which varied greatly in size, were held partly in gold but chiefly in Bank of England notes. The more prudent bankers invested some of their assets in government securities, and loans were made on mortgage—to farmers on the security of stock, to businessmen often on personal security only. The most important and general means of lending was, however, by the discounting of bills of exchange; banks in country districts often had difficulty in getting as many bills as they wanted, whereas those in expanding manufacturing areas were under constant pressure for loans and therefore began to sell bills to those in agricultural districts through agents in London, who thus constituted, in the early 19th century, the origin of the London discount market.

Central Banking, 1793–1844.—The wars with France of 1793–1815 imposed a great strain on the English monetary system, and in 1797 the government, by order in council, forbade the Bank of England to pay its notes in gold, a restriction that was confirmed by parliament and continued in force until 1821. Freed from the necessity of cash payment, both the Bank of England and the country banks thereupon increased the amount of their note issues and the volume of their lending. The government continued its inflationary methods of war finance with the result that prices rose; the foreign-exchange rates fell; and gold bullion was sold in the market at a premium over its mint price.

These events led to much controversy and to a parliamentary inquiry which produced the famous Bullion report (*Report of the Select Committee on the High Price of Gold Bullion*, 1810). The policy of the Bank of England's directors was to meet what they called "the legitimate needs of commerce" by discounting all good bills brought to them at a rate of 5%, the maximum allowed by the usury laws; they maintained that the resulting increase in their note issue had no influence upon prices or the foreign ex-

changes. The directors' critics, including such great economists as David Ricardo, Thomas Robert Malthus and Henry Thornton, though they disagreed over details, all maintained that there was a close connection between the volume of Bank of England notes and the level of prices and further that the level of prices affected the foreign-exchange rates and thus the inflow or outflow of gold and the reserve of the bank. Once this chain of reasoning was accepted it followed that the bank, as custodian of the central gold reserve of the country, must shape its lending policy according to general economic conditions and exercise a general control over money and credit. This critical period was thus of the highest importance in the development of central banking theory.

Only four years after the resumption of cash payments there occurred, in 1825, one of the most violent financial crises of the century. The course of events was one which became familiar, with slight variations, in later years; a rise in domestic prices and the value of imports caused the exchanges to fall and the Bank of England's reserve to be depleted; then a few big business failures precipitated a run on the banks and a further drain on the reserve, not for export but for domestic circulation. The remedy, which became classical, was for the bank to raise its discount rate to protect its reserve against the foreign drain and then to lend freely at the high rate in order to maintain confidence at home (the function of "lender of last resort"). In 1825 the bank allowed its reserve to fall dangerously low before taking protective action; nevertheless, at the height of the panic, it discounted all eligible bills and even relaxed its rules of eligibility.

The crisis caused the bank directors to take a broader view of their responsibilities both as lender of last resort and as regulator of the monetary system. In an attempt to build up a more stable banking system, the government persuaded the bank to open branches in a number of provincial towns; and, in 1826, parliament sanctioned the opening of joint-stock banks outside a radius of 65 mi. from London and prohibited the issue of notes of less than £5.

The act renewing the bank's charter in 1833 made three more important changes in the law: (1) Bank of England notes were made legal tender; (2) the usury laws were repealed as far as they affected bills of exchange, setting the bank free to raise its discount rate above 5% and paving the way for the use of variations in bank rate as an instrument of policy; and (3) joint-stock banks were declared to be legal even within the limit of 65 mi. provided that they did not issue notes.

Public dissatisfaction with the Bank of England was aggravated by further crises in 1836 and 1839, and criticism developed into a controversy between what are usually known as the Currency school and the Banking school. The Currency school, led by Samuel Jones Loyd (Baron Overstone), Robert Torrens and George Warde Norman, laid great stress on the close connection between the amount of money and prices; they defined money as gold and bank notes and from that deduced their main proposition, that the total of notes and coin in circulation ought to be made to vary in exactly the same way as would a purely metallic currency. The Banking school, led by Thomas Tooke and John Fullarton, pointed out the importance of other instruments of credit and argued that a varying amount of credit could be built up on a given cash base; they were no less critical of the policy of the bank than their opponents but did not wish to see it fettered by any rigid legal restrictions.

The Bank Charter act of 1844 embodied the views of the Currency school. The bank was divided into an issue department and a banking department. It was allowed a fiduciary issue (backed by government securities) of £14,000,000 beyond which amount all notes had to be covered by gold or silver (the silver not to exceed one-fifth of the whole); and was obliged to buy gold at £3 17*s.* 9*d.* a standard ounce and to pay its notes in gold coin, which was equivalent to selling gold at £3 17*s.* 10½*d.* an ounce. The note issue served both for the use of the public and as a reserve for the banking department. No new banks of issue were to be allowed; existing ones were limited to their average circulation in the three months prior to the introduction of the bill; and any bank which ceased to issue, stopped payment or amalgamated so as to give itself more than six partners was to forfeit its rights, whereupon the Bank of England was authorized to raise its own fiduciary issue by two-thirds of the permitted issue of the forfeiting bank. The last country bank to issue notes did not cease until 1921, but country banks' issues had become insignificant long before this.

Developments, 1844–1914.—The first provincial joint-stock banks were formed at Huddersfield and Bradford in 1827. The act of 1833 was followed the next year by the foundation of the London and Westminster bank, with a great banker, J. W. Gilbart, as manager. Gilbart had to fight both the Bank of England, which refused him a drawing account, and the London private bankers, who refused him admission to their clearinghouse; but his bank prospered and was soon followed by others. By 1841 there were 115 joint-stock banks in England and Wales, and the number of private banks had fallen to 321. After this boom, however, promotion of joint-stock banks diminished, and the structure of the system remained fairly stable until the great amalgamations at the end of the century; in 1886 there were 117 joint-stock banks but more than 250 private ones still in existence, the chief change since 1841 having been the extension of the branch system by the joint-stock banks.

Under the act of 1826 joint-stock banks still retained unlimited liability and had no corporate existence. These disabilities were removed by a series of acts from 1844 onward, and in 1862 banks were brought within the general law of limited liability. However, the established banks were reluctant to take advantage of the new law, and it was not until after the failure of the City of Glasgow bank, with heavy loss to the shareholders, in 1878 that limited liability became general.

The critics of the act of 1844 had feared that it would result in an undue restriction of credit; this was avoided by the rapid growth of the check system. The sponsors of the act had hoped that it would remove the need for any discretionary action by the bank; but they, too, were proved wrong. When gold was withdrawn from the Bank of England, notes had to be canceled and the reserve of the banking department was reduced; the size of the fiduciary issue was so fixed that, when a drain of gold occurred, the reserve of the banking department was threatened with exhaustion long before the gold in the issue department. The bank was thus obliged to develop and refine the same techniques to meet the new emergency as it had used, in a more primitive form, against the old.

The 50 years before 1844 had seen the evolution of central banking theory; the next 50 saw the Bank of England experimenting with its techniques of credit control and gaining steadily in power and experience, although in 1847, 1857 and 1866 it had to obtain from the government permission to exceed its legal issue with the promise of a bill of indemnity if it broke the law. The Bank of England allowed its private business to dwindle and concentrated on central banking; the commercial banks increased their balances with the Bank of England; and the system was developed whereby those balances were replenished, when necessary, by calling in loans from the discount market, the bill brokers then trying to borrow elsewhere and going to the Bank of England only in the last resort.

The international financial business of London was growing very rapidly at this time. The acceptance and discounting of foreign bills had begun as early as 1830 and, during the second half of the 19th century, the foreign bill largely displaced the domestic bill (which was being driven out of use by the check) in the London market. London became a short-term lender to the world and a clearinghouse for international payments. Foreigners deposited money with British firms, especially the merchant bankers who accepted bills, dealt in foreign exchange and floated foreign loans in London; British banks were formed to operate in the empire and in foreign countries; and foreign banks established offices in London. This business was not in the same hands as was domestic banking, but it was of vital concern to the Bank of England. The bank's reserve became much more sensitive to foreign influences although, since the discount of foreign bills far exceeded the holding of foreign deposits in London, a sufficient rise in bank rate

could always be relied upon to check discounts and so produce an inflow of gold as old bills matured and were paid off.

The main methods of credit control were bank rate and open-market operators. Bank rate, used experimentally before 1844, was used regularly soon afterward and became more important toward the end of the century, when other banks came to fix their rates for loans and deposits in relation to it. Open-market operations were a means of making bank rate "effective"; *i.e.*, of preventing other short-term interest rates from falling too far below bank rate. The Bank of England would sell securities, thus taking money out of the market, when it wished to raise rates and buy them when it wished to ease credit.

After the Baring crisis of 1890, in which the Bank of England took the lead in averting a panic by raising a guarantee fund for Barings, there was closer co-operation between it and the other banks. This was made easier by the rapid spread of amalgamation. The Bank of England could now communicate informal hints on policy to the other banks; and in 1911 a more formal arrangement was reached, whereby the Clearing Bankers committee met once a quarter at the bank.

It was only between 1890 and 1918 that English banking came to consist of a few very large banks operating a nationwide system of branches. The increasing scale of industry was the main reason for the series of amalgamations which brought this about; a subsidiary reason was the public demand for larger reserves that followed the Baring crisis. By 1914 there were only 16 members of the London clearinghouse, 13 of these being great joint-stock banks, and the small local bank was nearly extinct. The Birmingham and Midland bank (forerunner of the Midland bank) absorbed the Central Bank of London in 1891 and the City bank in 1898 to become the London, City and Midland; and in 1897 E. H. Holden, the person most responsible for the subsequent pace of amalgamation, had become manager. In 1896 Barclays bank had been formed by the fusion of 15 private banks, mostly of Quaker origin. In 1902 the Union of London and Smiths was formed by the combination of a London joint-stock bank (the Union), a London private bank (Smith, Payne and Smith) and a number of north midland banks linked with the private bank by family ties. The climax came during a few months in 1917–18; the Midland absorbed the London Joint Stock bank; the National Provincial absorbed the Union of London and Smiths; the Westminster absorbed Parr's; and Barclays absorbed the London and Provincial and London and South Western, which had themselves amalgamated less than a year before.

This spate of amalgamation gave rise to fears of a "money trust." A treasury committee reporting in 1918 suggested legislation making government approval necessary for further amalgamations; no such law was passed, but the banks entered into an informal understanding not to arrange further mergers without treasury approval. Since then, amalgamations have been very few.

History From 1914.—The gold standard was inoperative during World War I and formally suspended from 1919 to 1925. Gold coin was replaced in ordinary circulation by treasury notes, which circulated concurrently with those of the Bank of England until the issue was transferred to the bank in 1928. From 1925 to 1931 gold bullion was freely obtainable at the bank, though gold coin never came back into use; but in 1931 the gold standard was again abandoned, and in 1939 the bank's gold stock was transferred to the exchange equalization account. Thereafter, though the separation of departments established in 1844 was preserved, the bank held practically no gold, the note issue being wholly fiduciary with its amount fixed by the treasury.

The "cheap money" policy which followed the abandonment of the gold standard caused bank rate to fall into abeyance and led to a relaxation of the central bank's control over credit. Such control as it still had was of a qualitative rather than a quantitative nature and exercised through informal contacts and persuasion. Throughout this period the bank worked in close and increasingly harmonious contact with the government.

The Bank of England was nationalized by an act that came into force on March 1, 1946. Under nationalization the directors were appointed by the crown; the treasury might issue directions to the bank; and the bank could make recommendations and, if necessary, give directions to the commercial banks. The act might seem only to have given formal expression to a relationship that had grown up, by mutual consent, between the three parties; but any government so inclined could use the wide and rather vague powers of direction conferred by it to exercise a much more stringent control over the commercial banks than was at first attempted.

For the commercial banks World War I and the postwar inflation brought a great increase in deposits. As these banks were also large subscribers to war loans, war conditions brought them into much closer contact with the Bank of England than before. After the war cash ratios were more stable and the conventional 10% (reduced to 8% in 1947) became established. The banks also entered more into acceptance, discount and foreign-exchange business; and some of them formed subsidiaries to operate abroad. During the depression in the early 1930s banks were faced with a falling demand for commercial loans and increased the proportion of government securities in their assets, and this tendency continued during the great increase in deposits which took place during World War II.

The Labour government, elected in 1945, intensified the drive for cheap money in an effort to bring the yield of long-term government bonds down to 2½%. Bank rate was retained at 2%; the Bank of England kept the commercial banks liberally supplied with cash, and there was a further rapid growth of deposits. This policy was modified in 1947 and drastically changed, with a change of government, in 1951. Bank rate was raised to 2½% in Nov. 1951 and to 4% in March 1952, and the liquidity of the banking system was reduced by the funding of £1,000,000,000 of treasury bills. Thereafter the Bank of England, like the central banks of most other European countries, adopted a flexible policy, reducing bank rate in 1953–54 and raising it again to counteract inflation and a loss of gold reserves in 1955–56. A vigorous use of bank rate to control inflation was still evident at the beginning of the 1960s. During this period there were a number of technical changes designed to restore to the Bank of England the control over the financial system which it had largely abandoned between 1931 and 1951.

Scotland and Ireland.—Scotland differed from England in having no law against the formation of joint-stock banks and in the early development of branch banking. The core of the system was constituted by the three chartered banks, the Bank of Scotland (1695), the Royal Bank of Scotland (1727) and the British Linen company (1744). These firms began to found branches in the middle of the 18th century and were joined later by a number of unchartered joint-stock banks. By 1826 there were 36 banks in Scotland, all the most important being joint-stock. In 1845 Sir Robert Peel's government followed up the Bank Charter act by regulating Scottish note issues—no new note-issuing banks were to be allowed; and the 19 issuing banks in existence were restricted to a fixed fiduciary issue, further issues to be covered wholly by gold or silver. The privilege of note issue was more significant in Scotland than in England, and no important banks were founded after 1845. Concentration proceeded gradually, and the number of banks was reduced to eight by 1914. Toward the end of the 19th century connections with England grew closer; and in the final stages of the amalgamation movement Barclays acquired control of the British Linen bank; Lloyds, of the National Bank of Scotland; and the Midland, of the Clydesdale bank and the North of Scotland bank (amalgamated in 1949). The Royal Bank of Scotland, however, gained control of Glyn, Mills and Company and of Williams Deacon's. Contrary to the practice in English amalgamations, however, the Scottish banks retained their separate identities.

In Ireland there were many small and weak private banks and a few strong ones founded during the 18th century. The most important was David La Touche and Son, founded by a Huguenot poplin manufacturer around 1700. In 1783 the Bank of Ireland was given a charter that was closely modeled on that of the Bank of England. The Bank of Ireland originally had a monopoly of joint-stock banking, but this was modified in 1821 and finally abolished in 1845. The bank acted as government banker and

manager of the national debt in Ireland and later as banker and lender of last resort to the Irish commercial banks, but never attained the full stature of a central bank since it relied in time of strain upon the Bank of England, which was the ultimate holder of cash reserves for both countries. Also, the Bank of Ireland, unlike the Bank of England, continued to play an important part in ordinary commercial banking. After 1821 a number of joint-stock banks were formed; and these in 1845 were given their own fiduciary note issues as in Scotland. In the second half of the 19th century the remaining private banks were absorbed by the joint-stock banks, and in 1914 there were nine such banks operating more than 800 branches. One of them, the National, was also a member of the London clearinghouse. As in Scotland, there was some fusion with English banks, the Midland gaining control of the Belfast Banking company, the Westminster of the Ulster bank. The formation of the Irish Free State was followed by the issue of Irish notes under the control of a currency commission (1927) and the establishment of the Central Bank of Ireland (1942), but it did little to disturb the close banking connection between Great Britain and Ireland.

Commonwealth of Nations.—Banks were established in the countries which later formed the British Commonwealth at an early stage in their development. Control over banking varied with the degree of independence attained by the new settlements; initially it was exercised from London, then by the various state and provincial legislatures, finally by the dominion governments. Private banks played little part in this field and all the important banks were joint-stock companies. They naturally had close connections with London, kept reserves in London and formed an important element in the London money market. None of the dominions had a central bank until after World War I.

Canada.—The banks doing ordinary commercial business in Canada are the chartered banks; the oldest is the Bank of Montreal, founded in 1817 and chartered in 1822. Its charter was similar to that of the first Bank of the United States (*see* below.) Until 1867 charters were issued by the provinces of Upper Canada and Quebec; subsequently, the regulation of banking was in the hands of the federal government, which granted charters under a series of decennial banking acts, beginning in 1871. Law regulated banking in much more detail in Canada than in most other countries. Characteristic features were the fixing of a minimum paid-up capital ($100,000 in 1871 and $250,000 since 1890); the limiting of interest on loans and of dividends; the liability of shareholders for double the nominal value of their shares; the prohibition of loans on real estate (modified in 1944 and 1954); and the rigid control of amalgamations. On the other hand, there was no control over the amount of reserves and the only stipulation in this field before 1934 was that 40% of reserves (whatever they might be) should be held in Canadian notes (1881).

There were 28 Canadian chartered banks in 1867 and 20 more were formed between 1867 and 1881; but the number was reduced by amalgamations to 10 in 1931. Branch banking developed early and by 1931 there were more than 3,000 branches. The chartered banks issued their own notes, which formed the main currency of the country until displaced by those of the Bank of Canada after 1934. They also did all ordinary banking business and participated, unlike the English joint-stock banks, in the making of long-term capital issues for industry.

The Canadian central bank, the Bank of Canada, was set up by an act of 1934. It acts as banker to the government and to the chartered banks, which were bound to keep a reserve of 5% of their liabilities with it. The Bank of Canada gradually took over the note issue of the chartered banks and also their gold reserves and those of the central note reserve. Before 1940 the Bank of Canada was required to keep a gold reserve of 25% of its notes and deposits. In the decennial revisions of the banking law of 1944 and 1954, the banks were allowed to make mortgage loans, and in 1954 the Bank of Canada was empowered to vary the commercial banks' cash ratio. In 1944 the Industrial Development bank was set up to provide long-term finance for industry, and in 1954 the first steps were taken toward the building up of a call-loan market.

Australia.—In Australia the pioneer undertaking was the Bank of New South Wales, founded in 1817 and followed during the next 25 years by 18 other banks. These banks, unlike those of Canada, made loans on land and played a big part in the building-up of the large "squatter" estates. The discovery of gold in 1851 led to a further boom in bank formations; and when the search for gold subsided, the banks began to play an increasing part in the finance of secondary industry. Connections with England were very close and many banks drew a large part both of capital and of deposits from London at this time. In 1893 a severe financial crisis left some banks with liabilities which they took several years to discharge. Altogether more than 50 banks were formed in the 19th century, but the number was reduced by failures and amalgamations to 16, of which 3 have their head offices and the great part of their shares in England. Up to 1910 the banks had issued their own notes, but in that year a treasury-note issue was established and a tax imposed on bank notes. The Commonwealth Bank of Australia, formed in 1911, held the federal account and the accounts of some of the states and was intended to compete with the ordinary trading banks. By acts of 1920 and 1924 the note issue was transferred to it and, especially after 1929, it came to operate more and more as a central bank.

The Bank act of 1945 added to the central banking powers of the Commonwealth bank in several ways, including giving it the right of requiring commercial banks to deposit a variable amount of their assets in special accounts with it. At the same time the act provided that, in case of difference of opinion between the Commonwealth bank and the government, the federal treasurer might issue directions to the bank. This power was somewhat modified in 1950 by the setting up of a bank board with half its members drawn from circles outside both the Commonwealth bank and the government. The 1945 act also created a new industrial finance department of the bank, and encouraged it to develop its ordinary banking business, so that Australia is one of the few countries in which the central bank and the commercial banks are in active competition with one another.

New Zealand.—Of the five trading banks in New Zealand in the mid-1950s three were Australian, namely, the Bank of New South Wales, the Commercial Bank of Australia and the Australia and New Zealand bank (the last formed by a merger of the Bank of Australasia and the Union Bank of Australia in 1951). The first of their branches was opened by the Union in 1840. The Bank of New Zealand was chartered in 1861, but in 1894 it was in trouble and the government came to its support. From then on the government appointed part of the directorate until it was wholly taken over by the state in 1945. The National Bank of New Zealand was founded in 1872 with two-thirds of its capital in London. All these banks enjoyed the right of note issue until 1934, when this function was taken over by the newly created central bank, the Reserve Bank of New Zealand. The Reserve bank was nationalized in 1935 and the Bank of New Zealand in 1945.

India, Pakistan and Ceylon.—In India a banking system of the European type was superimposed upon an indigenous banking system of great antiquity. Besides small local bankers and moneylenders there are the joint-stock banks, the Imperial Bank of India, the exchange banks and the Reserve Bank of India. The first joint-stock bank, the Bank of Hindustan, was founded as early as 1770; development was slow during the 19th century but more rapid after 1900, and there was never the process of concentration which took place in Britain and the other countries of the commonwealth. In 1940 there were 180 banks, operating nearly 1,200 branches. The exchange banks, of which the oldest is the Chartered Bank of India, Australia and China, are mainly concerned with international transactions. The Imperial bank was formed in 1921 by the merger of the three presidency banks (Bengal, 1808, Bombay, 1840, and Madras, 1843). The presidency banks had originally possessed the right of note issue, but this was taken over by the government in 1862. The Imperial bank held government balances and acted as a clearinghouse, but never as a true central bank. The Reserve Bank of India was created as a central bank by an act of 1934 and commenced operations in 1935, taking over the note issue from the government.

The creation of the Republic of India and of the new dominions of Pakistan and Ceylon led to further changes. In 1948 the State Bank of Pakistan was established as a central bank, with the state owning a controlling interest in its capital. On Jan. 1, 1949, the Reserve Bank of India was nationalized and given increased powers over the commercial banks. In 1954 the Industrial Credit and Finance Corporation of India was formed with the co-operation of the International Bank for Reconstruction and Development. In the following year the Indian government took over the Imperial bank with the intention of merging it with a number of small local banks to form a state bank with a nationwide branch network. Pakistan set up a new central bank in 1948 and Ceylon in 1950.

The British Colonies.—The monetary history of the colonies has been varied, but they have certain fundamental features in common. There was no development of central banking; instead, currency boards were set up to issue local currency against reserves held in sterling and maintain an automatic convertibility at fixed rates. Commercial banking is not highly developed and is concerned largely with the finance of foreign trade; financial assistance to agriculture and industry varies with the economic development of the colonies, but in general is limited by the difficulty of obtaining adequate security from native cultivators. The most important banks are British companies, including the Bank of British West Africa, Barclays (Dominion, Colonial and Overseas), operating in east and west Africa and the West Indies, and the Chartered Bank of India, operating in Malaya. Some of the dominion banks also have colonial branches: three Canadian banks operate branches in the West Indies, several Indian banks in east Africa and Malaya and the Bank of New South Wales in the Pacific colonies. There are few local banks in the British colonies, though one, the Hong Kong and Shanghai bank, plays an important part in far eastern banking.

(E. V. Mn.; Fk. L. K.)

D. The United States

Banking in the United States had its origins, apart from its rudimentary beginnings in certain colonial institutions, with the grant of a charter (1781) to the Bank of North America. Doubts concerning the legal power of the continental congress to grant a charter to a banking institution led the bank successfully to seek a charter from the state of Pennsylvania in 1782, and later from New York, Massachusetts and Delaware. The establishment of the Bank of North America was a response, in part, to the needs of the continental congress, associated with the financing of the American Revolution, although the government had no voice in the management of the bank.

The Bank of North America was a very successful institution. It made substantial loans to the government, provided credit facilities for private business and issued a currency redeemable in specie on demand. The bank's success (it continued under renewed charters from the state of Pennsylvania until 1864 when it became a national bank, *see* below) provided encouragement to others. The Bank of Massachusetts was chartered in 1784 and the Bank of New York in 1791. These early institutions were the forerunners of a large number of state banks. One estimate indicates that there were 28 such banks by 1800 and 88 by 1811. This development, implying as it did the need for credit institutions, established the precedent for the far-ranging state banking systems which, apart from the first and second Bank of the United States, constituted the whole of the banking system of the nation until the establishment of the national banks pursuant to the National Bank act of 1863 as amended.

First Bank of the United States (1791–1811).—Establishment of a national bank to be the creature and the agency of the national government under the new federal constitution was one of the important measures urged by Alexander Hamilton (*q.v.*), first secretary of the treasury, in developing the powers of the new government. The proposal aroused an important and lasting controversy, for it directly involved certain basic issues upon which Jefferson and Hamilton were to remain divided. There was opposition not only on the general ground that a banking monopoly was incompatible with U.S. ideals, but also on the particular ground that the federal congress had no authority under the constitution to issue corporate charters. The Federalist majority in congress followed Hamilton's proposal, and a charter was enacted. The bank began business in 1791, with a capital of $10,000,000, of which the government owned one-fifth and was the largest stockholder. The bank's charter ran for 20 years, but political opposition and the ineffective organization of the bank's supporters prevented its renewal.

Experience meanwhile had developed a function for the bank that had not been foreseen, namely, its regulation of the private banks. At this time note issue continued to be a more important, or at least a more conspicuous, feature of banking than were deposits. Bank notes, which entered circulation as the money that banks lent to their borrowers, comprised much the greater part of the total amount of currency in circulation. Since the country was growing fast, there was a powerful demand for loans which tended to produce an overextension of credit. Consequently it was to the general interest that expansion be restrained from proceeding to extremes from which recovery was bound to be costly and painful. The Bank of the United States imposed such restraint automatically. As depository of the government, with offices in the chief seaports and commercial centres, it constantly received from collectors of revenue the notes of private banks with which dues to the government were paid. As fast as it received these notes, it called for their redemption in gold and silver by the banks of issue, automatically restricting thereby the overextension of credit and protecting the economy from inflation. Conversely, in periods of panic and deflation, the bank could ease the pressure. Essentially, it was engaged in what was subsequently called central banking.

The first Bank of the United States was successful as a banking institution. Political opposition supported by those who objected to the restraints with which the growing number of state banks were faced as a consequence of the bank's practice of presenting state bank notes for redemption led to the lapse of its charter in 1811. The officers of the bank successfully sought a state charter in New York and continued to operate as a state bank.

Second Bank of the United States (1816–36).—Shortly after discontinuance of the first Bank of the United States, economic conditions made it evident that re-establishment was necessary, and congress in 1816 chartered a new institution with wider powers than before and with closer links to the government. Although the new bank made a good start, it was for a time grossly mismanaged, and did not really prosper until after 1822, when Nicholas Biddle (*q.v.*) of Philadelphia became its president.

Under Biddle its central banking responsibilities seem to have been as consciously recognized and developed as were those of the Bank of England at the same time—perhaps more so. But since these responsibilities had usually to be exercised as restraints, private banks resented them and complained of oppression. It was a period when developments in industry and transportation were enhancing the richness of U.S. resources, and when the idea of democracy was beginning to connote free enterprise and *laissez faire*. Hence the very conditions that made restraint upon credit advisable made it objectionable.

This opposition to the Bank of the United States on the part of the more speculative and impatient men of business united incongruously with the traditional agrarian opposition to it. The agrarians disliked all banks, associating them with privilege, wealth and aristocracy; and they disliked the Bank of the United States because it was the biggest and because it was a creature of the federal government, the growth of which they had always feared. Opposition to the bank centred behind the leadership of Andrew Jackson (*q.v.*), who had become president in 1829; his attack and the bank's unsuccessful defense are matters of political history, the bank war being one of the most bitterly controverted episodes in U.S. history. Again the constitutional issue was raised; nor did a leading decision of the U.S. supreme court (*McCulloch* v. *Maryland*, 1819) upholding the constitutionality of the bank prevent the constant reiteration of this theme. Again, too, it was alleged that the bank was a monopoly antithetical to the ideals of

the U.S. Clearly the restraining influence which the bank exercised resulted in the pressures which led President Jackson to prevent the renewal of its charter. In 1832 congress renewed the bank's charter, which was to expire in 1836; Jackson vetoed the act and arranged to have the government's funds deposited in banks incorporated under state law. Practically speaking, this cut the bank's operating contact with the government and ended its performance of the central banking function. (*See* also UNITED STATES [OF AMERICA]: *History*.)

During the period of the bank war and of Jackson's second term, 1833–37, economic activity was intense, prices were rising and speculation was feverish. The bank made some attempt at restraint, but its effectiveness was gone. Moreover, in expectation that it would not continue, there was a general move to set up new local banks. In May 1837 the boom burst with a disastrous flood of bankruptcies and slackening of business, and all the banks of the country stopped paying out specie. A year later payments were resumed under the leadership of New York bankers, the primacy of New York as the country's financial centre being thereby established.

There was still a long aftermath of banking trouble, however. In effect, the federal government in ending the Bank of the United States without alternative, abandoned responsibility for the monetary system. The constitution plainly intended to take all such responsibility from the individual states and lodge it in the federal government, and since bank liabilities in the form of circulating notes constituted the principal part of the circulating medium, the federal government's responsibility included regulation of bank notes. That responsibility was not resumed until 1863.

The State Banks (1816–63).—The lapse of the charter of the first Bank of the United States in 1811 encouraged the establishment of additional state banks which increased from 88 in 1811 to 246 by 1816. The growth in the number of state banks continued even after the establishment of the second Bank of the United States in 1816, approximating 330 by 1829 and 788 by 1837. It is generally agreed that while the regulations of the several states with respect to banking varied enormously, they were directed—even in the best of circumstances—primarily toward the control of the note liabilities of banks, ignoring essentially the bank's liability to depositors. A large number of the newly established banks followed banking practices generally thought to be unsound, particularly with respect to note issue and to appropriate provision for the redemption of notes. During this period legislative attitudes in the several states respecting banking ranged from a prohibition thereof to a nearly complete abdication of public responsibility for banking practices. As one might expect, this range of attitudes led to quite sound banking practices in certain areas and to the most serious abuses of financial responsibility in others. In the early years of this period, charters were issued to banks by the several states by special legislative enactment. This practice allegedly, and the evidence in numerous cases bears out the allegation, led to corruption and bribery associated with bills to grant corporate charters to banks and, in turn, led to the establishment in many states of "free" banking, a system which provided that banks, like other business enterprises, were to be viewed as "associations," not "corporations." In New York it was provided that notes issued by such associations be secured by pledges of state bonds.

The laws of the several states respecting free banking varied greatly and produced both good results and bad. The results in Alabama, Florida, Illinois, Kentucky, Mississippi, Michigan, North Carolina and many other states were very unfavourable, whereas Indiana, Louisiana, Missouri, Ohio and Virginia established sound and successful banking systems each having a central bank with branches. In general, however, and taking the country as a whole into account, the banking system, consisting as it did of many separate state systems, was chaotic. This situation was particularly had with respect to the issue of bank notes, which constituted a much larger part of the circulating medium than is true in the 20th century (because of the comparative growth of demand deposits); several early efforts at control, both private and public, centred around note issue.

The Suffolk System (1818–58).—This system, created by the Suffolk bank of Boston, provides an illustration of private control of bank-note issue by bankers. It was a common thing throughout the country for notes to turn up in cities far from the banks that had issued them, and because of the difficulty and expense of getting such notes redeemed they circulated at a discount. Some brokers and bankers specialized in the collection of notes if they could reduce the expense of collection to less than the discount. The Suffolk bank arranged to redeem the notes of New England banks which would maintain balances with it, and to make the plan effective it systematically called on other banks for payment of their notes. The Suffolk, in fact, paralleled the function of the Bank of the United States and was itself in a rudimentary way engaged in central banking. In one important respect, it was more advanced than the Bank of the United States, for other banks maintained with it balances to which their notes were debited, whereas the Bank of the United States, as it received the notes of other banks, demanded payment accordingly. The Bank of the United States, in other words, regulated banks as their creditor; the Suffolk regulated them as their debtor. The latter relation became typical of modern central banking. Although the Suffolk bank was an efficient regulator, it was peremptory and severe toward other banks, whose hostility had greatly modified its operations by 1858, shortly before the National Bank act ended state bank-note issue.

A public attempt to the same purpose was represented by the New York Safety Fund established by legislative enactment in 1829. The provisions of the act required the maintenance by the banks of a general fund—administered by the state—for the redemption of the notes of banks that failed. This was in a real sense a forerunner of the Federal Deposit Insurance corporation. The fund was made proportional to the assets of the several banks instead of to their note issues, which would have been more reasonable. When the fund was held to be, in essence, a guarantee of bank deposits as well as notes, difficulties which otherwise could have been avoided became insurmountable. New York thereafter adopted, in connection with its free banking policy, provision of law which required that associations freely engaged in banking might issue notes only upon deposit of securities of the United States or of New York with the state comptroller. This method of restraining the note issue and of protecting the note holder was relatively sound and it was the precursor of the method of note issue provided by the National Bank act of 1863.

The Condition of the Currency to 1863.—Despite the meritorious efforts of the Suffolk bank, of the New York Safety Fund and of other reasonably appropriate bases for bank-note issue, it may be said that the condition of the currency in the country as a whole was deplorable, and increasingly so, in the years prior to the Civil War. The state bank notes constituted a most varied currency; varied in design, size and material, and varied, too, in respect of degrees of protection of the note holder and of limitation of total issue. Consequently, apart from the notes of the New York banks and of the New England banks (because of the Suffolk system), most state bank notes had only local circulation. So varied and numerous were the notes issued that at one time, so it is reported, about 1,600 banks issued in all approximately 10,000 different kinds of notes. Every principal financial house made use of a publication known as a "note detector," which purported to identify counterfeit and genuine notes; and the notes of the several state banks circulated, in parts distant from their place of origin (if at all), at discounts ranging up to 10% and 15%.

It was this unsatisfactory condition of the currency of the country, together with needs associated with the financing of the Civil War, which led to the passage of the National Bank act in 1863.

National Bank Act of 1863.—In 1863 the federal government resumed its monetary responsibilities with the National Bank act, which provided that banks under federal charter and known as national banks should issue notes on the security of United States government bonds pledged in Washington, D.C., with the comptroller of the currency. These notes were uniform and of standard denomination, and provision for their redemption, modeled after

the procedure followed by the Suffolk bank, gave the country a currency that circulated everywhere at par. The immediate incentive to passage of the act was not banking or currency reform, though that was achieved by it, but increased funds for waging the Civil War, the expectation being that national banks would buy great quantities of government bonds in order that they might issue as large a volume of notes as possible. This expectation was disappointed; the deposit business of banks already exceeded their note circulation and was growing far more rapidly. Moreover, the system was not established till so late in the war that it could not contribute significantly to the financing thereof.

It had been expected also that national charters would be so attractive that state banks would convert to the national system; and when this did not occur, a tax of 10% was imposed on state bank notes, the assumption being that this would render note issue unprofitable and drive state banks out of existence. But this assumption, again, was based on the false notion that note circulation was essential to banking. So state banks that had no circulation remained untouched, and others gave it up, continuing as banks of deposit only.

The National Bank act was based in its essentials and in much of its language upon the New York Free Banking act, which had already been the pattern for bank laws in many other states. It provided that any number of banks might be established, the organization of each having to satisfy certain stipulations of the law. It continued and amplified official bank examination, which was to become an increasingly important characteristic of United States banking.

After adoption of the National Bank act the most important monetary and banking measures were those taken by the federal government. Before the Civil War, banking practice and banking control were diverse and experimental. Different states followed different courses—some being restrictive, some being loose, some having a good experience, some having disasters and some changing from one thing to another. Beginning with the National Bank act, banking practice and banking legislation developed a new national unity. Substantial improvements in banking practice resulted therefrom, particularly with respect to the currency. National bank notes circulated at par throughout the country. The note holder was entirely protected by virtue of the redemption provision. The federal government's liability in the matter was covered through the pledge of U.S. securities with the comptroller of the currency by the issuing banks.

The system which emerged under the National Bank act had, however, certain inherent defects which resulted in frequent bank failures and recurrent financial stringency. The defects related both to the factors affecting the volume of currency and to the concentration of pyramiding of bank reserves.

The currency, while entirely safe as indicated above, failed to expand and contract in volume in response to the changing needs of the business community because through the bond security requirements it was more clearly related to the fiscal operations of the federal government than it was to the level of economic activity.

The national banks were required to hold reserves in varying proportions to their deposits, depending upon the location of the bank. The banks in the central reserve cities, New York, Chicago and St. Louis, were required to hold their reserves in the form of vault cash; however, the banks in reserve cities (a substantial number of other financial centres) were permitted to hold a proportion of their reserves in the form of deposits with other banks in the central reserve cities, and the so-called country banks (national banks located neither in central reserve nor reserve cities) were permitted to hold a proportion of their reserve in the form of deposits with national banks located in reserve cities of either category. This system produced the pyramiding of reserves noted above, the concentration being most serious in New York. It is widely believed that this concentration led to recurrent financial panics since, in periods of monetary stringency, many banks would call upon their reserve city correspondent banks for cash. This action, in turn, would involve substantial withdrawals from the New York city banks and the latter—being aware of this eventuality—typically had their funds invested in call money loans which would have to be called with consequent liquidation and declines in security prices.

To these substantial defects must be added certain others, some major and some minor: provisions for the clearing of checks were inefficient or unsatisfactory and there was no unified "banking system" in the sense of a central bank with powers to influence and control the flow of money and credit. During this period, moreover, the independent treasury system established in 1836 continued to be operative in spite of the fact that national banks could be employed both as fiscal agents and depositories.

The defects here described led to serious discussions of the monetary and banking system, culminating in the establishment of a national monetary commission in 1908 and leading, ultimately, to the establishment of the federal reserve system (*q.v.*). The enactment of the federal reserve system in 1913 effected substantial improvements in the banking system of the United States but—at least in its original formulation—it fell far short of meeting the most important requirements of a central banking system.

Bank Suspensions and Crisis of 1933.—Beginning before 1900 there was a prolonged increase in the number of banks; for the whole country the number more than doubled between 1900 and 1920. Most of this increase was in farm regions and comprised small banks that could survive only under the most favourable conditions. About 1920 a fall in agricultural prices occurred which immensely reduced the income of farmers and made impossible the situation of those who had gone into debt in the period of prosperity. The upper Mississippi valley states, which were predominantly agricultural, were subjected to a general reduction of income while remaining under the necessity of repaying indebtedness and purchasing supplies. The creditors and suppliers were largely in the eastern industrial regions so that there arose what is known in international trade as an adverse balance of payments, the agricultural west owing more to the outside world than it received therefrom for the products it sold. The banks were inescapably involved as their deposits dwindled and as their debtors became unable to pay. Bank failures became common. From 1921 to 1933 the number of banks was reduced by about 16,000—a reduction that offset the corresponding growth of the earlier two decades. It was not all a matter of insolvencies, for many banks consolidated and some liquidated without loss. Most of the contraction occurred among the small banks in the middle west which were, of course, the most vulnerable. Iowa, for example, which in 1924 had 1,600 banks, lost 1,000 of them by 1934.

By Jan. 1933 panic began to spread eastward. Holidays, or moratoria, were proclaimed in state after state in order that banks might close under cloak of legality and avoid devastating runs, and almost the first act of the Roosevelt administration, on March 6, 1933, was a proclamation making the closure nationwide. Thereafter, banks deemed to be in satisfactory condition were gradually authorized to reopen. The greater part of the weeding-out process was a matter of weeks. At the end of the next year, 1934, the number of banks was 16,000; 12 years before it had been more than 30,000.

The banking crisis of 1933 was probably the most severe in U.S. history. There had been general suspensions before the Civil War, but they had not necessarily entailed closure; suspension had then meant that a bank would not redeem its obligations in gold and silver but continued operations otherwise. In 1933 and in the years preceding, suspension meant absolute closing, which was, however, temporary in most cases. But meantime it entailed a drastic stoppage of the customary means of payment. The condition affected whole regions and whole economic groups involved in the aftermath of a prolonged rise in prices and values that was inordinate and could not be sustained. It might theoretically have been avoided but, once developed, no credit institution could stop its consequences. The government revived the War Finance corporation for the purpose of agricultural financing, developed a farm-loan system with intermediate credit banks and in 1932 set up the Reconstruction Finance corporation, which lent on a larger scale to banks. It also liberalized the terms

on which federal reserve banks might lend, but all these emergency measures, though they tempered the inevitable, could not prevent it.

The problem was complicated by the fact that the agricultural depression was simultaneous with speculative booms in Florida real estate and in corporate stocks. Funds intended for relief in depressed regions found their way swiftly into speculation; and measures intended to restrain speculation threatened recovery in agriculture. In 1929 a collapse in stock-market speculation began a period of general depression lasting several years.

The great weaknesses manifested in this period renewed a dormant advocacy of branch banking and also developed a variation of it in organizations comprising separate banks owned by holding companies. In the larger cities of the east and the far west, banks built up systems of numerous offices; and in many states, including notably California, branch organizations of considerable size were formed, partly by the establishment of new offices and partly by the merging of independent banks.

There was intense controversy over the question in congress, but the opponents of branch banking, who were strongest in the regions where there was no branch banking and where bank failures were most numerous, resisted successfully all attempts to do more than make federal law as liberal as state law in those states where branches were not forbidden. As a result, banking in the United States at mid-20th century was still typically conducted by individual banks, mostly small, local and having but one office. This situation was a peculiarity as compared with banking elsewhere in the world and as compared with other kinds of business in the United States. Yet despite the disinclination of most small banks to become units in large organizations and despite the disinclination of most large metropolitan banks to undertake the responsibilities of widespread branch systems, the ratio of the number of banks to the number of banking offices continued to rise after 1933. Though peculiarly resistant, the banking business seemed to be gradually yielding to a general trend toward large-scale organization. In this period unincorporated banks practically disappeared. In 1900 they numbered about 5,000, mostly very small. Though little is known of them collectively, some were important, the most famous being J. P. Morgan and Company, New York, which did not incorporate until 1940.

The crisis of 1933 occasioned establishment of the Federal Deposit Insurance corporation, to insure deposits in all member banks of the federal reserve system and in nonmembers which qualified. Each insured bank was to pay an annual assessment for the insurance, which was to cover deposits up to $5,000 (later $10,000) in each account. The corporation was also authorized to take over insured banks in difficulties to rehabilitate or liquidate them. Bank failures diminished to almost nothing after 1933.

The Late 1930s and World War II.—In 1935 there was an important reorganization of the federal reserve system, involving the federal reserve board (the legal name of which was changed to board of governors of the federal reserve system), the federal open market committee (which thenceforth comprised the board members and five reserve bank presidents) and the management of the federal reserve banks. This change increased the authority of the board and the committee and also recognized more fully the primary importance of open-market operations.

When the system was established in 1914, it was expected that banks in need of reserve funds would borrow from the reserve banks and that in consequence the discount rate of the reserve banks would have a regulatory effectiveness. Actually, it came about that banks were extremely reluctant to borrow. The result was that the scope of regulatory action was much diminished and the monetary authorities were left little initiative. Open-market operations—the purchase and sale of government securities by the federal reserve banks—were found to be immediately effective in augmenting or reducing the reserves of banks, and they allowed the authorities to take the initiative in regulating credit. The usefulness of open-market operations was first realized in the early 1920s but their effectiveness depended on unified action by all 12 federal reserve banks. The Banking act of 1935 recognized in law the results of about 15 years' experience.

This accomplishment was already in process of being nullified, however, by the sale of gold to the United States by the rest of the world. Political and economic uneasiness in Europe was mainly responsible for the pouring of the world's gold into the United States, and its domestic effect was such an augmentation of bank reserves that regulatory powers were inadequate to offset it. The authorities were committed to an easy money policy because they wished to encourage business recovery, but they could scarcely have chosen otherwise, even though they received and from time to time used the power to require member banks to maintain larger reserves. Toward the end of the 1930s, however, preparations for war began to quicken activity decisively; there began, also, an expansion of the public debt which raised the total from $45,000,000,000 in 1940 to $279,000,000,000 in 1945. A large part of the debt was acquired by banks and paid for by an increase in their deposit liabilities. Still further inflationary potentials were created when the banks sold their government obligations to the federal reserve banks and enlarged their reserves and thereby their lending power. The federal reserve banks were inhibited from declining to purchase the government securities because to do so would have depressed their market price, impaired the government's credit and raised the interest cost.

The dilemma thus faced by the monetary authorities—whether to follow policies primarily directed to the maintenance of low interest rates on the federal public debt or to exercise greater control over inflationary pressures—was not resolved until early 1951. In the course of the discussions leading to the resolution of the dilemma, the semi-independent status of the federal reserve system was brought into question in some quarters. (*See* FEDERAL RESERVE SYSTEM, THE.)

In March 1951, however, a joint announcement was made indicating that the treasury and the federal reserve system had reached an agreement with respect to the "debt management and monetary policies to be pursued. . . ." Thereafter, the federal reserve system did exercise certain of its powers anew. During 1952 and 1953 policies looking to the control of inflation and to the restraint of credit expansion were followed. They were modified as a consequence of the mild recession of 1954 and thereafter were again strengthened in the interest of credit control until the autumn of 1957 when business conditions again suggested the desirability of further easing the flow of bank credit.

There was substantial discussion in the late 1950s of the possible establishment of a national monetary commission or other device to re-examine the banking and financial system of the United States. No official body had been established for this purpose at the beginning of the 1960s but the Committee for Economic Development, a private organization, had established a commission of outstanding experts charged with the task of studying the problem in its broadest aspects. The multiplicity of financial agencies together with defects alleged by some to characterize the current banking system have combined to suggest a re-examination of the whole. (FK. L. K.)

II. PRINCIPLES OF BANKING

As noted in the introduction to this article, banking institutions may perform a wide variety of services for their customers. But, apart from the one function which characterizes a commercial bank—the creation of credit—these functions are not peculiar to banks and none requires theoretical analysis of a kind peculiar to banking.

The theory of banking, then, has to do primarily with the operations of commercial banks. The distinguishing characteristics of commercial banks is that claims against them, called bank deposits, are themselves money. Commercial banks, by accepting deposits against which checks may be drawn, provide a means of payment. This means of payment, the circulation of bank deposits by check, constitutes the major part of the circulating medium in all Anglo-Saxon countries and in many other highly developed countries. In the United States at mid-20th century, for example, commercial bank deposits accounted for approximately 75% of

the money supply. It was estimated that in excess of 80% of all transactions measured in terms of total value were effected by the transfer of such deposits by check.

Money is defined as anything that is generally acceptable in exchange for goods and services and in the discharge of business obligations and that has a fixed price in terms of the unit of account. Clearly, then, in all countries with highly developed banking systems, commercial bank deposits—deposits subject to withdrawal or transfer by checks drawn upon them—are viewed as a part of the money supply. All contemporary literature in the theory of money and banking proceeds from this fundamental definition.

It is true that the theory of banking deals largely with the operations of commercial banks and in particular with the way in which those operations influence the supply of money. In connection with these topics it is necessary not only to treat the operations of commercial banks but also to consider the relationships which exist between commercial banks, central banks and national treasuries.

The term commercial bank embraces institutions ranging from a small neighbourhood bank such as is found in most medium-sized communities to a huge metropolitan institution or a widely spread organization with hundreds of branches. In the United States there are many banks, approximately 1,300 at mid-century, most of which are relatively small banks conducting the whole of their business in a single banking office; there is also a substantial number of banks operating many branch offices. In the United Kingdom, and in most other parts of the world with developed banking systems, there are a few large banks each of which operates many full-scale branch offices.

A. Creation of Deposits

The act of lending money may take any one of three forms: All three forms may be observed in the day-to-day work of a commercial bank but it is to the third that the theory of banking primarily addresses itself. Some have viewed these three forms as successive stages in the historical development of the art of lending although the validity of this view is difficult to demonstrate by the methods of historical scholarship.

Methods of Lending Money.—The first method of lending money involves the simple act which takes place when one person lends his own money to another in return for the promise of the latter to repay it at some future time usually, and always in commercial lending, together with interest. This simple act of lending is the process which most people have in mind as the essence of the typical transaction. It may be observed in the operation of a commercial bank to the extent that such a bank may extend a loan of funds accumulated from its earnings. If the bank in this case were to purchase, for example, a government bond, it would be practising the first method of lending, that of lending its own money.

The second method involves an intermediary. It occurs, for example, when a government bond or other debt instrument is purchased by the bank with funds left with the bank by a depositor. In this case the bank has acted as an intermediary between the depositor who wished to leave cash for safekeeping, and for, perhaps, a small return, and some other person or institution desiring cash and with a debt instrument to sell.

In such transactions as these, where there is a transfer of bonds or commercial paper to a bank, the borrower is not necessarily the one who receives the money from the bank. Unless the individual who gets the money is also expected at a later date to pay the obligation, the transaction amounts to a passing on of a debt from one creditor to another. In the above example the government is clearly, from the standpoint of the bank, the borrower. Likewise when a businessman discounts a customer's note at a bank, the bank becomes a lender not to the businessman but to his customer. The owner of a government bond who sells it to a bank, or the businessman who discounts a trade acceptance at a bank, thereby steps out of the role of lender; and the bank steps into the role of lender.

From an economic standpoint, in this case the bank acts primarily as an intermediary in lending of the second type since it takes the money of depositors and places it at the disposal of borrowers or of those who previously occupied the position of lenders. The legal position, however, is that the bank owes the depositors; and the borrowers (*i.e.*, the ultimate payers) owe the bank.

In lending of the third type, banks furnish neither their own money nor money received from others; instead, they establish deposit credit against which the bank's customer can draw checks. These deposits are created as part of the lending operation. New money is created.

In the simplest case, a businessman with an established credit rating with his bank and in need of ready funds in the amount, for example, of $10,000 borrows from the bank, tendering to the bank his own promissory note as evidence of the debt. In this case the bank acquires an income-yielding asset and the businessman will ask that the loan be credited to his deposit account. Assuming that the bank has adequate reserves to meet its legal reserve requirements and disregarding, for the moment, the existence of other banks, the bank's customer has acquired an addition to his checking account and the bank has acquired a new earning asset. The results of this operation may easily be seen in the changes in the bank's balance sheet which flow from it.

Table I.—*A Bank's Balance Sheet for a Customer*

Assets		Liabilities	
Notes	$10,000	Deposits	$10,000

It should be noted that the addition to the borrower's deposit account is a net addition to the deposits of the banking system as a whole. It has been created through the process of an expansion of bank loans; and since deposits constitute a part of the money supply it represents an increase in the quantity of money in the society.

This is frequently a difficult idea for many people to accept. In essence the process is simple but the preoccupation of those who identify "money" solely with coin or currency stands in the way both of their ready understanding or acceptance. Hence, it is worthwhile to examine the process in more detail and to raise and reply to some of the common questions concerning it.

The Nature of Deposits.—Contrary to the usual understanding of the word deposit, the expression "bank deposit" does not signify something which is physically present. A bank deposit is simply an entry on the books of a bank recording its obligation to a customer. While it may arise out of the transfer of cash or other assets to the bank, it is not itself an asset but a liability of the bank.

The terms primary and derivative deposits relate to the manner in which demand deposits (those bank deposits against which checks are freely drawn) originate. A primary deposit is one which arises out of the deposit of checks or currency at a bank. The balancing item on the books of the bank is an addition to so-called nonearning assets in the form of cash or claims on other banks. A derivative deposit, on the other hand, is one which results from a loan or investment by the bank. The balancing item is an addition to the bank's earning assets under the classification of "loans and discounts" or "investments." The creation of derivative deposits, which may be thought of as identical with the third stage of the art of lending, is sometimes described as the "monetization of credit." The adjectives derivative and primary refer only to the way in which a deposit gets on the books of a bank. When a derivative deposit is transferred to another account by being checked against, it becomes a primary deposit. The deposit which emerged in the transaction illustrated in the balance sheet entries above, is a derivative deposit, *i.e.*, it arose from the lending operations of the bank.

The distinction between primary and derivative deposits is of great importance in relation to the effect of banking operations on the total volume of circulating medium. A deposit of checks merely transfers demand deposits from one bank to another or from one checking account to another and does not alter the total. When demand deposits are created by the deposit of cur-

rency, the expansion of deposits is accompanied by an equivalent reduction in the amount of currency at the disposal of the public; the effect is to exchange one medium of payment, currency, for another, demand deposit, but not to increase the total means of payment available to the public. A primary deposit, at most, may change the form of circulating medium but does not directly alter the total volume. When derivative deposits are created, on the other hand, there is an increase in total circulating medium.

In the normal operation of the banking system, the second and third stages of the art of lending are not so distinct as may appear from the description. Once the volume of bank deposits has grown to a size more or less adapted to the current requirements of a community, new loans will be made as old loans are repaid and a growth in the deposits of one customer will correspond to a decline in the deposits of others. In such a situation the banking system can be looked upon as an intermediary in the disposal of demand deposits already in existence. Alternatively, of course, each repayment of a loan might be regarded as involving a destruction of old deposits and each new loan as leading to the creation of new deposits. It would still be true, however, that a net creation of demand deposits occurs only when the total is rising. The great majority of credit operations, whether of an individual bank or a banking system, involve no significant change in total deposits and are in effect similar to the second type of lending operation. The effect of banking operations in bringing about a change in the supply of circulating medium is particularly apparent in periods of rapid expansion such as occurred in World Wars I and II and of sharp contraction such as has usually occurred in periods of severe depression. *See* also CURRENCY; INFLATION AND DEFLATION; MONEY.

B. Reserves and the Limitation of Deposit Creation

The basic limitation on the process of deposit creation is the necessity of maintaining reserves of currency or its equivalent. In order to provide for routine operations and to be able at all times to redeem deposits on demand, banks must have at their disposal an adequate amount of currency or its equivalent relative to the volume of their deposit liabilities. There must be enough till money to meet day-to-day demands and there must be additional funds on hand or on deposit with other banks to meet a sudden increase in demand for cash payments. The proportion of cash to deposit liabilities may vary from time to time and it customarily differs for different sizes and types of banks. Whatever the precise relationship of reserves to deposits and however it is determined, the necessity of maintaining adequate reserves sets the ultimate limit to the process of deposit creation.

Reserve Provisions.—In some countries, notably the United States, certain minimum ratios of reserves to deposits have been prescribed by law. In other countries, such as England, the ratio of reserves to deposit liabilities is left to the discretion of the banks themselves. Whether the ratio is established by law or custom, the creation of deposits must be halted when deposits have reached that multiple of the reserves held by banks which corresponds to the accepted ratio of reserves to deposits. Similarly, a reduction of reserves below this point would force a contraction of the amount of deposits based upon these reserves. Just as the banking system can expand deposits by a multiple of any addition to reserves, so deposits would be expected to contract by a multiple of reserves which are lost. The size of the multiple is the reciprocal of the reserve ratio.

Illustrations of the extent to which the process of deposit creation is limited by required or customary bank reserves and of the manner in which changes in the size of bank reserves may result in multiple expansion or contraction of deposits may aid in understanding the process. Assume, for the moment, an economy with one commercial bank. Assume, moreover, that the bank has deposits of $1,000,000 and a reserve account of $200,000 on deposit with the central bank, in the United States a federal reserve bank. Assume, moreover, that the reserve required by statute is 20% of deposits. The bank, then, is fully "loaned up," that is, it could not expand its loans unless it could acquire new reserves. The bank would, of course, have assets and liabilities other than its reserve account and its deposits. Their totals and changes in them, however, are not essential to the present illustration. The situation of the bank, then, might appear as follows:

TABLE II.—*A Commercial Bank's Required Balance*

Assets		Liabilities	
Cash	$ 70,000	Deposits	$1,000,000
Investments	500,000		
Reserve acct.	200,000	Other liabilities	10,000
Notes & discounts	230,000		
Bldg., equip., other assets	100,000	Capital surplus.	90,000
Total	$1,100,000	Total	$1,100,000

It will be noted that the reserve account of this bank is exactly equal to the minimum 20% of deposits as required. The bank, therefore, is not in a position to expand the total of loans and investments since this would give rise to deposits and would, therefore, mean that its reserve account was different. Moreover, since we are operating upon the assumption that this is the only commercial bank in the system, it would not be possible for this bank to augment its reserves by the sale of securities to another bank. The system as a whole is "loaned up."

Now suppose that an increase occurs in the reserves of the bank arising from the importation of gold in the amount of $100,000. In effect, in the United States, the gold would be purchased by the treasury. The treasury would pay for the gold with a check on its account with the federal reserve bank. The seller of the gold would deposit the check to his account in our single commercial bank which, in turn, would deposit the check to its reserve account in the federal reserve bank. The balance sheet of the commercial bank would then appear as follows:

TABLE III.—*A Commercial Bank's Balance Sheet*

Assets		Liabilities	
Cash	$ 70,000	Deposits	$1,100,000
Investments	500,000		
Reserve acct.	300,000	Other liabilities	10,000
Notes & discounts	230,000		
Bldg., equip., other assets	100,000	Capital surplus.	90,000
Total	$1,200,000	Total	$1,200,000

It will be seen that our single bank has acquired an addition to its deposits of $100,000 which, upon the assumption of a 20% required reserve, would require an increase in the reserve account of $20,000; but the reserve account has increased by $100,000. Hence our single bank has reserves in excess of the requirement in the amount of $80,000. Since this would provide required reserve for a further increase in deposits of $400,000 the bank may make loans or investments and thereby create new derivative deposits in that amount. Thus the increase in reserves of $100,000 provides a base for a multiple expansion of deposits, the multiple being equal to the reciprocal of the reserve ratio. (Possible expansion of deposits = increase in reserves ÷ reserve ratio or $\$500{,}000 = \frac{\$100{,}000}{.20}$). Clearly, if our single commercial bank were fully "loaned up" and reserves were to leave the system, a multiple contraction of deposits of the same proportion would ensue. The assumption of a single bank is, of course, an artificial assumption; but so long as the reserves of the system of commercial banks as a whole remain unchanged, it is not unrealistic for, in these circumstances reserves lost by one commercial bank must be acquired by another and thus, in this respect, the system may be likened to a single bank. But, as we shall see below, the existence of many banks does make a difference. The allocation of reserves between banks and the distribution of new reserve funds in the system between banks and nonbank holders will be considered subsequently.

Because reserves are the basic factor limiting demand deposits, the theory of the behaviour of bank deposits is essentially a theory of the determination and allocation of reserves. The ultimate restraining influence of reserves would apply in a banking system entirely devoid of laws or institutional controls. It is

the key to the operation of the individual bank or of the entire system of banks. In addition, reserves are the principal basis by means of which central banks, as will be noted later, undertake to control bank credit in the interests of general economic stability.

Internal Drain.—The allocation of reserves is most clearly described in terms of the so-called internal and external drain of reserves. It is to be observed, first of all, that the presence of other banks within a banking system modifies the behaviour of any individual bank within that system. This is because a bank which is one of many having mutual relations is subject to the possibility of an internal drain of reserves. By this is meant the shift of reserves from one bank to other banks in the system. It is regarded as internal because, while external to the particular bank losing reserves, it is internal to the banking system.

The shift of reserves to or from a particular bank results from the necessity of settling balances between that bank and other banks in the system. The net amount that must be paid by a bank is governed in turn by the dollar volume of checks drawn against the bank relative to the sums drawn on other banks which are payable to it. Payments between banks in settlement of checks drawn can be offset against one another (*i.e.*, "cleared") but any remaining difference must be paid in cash. Such payments are likely to involve a corresponding shift in reserves. The mechanical operations of check clearances are conducted through central banks, correspondent banks, clearinghouses and by direct collection between banks.

The way in which internal drain controls the lending operation of a particular bank may be seen by supposing that a bank, having received additional reserve money, expands its deposits more rapidly than others in the system. It would almost immediately be subjected to a drain of reserves as checks drawn against the new deposits were exchanged for cash or deposited with other banks. Withdrawals over the counter and payments to settle balances due other banks would sharply reduce the reserves of the original bank. Because of internal drain, therefore, it is generally assumed that an individual bank can expand deposits by little more than the amount of the addition to its reserves. Provided that all reserves drawn out of the first bank were redeposited in other banks, the banking system as a whole, however, would be able to expand, as indicated in the illustration above, by approximately the full reciprocal of the reserve ratio. If the reserve ratio were 20%, total deposits could rise about fivefold. An increase in reserves at one bank will, in any case, be shared with other banks in the system as a result of the checks drawn against the deposits created by the initial deposit of new reserve money being placed to the credit of deposit accounts in other banks.

External Drain.—The assumption that all new reserve money remains within the banking system is, of course, highly unrealistic. It is probable not only that most of the reserves will be drawn out of the original bank and into other banks but also that a part will be drained entirely out of the banking system. Such a movement of reserves is known as external drain. There are two principal places where funds may go which are withdrawn from the banking system. A certain amount of currency may be drawn out to circulate within the country and under certain circumstances reserve money may be sent out of the country to settle foreign-exchange balances. (*See* EXCHANGE, FOREIGN; INTERNATIONAL PAYMENTS.)

Whether an external drain involves withdrawal of cash from the banking system only or from both the system and the country, the effect in either case is to restrict the possible creation of deposits. This is because external drains represent a reduction in the volume of bank reserves within the banking system. Whereas internal drain restricts the expansion of deposits for an individual bank but not for the system, external drain restricts it for both.

Both internal and external drain relate to the movement of reserves away from banks. They are the reverse of primary deposits, which represent the movement of checks or currency, and therefore of reserves, to a bank. The same transaction would be called a primary deposit if viewed from the standpoint of the bank in which a check was deposited and internal drain if viewed from the standpoint of the bank against which it was drawn.

The expressions primary deposit, internal drain and external drain, then, identify the movement of reserves to, within and from the banking system. They refer to specific operations related to the mechanics of the allocation of reserves. They do not, however, explain what causes the movements which they serve to designate.

Allocation of Reserves.—Reserves are allocated throughout the financial system in response to the necessity of effecting settlements between countries, regions, communities and individuals. These settlements are simply the residual of payments that result from the existing volume of business transactions and the manner in which they are carried out. If economic activity expands in a particular area more rapidly than elsewhere, the change in the relative proportion of business carried on will find its logical sequel in a correspondingly larger proportion of bank reserves concentrated in that area, and likewise of deposits based upon them. While the regional allocation of reserves will be altered by a change in the regional structure of business activity, the normal expectation is that at any given time an addition of new reserve money, no matter where it enters, will tend to be distributed throughout the financial system according to the same pattern as the existing stock of reserve money.

The presumption is that at the end of a period of expansion each bank in the system will have gained reserves approximately in proportion to the size of its reserves relative to the total of reserves held by all banks in the system. This will tend to be true also of the bank which receives the original deposit of additional reserve money. Depending on its relative size, the permanent increase in its deposits might well be less than the original deposit of additional reserve money and also less than that of other banks in the system. Moreover, if two banks, one large and the other small, were to receive new reserve money in equal amounts the first bank could expect to retain a correspondingly larger proportion of the increase than the smaller bank.

Following a net gain in reserves, each bank will tend, after all adjustments have worked themselves out, to experience an expansion of demand deposits corresponding to the reciprocal of its reserve ratio. The basic factor in the analysis of the banking process, however, is not what happens to deposits but what happens to reserves. Deposits are to be thought of as a result and reserves as the governing, or at least the limiting, causal factor. Theoretically, the pattern by which reserves are distributed will also determine the pattern by which deposits are created.

(C. R. WY.; FK. L. K.)

C. Central Banking in Relation to Commercial Bank Reserves

The expansion of central banking in the 20th century was accompanied by a fundamental alteration in the composition and behaviour of commercial bank reserves. Until the early years of the 20th century the reserves of commercial banks throughout most of the world consisted chiefly of gold and silver and, to a limited extent only, of the obligations of central banks. As a result of policies introduced in World War I, reserves came to consist mainly of the liabilities of central banks. Automatic forces governing the movement of commercial bank reserves became relatively less important; and monetary management, in a variety of forms but usually under the guidance of central banks, became more important.

The principal function of a central bank is to act as a stabilizer by attempting to prevent or moderate economic disturbances. In the latter part of the 19th century it came to be generally agreed that in order to maintain confidence and prevent financial panic, a central bank should stand ready at all times to lend additional cash when needed, but at a price high enough to discourage less deserving borrowers. Back of this conception of the role of a central bank as lender of last resort lay the belief that in time of crisis a spirit of panic is promoted by fear of not being able to secure ready money including additional reserves

for commercial banks. The ability of the central bank to discharge the function of lender of last resort was expected to give assurance that deserving borrowers could always obtain additional money when it was needed, but at the same time, that unwarranted borrowing could be effectively deterred. Provision of potential bank reserves was integrated with the use of the discount rate, at one time the most important instrument of credit control by central banks.

Creation of Commercial Bank Reserves.—In order to be able to provide commercial banks with additional reserves whenever it may be necessary, the central bank must be able to create reserves if called upon to do so. The manner in which this can be accomplished is by resorting to the third stage of the art of lending, which was described above in explaining how demand deposits may be created by commercial banks. In countries where the legal reserves of commercial banks consist of deposits with the central bank, the creation of deposits for commercial banks, through the discounting of commercial paper, extension of advances or purchase of government obligations by the central bank, constitutes an increase in their reserves. Where reserve ratios are prescribed by law, reserves may be made available by a reduction of the legal reserve requirement. The principles involved are the same where central banks create liabilities in the form not of deposits but of bank notes, which may either circulate as currency or be used as reserves by commercial banks.

The basic factor limiting the ability of a central bank to create commercial bank reserves or currency is similar to that which limits the ability of the commercial bank itself to create deposits; namely, the necessity of maintaining reserves against its note or deposit liabilities. As in the case of commercial banks, the maximum amount of liabilities which a central bank can create on the basis of a given amount of reserves is determined by the reciprocal of its reserve ratio. The reserve ratio may be set by custom or law and is subject to modification in time of emergency. Under an international gold standard the amount of reserves was determined primarily by gold movements between countries. In the absence of a metallic standard, reserve limitations are ordinarily set by law.

The ability of central banks to create reserves greatly extends the limits of deposit expansion by commercial banks as they were described earlier. In a system where commercial banks must keep a 20% reserve and the central bank a 25% reserve, the maximum deposit expansion possible on the basis of the addition of new basic reserve money is 20 to 1 in contrast with an expansion of only 5 to 1 within the central bank. The larger figure represents a combination of the third stage of the art of lending both at the member bank level and at the central bank level. Credit expansion by a reciprocal of the commercial bank reserve ratio is superimposed upon credit expansion by a reciprocal of the central bank reserve ratio. Substantial as credit expansion by the commercial banks is, the possibility of expansion that can result from the action of the central bank is much greater. This feature of central banks is the source of great flexibility if it functions well, but it can also be the source of extreme inflation and deflation if it operates badly.

The foregoing description of deposit creation may be summarized by noting that there are three distinct levels of deposit expansion. In the first place, a single bank can expand its deposits by little more than a 1-to-1 ratio with an addition to reserves. This is because of the loss of reserves to other banks within the system; *i.e.*, internal drain. Second, the commercial banks as a group can expand collectively to the limit of the reciprocal of the reserve ratio. Finally, the system of commercial banks together with the central bank can expand far beyond this amount, theoretically up to the limit of the reciprocal of the reserve ratio of the commercial banks multiplied by the reciprocal of the reserve ratio of the central bank.

The Control of Credit.—Probably the most familiar aspect of central banks in relation to the reserves of commercial banks has to do with the control of credit by the central bank. The principal general instruments of credit control are the making of discounts and advances at prescribed discount rates, open-market operations (*i.e.*, purchase or sale of government securities) and changes in reserve requirements. All of these instruments represent devices for influencing the volume of commercial bank reserves. The theoretical basis on which these policies rest is that since reserves limit deposits the way to control deposits is to control reserves.

Certain selective controls designed to limit particular types of credit directly, as through restricting or even prohibiting the amount of stock-market or installment credit that may be used, became familiar in the United States and various other countries after 1930. Despite substantial modifications in the art of central banking, the control of credit remained the principal method by which central banks attempted to promote economic stability, and the general methods operating through commercial bank reserves continued to be the principal means of exercising credit control. Chief reliance is likely to be upon the general instruments under relatively normal economic conditions. The selective instruments have found their greatest use in times of severe disturbance such as war.

The effectiveness of the general instruments of central bank control depends upon the fulfillment of certain well-defined conditions. The first of these is a governable relationship between the reserves and deposits of commercial banks. This means either the maintenance of a constant ratio or of a ratio which can be controlled by the action of the central bank. The second requirement for effective control of credit is the ability of the central bank to influence the volume of commercial bank reserves. In certain countries these conditions were vitiated at times after 1930, first by the emergence of excess commercial bank reserves and later by the pursuit of policies which enabled commercial banks to obtain reserves almost at will through the sale of government securities to the central bank. The consequent impairment of the power of central banks to exercise effective control over credit was partly a reflection of the more dominant place occupied by treasury policies. *See* also CENTRAL BANK.

D. Theory of the Banking Firm

The banker has been described as a dealer in debts. In contrast with other businessmen, he holds few assets of a tangible sort; his resources consist almost entirely of the debts of businessmen and the government. At the same time, he owes large sums in the form of time and demand deposits. The demand deposits impose an unqualified obligation to pay in currency whenever it is requested and the time deposits, even though a short period of grace is allowed by law, are usually expected to be paid when the customer wishes. Thus, the bulk of the bank's liabilities are subject, nominally at least, to payment on call. In actual practice, of course, net payments are likely to be relatively small. It is absolutely essential, however, that the resources of the bank be managed in such a way that it can meet all demands for currency as they are presented.

The problem confronting any bank, therefore, is to keep the realizable value of assets equal to the bank's liabilities to depositors.

The Fundamental Banking Problem.—In practice, the fundamental banking problem may be divided into two parts, the immediate and the long run. The immediate, or short-run, problem is that of keeping liquid assets equal to liquid liabilities. The question of the liquidity of liabilities is not so much a matter of form or legal provisions as it is of the actual presentation of claims for payment in currency, or its equivalent. The short-run phase of the banking problem, in other words, is the problem of liquidity; *i.e.*, of being able to meet all demands as they are presented. The long-run banking problem, on the other hand, is the problem of solvency. It is a question of keeping the realizable value of total assets equal to that of total liabilities; it turns on the question of whether the bank could be dissolved without loss to anyone.

Of the two, the short-run banking problem is the more critical. Failure to remain in a position to meet all claims as they are presented leaves the bank with no choice but to close its doors. It is synonymous with bankruptcy. The long-run problem, on the

other hand, would presumably be of direct importance only if it became necessary to close out the bank. There is a classic instance of a Canadian bank which was technically insolvent for 40 years but continued to remain open throughout that entire time because it was able to maintain short-run liquidity and meet all claims for cash as they were presented. The long-run banking problem is likely to be of great practical significance in an indirect manner. Unless proper consideration is given to the ultimate safety of bank assets, a situation is much more likely to develop where the bank will not be able to meet the critical problem of short-run liquidity.

The bases of a solution of the fundamental banking problem are implicit in the statement of the problem: since the object is to keep assets equal to liabilities, it follows that the solution lies in maintaining the value of assets and in preventing an undue expansion of liabilities. In the long-run phase of the problem the solution relates to all assets and liabilities, and in the short-run phase it relates to those which are highly liquid. While much depends on the quality of management, certain general lines of policy in meeting the fundamental banking problem may be indicated.

Policies directed toward the restriction of liabilities require much less attention from bankers and are ordinarily less important than those directed toward the maintenance of assets. In time of crisis, as during a run on a bank, banks may seek to delay presentation of claims. Attempts may be made to reassure depositors and persuade them that it is unnecessary to demand cash. Most of the paying windows may be temporarily closed and excessive time may be taken in counting out currency. Safeguards, or guarantees, may be introduced under governmental sponsorship. More fundamental methods are also employed to restrict not the presentation but the expansion of liabilities. The most familiar of these is the imposition of legal requirements with respect to the ratio of reserves against deposit liabilities. At times the authorities have attempted with less success to enforce certain ratios of capital accounts to deposit liabilities. Certain types of bank liabilities, particularly bank notes, have been prohibited or subjected to quantitative limitation.

Portfolio Policy.—The problem of maintaining the realizable value of assets is complicated by the fact that the features which enable particular assets to satisfy banking needs may be more or less in conflict with one another. A bank which held cash equal to its deposit liabilities would be assured of meeting all demands for withdrawal but it is unlikely that such a bank would be able to cover necessary expenses, let alone show a profit. On the other hand, if it were to put all its available funds into high-yield, relatively illiquid instruments, it might find itself in a position where it could not meet its promises to pay currency when requested to do so. Between these two extremes lies the path the successful banker must follow.

The amount of currency, or its equivalent, which a bank holds is set partly by law and partly by what experience demonstrates to be necessary for the satisfactory conduct of the business. In acquiring earning assets, a banker must constantly consider the criteria of liquidity, safety and profitability. The first of these tests is addressed primarily to the short-run phase of the banking problem and the second to the long-run phase. Profitability ordinarily varies inversely with safety and liquidity. Portfolio policy (*i.e.*, the bank's policy toward various types of earning assets) is directed, therefore, to effecting a satisfactory compromise among these three criteria; *i.e.*, to obtaining assets which are as profitable as possible while providing as great safety and liquidity as the bank considers essential.

While profitability is ordinarily measured by the interest on the securities owned, it may also include an appreciation in the principal value of the assets between the time of purchase and the time of sale. Safety relates to the realization of all anticipated payments because of interest and principal. A security is not necessarily unsafe merely because its market value may decline temporarily. If the stipulated payments for principal and interest are fully met and if the payments are never in doubt, the security must be regarded as possessing safety even though its market value may vary from time to time. The quality of liquidity, on the other hand, refers to the ability to exchange a particular asset promptly for cash without loss. While a substantial decline in the market value of a particular security would not necessarily destroy its safety, it would impair its liquidity.

Liquidity may be achieved through holding a security until the maturity date is reached. The so-called self-liquidating commercial paper and the short-term bills and notes of governments are customarily expected to provide liquidity in this way. An asset is also liquid, however, if it can be sold or borrowed upon at its full book value. This type of liquidity is said to depend upon shiftability. From the standpoint of the individual bank, it is immaterial whether the shifting takes place to another bank, to a central bank or to any agency of the government, except so far as the difference affects the certainty of being able to make the shift. The difference may be highly significant from the standpoint of the banking system, however, since shifting to another bank does not provide liquidity for the system as a whole. While shifting to another bank would merely transfer existing reserves, shifting to the central bank would presumably increase total bank reserves and thereby make the entire system more liquid.

E. Development of Banking Principles

What came generally to be regarded as the traditional theory of commercial banking was first clearly set forth by Adam Smith in *An Inquiry Into the Nature and Causes of the Wealth of Nations* (1776). This theory focuses on the part played by commercial paper and is sometimes referred to as the "real-bills doctrine." It proceeded in its simplest terms from the assumption that commercial banks would confine their lending operations to the purchase of short-term, self-liquidating bills and notes arising out of production and trade.

The Real-Bills Doctrine.—An increase in production and trade was presumed to give rise to a larger volume of bills and promissory notes. By the discount of this commercial paper at banks, demand deposits would be increased with the result that the growth in volume of business would lead directly to a corresponding increase in the volume of circulating medium. Likewise, with declining business, fewer bills would be drawn so that as old bills matured there would be an automatic contraction in the volume of commercial paper held by banks and with it a corresponding reduction in demand deposits.

An essential part of the theory was the so-called law of reflux, whereby any excess of deposits was expected to flow back and be canceled through the retirement of maturing loans. Shortness of term to maturity was, in part, a device for enabling the process of reflux to operate promptly, and the necessity of paying interest was expected to provide an inducement for credit to flow back when it was no longer required.

The basic assumptions of the real-bills doctrine were that the volume of commercial paper would be proportional to the volume of trade, that a roughly constant proportion of commercial paper would be presented for borrowing at the banks, and that on the basis of commercial paper alone the banks would create demand deposits. These were the fundamental features, conceptually, of a mechanism whereby the volume of circulating medium was expected to adjust automatically to the changing level of economic activity.

The banks performed an important function in passing judgment on the credit worthiness of borrowers and by inference at least on the economic soundness of the undertaking out of which the commercial paper arose. At the same time, banks were assumed to be passive since the initiative lay with the businessman who presented commercial paper at the bank. Thus, the banking process was conceived of as operating automatically. In addition to guiding the allocation of deposit credit among competing uses and users, the banks performed two other important functions: (1) they raised the quality of credit available to the public by exchanging their own well-known credit for the less well-known credit of the borrower; and (2) they made credit available in more convenient forms and amounts.

Not only was the real-bills doctrine a theory of the adjustment of the circulating medium to the "needs of trade" but at the same time it implied a solution to the fundamental banking problem of maintaining assets equal to liabilities. Insistence on the short-term feature of commercial paper was presumed to assure liquidity of assets and insistence on the self-liquidating feature was presumed to assure safety. Short-term commercial paper was regarded, then, as offering the most satisfactory means of meeting the portfolio requirements of safety, liquidity and profitability.

The real-bills doctrine, as Lloyd W. Mints pointed out in his *History of Banking Theory in Great Britain and the United States,* had a long and influential history. It was the basis of the defense of the Bank of England during the restriction period from 1797 to 1821. Under the name of "the banking principle" it was widely endorsed by bankers, economists and government officials; it was a major factor in the conception, organization and early operation of the federal reserve system in the United States. The doctrine, however, was by no means free from attack. The most significant criticism related to what R. G. Hawtrey described as "the inherent instability of bank credit." The basis of the argument was that the volume of commercial paper may vary with changes in the value rather than the physical volume of what is produced and traded. Rising prices and increasing business activity would lead, it was said, to more commercial paper and so to an expanding volume of bank deposits. The expansion of deposits, by further raising prices, would contribute to a continuation of the upward movement of the money volume of business and the quantity of commercial paper, with a resulting tendency toward a self-inflammatory upward spiraling of prices. Conversely, falling prices and business activity would cause loans and discounts to decline, which would cause a contraction of demand deposits. This destruction of circulating medium would induce a further decline of prices, business and volume of commercial paper, thus feeding a continuing downward spiral of prices. The substance of this line of reasoning is that bank credit is not only inherently unstable but that it is unstable in a manner which is sympathetic with and conducive to swings of the business cycle.

Critics of the real-bills doctrine also maintained that in actual operation changes in the rate of lending by banks were likely to reflect differences in the expectations of bankers with regard to the future profitability of business rather than changes in the physical volume of business activity. To the extent that credit standards applied by bankers varied in different phases of the business cycle, bank lending on commercial paper would not provide an accurate adjustment of deposits to the physical volume of business activity. It was also argued that, on the one hand, rigid insistence on real bills would rule out many types of productive lending which were desirable from the standpoint of both borrower and lender and, on the other hand, paper which formally gave the appearance of being short-term and commercial might fail, in actual practice, to demonstrate these qualities. Nor was it to be assumed, in view of the changes constantly taking place in methods of business financing, either that fluctuations in business activity would lead to corresponding variations in the volume of commercial paper or that a constant proportion of the commercial paper that did arise would find its way to the banks.

Criticisms such as these challenged the view that bank lending on commercial paper would provide a satisfactory automatic means of increasing and decreasing the quantity of circulating medium. The view was also questioned that commercial paper provided an ideal solution for the fundamental banking problem. Experience had shown that at times of rapidly falling prices substantial losses on commercial paper might occur. Apart from the possible impairment of the safety and liquidity of commercial paper at a time of declining business, the entire conception of a general liquidation of bank-held commercial paper implied the contraction of credit and circulating medium on a scale that might be severely disruptive to business. Finally, the diminished use of commercial paper relative to other methods of financing meant that it could no longer be counted on as an adequate source of banking income.

Composition of Bank Assets.—Traditional banking theory, especially as developed along the lines of the real-bills doctrine, was not a general theory of banking. It applied to a special case; *i.e.,* one where bank assets consisted of the particular type represented by short-term, self-liquidating paper arising out of production and trade. In many areas, especially outside English-speaking countries, the theory was never entirely applicable, and elsewhere, notably in the United States, it became highly unrealistic after 1930 and especially after 1940. Where there is a high proportion of treasury obligations and other noncommercial securities in the portfolios of commercial banks, a situation which became general after 1930, the theory of banking as traditionally formulated requires substantial modification.

The change in the composition of bank assets did not alter fundamentally the mechanical operation of the banking system or the general principles of deposit creation. It did, however, signify a change in the consequences of bank operations and in the cyclical behaviour of banking.

In the first place, the different basis of deposit creation signifies a change in the economic functions performed by banks. To the extent that assets consist of treasury obligations, the credit operations of banks are no longer directly related to the production and exchange of goods and services, and banks cease to play the same part in allocating economic resources among competing users and uses that they do when making commercial loans. Moreover, since treasury obligations are assumed to have the highest credit standing, banks can hardly be said to be raising the quality of credit when they exchange their credit for that of the government. The one major function that remains substantially unchanged is that of providing, in the form of demand deposits, the principal element in the circulating medium. As part of this activity banks continue to be the centre of a clearing organization by means of which payments and financial transfers are conveniently and efficiently effected throughout the economy.

A further consequence of the relative shift from assets of a loan type to those of an investment type is to make the operation of banks less automatic than before. When banks extend credit on the basis of loans and discounts the initiative rests primarily with the businessmen who offer them to the bank. In acquiring or selling bonds and other treasury obligations, on the other hand, banks are able to take the initiative by entering the open market in the same manner as any other buyer or seller of securities. As banks become less passive the banking process becomes less automatic.

Most important of all, a shift to assets of a noncommercial type implies a modification of the cyclical behaviour of bank credit. This follows partly from the decline of automatism but even more from the fact that the volume of investment securities and particularly treasury obligations, unlike the volume of commercial paper, does not tend to vary directly with the total money value of business transactions. To the extent, therefore, that deposits are tied to investment securities rather than to commercial paper, the basis of the automatic adjustment of circulating medium to business activity disappears. The effect is to remove the principal reason for expecting banks to provide automatic elasticity of the money supply. By the same token, there is likewise less justification for regarding bank credit as inherently unstable, and particularly as unstable in a manner tending to aggravate cyclical fluctuations in business activity.

The course of banking development in the mid-20th century demonstrated the shortcoming of the real-bills doctrine as the central core of a general theory of banking. In altering the basis of banking functions and behaviour the change in character of bank portfolios also weakened the force of much of the familiar criticism of banking. The readjustment of bank portfolios away from the extreme concentration on treasury obligations that existed at the end of World War II was notable not so much for a return to earlier proportions of short-term self-liquidating commercial paper as for the expansion of newer, noncommercial types of assets. These included term loans with a maturity often of several years, mortgages and various categories of consumer installment paper. In the course of time, then, banking theory has

become more general by becoming less narrowly identified with any specific type of asset. The composition of bank assets continues to provide a key to the operation of the banking system at any given time. It is, moreover, the most important element to be borne in mind when comparing the banking system of one country or one period with that of another. *See* also COMMERCIAL PAPER.

III. PRACTICE OF BANKING

The legal framework within which banks carry on their activities differs widely from country to country. In the United States there are three supervisory bodies within the federal government in addition to one in each of the states. Banks are subject to detailed regulation and to close and sometimes duplicating examination. At the other extreme are the banks of the United Kingdom and the continent which, for the most part, operate under the provisions of laws governing business corporations in general and are subject to no official supervision or examination. In some countries banks are not even required to make public annual reports of their operations.

While banking practices likewise differ substantially in the various countries, the contrasts are less pronounced than differences in legal status might suggest. The character of banking practices is influenced to a considerable extent by the banking organization of the country, depending, for example, on whether or not there is a strong central bank.

Banking Structure.—The most usual form of corporate organization is the branch banking system, which consists of a home office at some central point with branches situated elsewhere. The number of branches may range from one or two to several thousand, and the branch system may be local or may extend over the entire country and even beyond into foreign countries. At the other extreme is the unit-bank form of organization with all of the bank's operations carried on at one central establishment. Where two or more banks are under common ownership, they are known as a group banking system if the ownership is vested in a holding company, and as a chain banking system if they are owned by an individual or a small group of individuals. Outside the United States banking is carried on principally by branch banking systems. In the United States the typical form or organization is the unit bank; although the other forms are also encountered, they are less common and are not widely distributed geographically.

The capital structure of a bank includes three principal accounts: capital, surplus and undivided profit. (*See* FINANCIAL STATEMENTS: *Accounting Terminology.*) The last is an operating account which is increased by current earnings and decreased by payment of certain expenses, dividends and occasionally by transfers to surplus. The other two accounts are relatively permanent. Aside from the use of these accounts in the starting of the bank, they act as a cushion to protect depositors against possible loss. Since they represent the stockholders' stake in the business, they are usually regarded as providing an inducement to exercise care in the management of the bank. A certain amount of surplus may be paid in at the time of subscription to the original capital, and the surplus account is likely to be built up further out of earnings. When losses have been incurred greater than can be charged against undivided profit, they may be absorbed by transfers out of surplus account.

The administrative structure of a bank is headed by a board of directors, who ordinarily serve without direct compensation other than fees for attending meetings or for special services performed. They are chosen for their standing in the community as well as for the breadth and variety of their business experience and their connections which may serve to attract business to the bank. They are responsible for electing officers, determining major policies of the bank and ordinarily for deciding on transactions in which relatively large sums of money are involved. The actual administration and operation of the bank are under the guidance of the bank's officers, whose numbers, duties and degrees of specialization vary greatly according to the size and character of the bank. The president, or chief executive officer, is customarily on the board of directors and other officers may be. In small banks the position of president is often more or less honorary and he may serve without salary.

A. Deposits

Deposits constitute the great bulk of the liabilities of banks. They ordinarily far exceed the capital accounts. Other liabilities such as unearned interest, deferred maintenance and reserve for contingencies are chiefly of an accounting character and usually are of minor proportions. It is through the holding of deposits that banks perform their most distinctive services to the public.

According to the terminology employed in the United States, deposits are of two general types: demand and time. The demand deposits, called current accounts in England and sight deposits in France, are payable in currency or by transfer via check (*q.v.*) to other banks at any time the depositor requests. In the case of time deposits, known as deposit accounts in Great Britain, the bank has a legal right, though it may not be exercised, to require notice of perhaps 15 to 30 days or even longer in advance of payment. Time deposits include not only savings deposits, which have the character of thrift accounts and are usually relatively small in size, but also deposits of businesses and others which may amount to large sums. Such deposits are sometimes evidenced by time certificates bearing specific maturity dates. These correspond to the "fixed deposits" of British banks. It is customary for banks to pay interest on time deposits but not on demand deposits. (*See* also SAVINGS BANKS.)

Differences in the ownership of demand deposits are a matter of great concern in the operation of banks. Since these differences largely govern the behaviour of deposits, they help to determine the policies which a bank must follow in maintaining a liquid position; *i.e.*, in making sure that it will always have sufficient cash to meet demands. Small personal deposits are highly stable in gross amounts; inward and outward payments tend to offset each other and such fluctuations in totals as do occur are mainly seasonal and can readily be anticipated and provided for. Large deposits are much more unstable and the extent and character of variations in their amounts differ widely with the type of depositor. In general, the deposits of financial institutions such as banks and insurance companies are subject to greater and more sudden fluctuations than those of other types of corporate depositors. Other large deposits may vary seasonally or with particular business transactions, such, for example, as the purchase of additional rolling stock by a railroad company, which the officers of the bank are often able to learn about in advance. Large corporate depositors sometimes keep their banks informed of impending requirements. Similarly, in the United States the treasury gives advance notice of expected withdrawals, something that can readily be done since funds are left with banks only for safekeeping, actual payments being made against deposits at the federal reserve banks.

Large deposits may become particularly volatile in periods of uncertainty and fear. It is deposits of this type rather than the small deposits of individuals that are likely to be withdrawn first when doubt arises concerning the future solvency of a bank. This may be partly because of the greater amount which a large depositor has at stake but is probably chiefly because such depositors pay more careful attention to such matters and are in a position to be better informed.

Practices With Respect to Deposits.—Banks often devote great attention to the character of the deposits they carry and to their possible future behaviour. In addition, it may be the practice for the bank's comptroller or some other operations officer to be notified the moment a large check is presented for payment. The purpose of such notification is to assist in enabling the bank to provide adequate cash to meet all demands without maintaining greater liquidity than is needed, since this would have the effect of encroaching on income.

The amount of earning assets a bank can own is directly related to the total of its deposit liabilities. Consequently, a strong incentive exists for attempting to expand deposits. Efforts to attract and retain deposit balances may take the form of advertising and direct negotiation, providing various types of free serv-

ice and appointing influential businessmen to the bank's board of directors. At one time it was customary for banks to compete for deposits by means of the rate of interest paid on them. This form of competition carries the danger of unduly increasing the costs of banking operations. To the extent that it merely results in taking deposits away from other banks without expanding the total of all deposits, costs may be raised with no corresponding benefit to the banking system as a whole. Because it was felt that the effect of such a practice might be to weaken the banking system, governments intervened in some countries to restrict the payment of interest on deposits. In the United States, for example, banks are forbidden to pay interest on demand deposits and are limited as to the rate that may be paid on time deposits.

Since smaller reserves are necessary against time deposits than against demand deposits, economy may be effected by encouraging depositors to transfer balances from demand accounts to time accounts. Under certain circumstances, the release of reserves by such transfers may contribute to an inflationary expansion of the volume of demand deposits. The administration of deposit accounts necessarily involves certain expenses for the bank. If the activity of a particular deposit account is great relative to the average size of the account, the cost to the bank may exceed what it can earn because of the deposit. It is customary, therefore, for banks to analyze deposit accounts and, on the basis of the number of checks drawn and deposits entered relative to the average balance maintained, to determine whether or not service charges should be levied and, if so, what these charges should be.

Banks may also require or expect depositors to maintain certain minimum or average balances in their deposit accounts. Loans may be granted upon the understanding that the borrower will leave 20% or 25% of the loan on deposit at all times. Such practices help to assure that the cost of operating the account will be met and increase the stability of deposit liabilities.

The handling of deposit accounts involves a great amount of rather mechanical, routine work in connection with scrutinizing and counting coins and other currency and with sorting, recording and distributing checks drawn on the bank itself and on other banks. Much of this work can be carried out with the aid of highly complex machines. In banks located in smaller communities most check transactions pass directly through the hands of paying and receiving tellers. In large city banks most of them may be conducted by mail. A bank may assume the task of receiving and crediting directly to the customer's deposit account payments for dividends, interest, bills receivable and the like, supplying the customer with a detailed record of the transactions handled by the bank. The work of handling mail deposits and of the transit department, which receives and forwards checks, may be on a continuous basis day and night seven days a week.

B. Lending Operations

The granting of loans to business borrowers has traditionally been regarded as the primary basis of commercial banking. During the first half of the 20th century and especially in the 1930s and 1940s, the extension of bank credit through purchase of investment securities by banks became increasingly common while the granting of commercial and industrial loans declined in relative importance. Investments generally carry a lower rate of return than loans but the work entailed in making investments is less than in granting and administering loans.

A bank may lend on a promissory note which bears interest until the note is due. It may also lend on drafts or acceptances which are in the form of noninterest-bearing obligations to pay a stipulated sum of money at some future time. Little distinction is made between the two types and they are ordinarily combined in a common account called "loans and discounts." When a bank acquires a noninterest-bearing obligation, it calculates the proceeds by subtracting from the face value a sum equal to interest on this amount from the date of purchase to maturity, a procedure known as "discounting." The fact that interest is deducted in advance makes the net rate on the sum actually lent by the bank slightly higher than the nominal rate.

It is a common practice for banks to grant their regular customers a "line of credit" under which the bank agrees to extend loans up to a certain maximum when requested to do so, subject, of course, to the meeting of certain specified conditions. The potential borrower can carry out his business plans with greater assurance because of the knowledge that he will be able to obtain funds quickly when they are needed. Banks often require a customer to maintain a deposit balance of from 10% to 25% of the line of credit granted. This practice is frequently criticized and is by no means universal. Borrowers sometimes pay a small interest charge, amounting to perhaps ½% of the unused part of the line of credit, under so-called "stand-by" agreements. A slightly different practice, common in Great Britain and a few other countries, is to grant customers an overdraft privilege. Under this arrangement the bank agrees to honour drafts up to a specified amount and charges interest on such overdrafts until they are paid off. Where this method is used, the overdraft privilege becomes a means of granting loans automatically and without separate formality as they are desired.

Larger banks maintain departments of substantial size for soliciting and serving loans. New business departments may engage aggressively in competing for loans and in seeking opportunities for the extension of credit. Credit departments maintain extensive files on the credit standing of actual and potential customers. Officers of the bank may furnish financial counsel and the bank may supply the services of technical experts to advise on plans designed to increase the operating efficiency of the borrower's business. Sometimes such assistance is related to the provision of additional credit by the bank or to the safeguarding of past loans. At other times it is designed to strengthen good will by promoting the customer's prosperity.

Types of Loans.—At one time bank lending was largely confined to short-term, self-liquidating paper arising out of actual business transactions. The maturity of such paper was usually from 30 days to 6 months, or somewhat longer in the case of agricultural operations. Through the granting of renewals, the credit might, in actual practice, be extended for a much longer period of time. Many bankers adhered to the so-called "golden rule" of banking by requiring customers to clear up their indebtedness to the bank at least once a year. Others were less strict; there are records of loans which were nominally of a short-term character but which had a continuous life, through renewals and extensions, of 25 years or longer.

Other types of loans are also commonly granted by commercial banks. Term loans have a maturity longer than that of the ordinary commercial and industrial loan. They usually run not less than 1 year and may run 15 years or even longer. In the case of term loans running more than five years, the loan contract may be divided with banks taking the earlier period of the loan and an investor of some other type taking the later period. Term loans may be used to provide working capital but are more likely to be used to pay for fixed capital, modernize equipment, obtain rolling stock and the like. Such loans may be drawn in such a manner as to permit changes to be made within the life of the loan, as by shortening or extending the time to maturity or expanding the loan to meet supplementary requirements. Term loans are usually of the amortizing type with current installments applied both to payment of interest and gradual reduction of principal.

Considerable flexibility and variety have been introduced into lending practices. For example, loans may be granted for the construction of tankers with provision for the payment of interest and principal out of the earnings of the ships. Loans of this sort are often extended jointly by commercial banks and long-term investors such as insurance companies. Again, loans are sometimes made on security of underground oil reserves, payment being provided for through the gradual pumping and sale of the oil.

Various types of collateral may be pledged as security for loans granted by banks. The most familiar types of collateral are real estate, stocks and bonds and bills of lading, warehouse receipts and trust receipts. The market value of the collateral at the time the loan is made is always expected to be substantially greater than the face value of the loan and provision is often made for

posting additional collateral if necessary to protect this so-called "margin." Collateral loan agreements ordinarily permit the borrower to substitute different collateral of suitable amount and quality in place of the collateral originally pledged. This feature is designed to protect the borrower against possible loss through inability to sell or against being deprived of possible gain if a favourable time to sell should occur, either of which might happen if the collateral were completely immobilized for the duration of the loan. While the collateral pledged against outstanding loans is subject to continuous scrutiny, the attention devoted to it is particularly close during periods of weakness in the markets with which the collateral is concerned. Likewise the size of the margin required may be increased to provide against the possibility of sharp price declines. In addition, central bank authorities may stipulate increased margin requirements with a view to restricting the volume of credit extended for use in the stock market.

With the expanded use of relatively expensive durable goods, such as automobiles and household appliances, the banks gradually turned to lending for consumption purposes. Techniques were devised for insuring the automobile or other durable consumer goods against theft or damage during the life of the loan, and for seizure and sale of the article purchased in case of default. Banks also entered the field of so-called personal loans, usually made for such purposes as medical expenses, education and the consolidation of indebtedness. Loans of this sort are ordinarily granted without the pledge of specific collateral and without requiring a cosigner of the note.

Repayment of both consumer and personal loans is typically provided for by a series of uniform payments which combine payment of interest with amortization of the principal. The debt may be represented by a book of coupons, each of which represents one of the payments due, the coupon being torn out and receipt acknowledged on the stub at the time the payment is made. Consumer and personal loans proved profitable to banks, despite the relatively high costs of operation resulting from the small sums involved in each individual transaction and the large amount of administrative detail. Rates, although considerably below those charged on similar loans by most other lenders, are higher than on other bank assets. Banks in larger communities maintain separate consumer credit and personal loan departments and engage in extensive advertising and promotional activities to expand this type of business.

Banks furnish credit to their competitors in these fields by lending to companies which specialize in the granting of consumer and personal loans. Furthermore, while rates charged by banks on consumer and personal loans are in general the highest received by banks, the rates charged consumer finance and personal finance companies are among the lowest.

Rates.—As has been indicated, the rates charged by banks on different types of loans vary substantially. The principal factor in such differences appears to be the size of the loan, though the type of the loan, which is likely to be closely related to size, is also an important consideration. Customers who borrow in large amounts, such as finance companies, large industrial corporations and transportation companies, are likely to enjoy a high credit standing. Furthermore, the fact that the sums involved are so large usually means that the costs of administration are small when calculated on a percentage basis. There is the further fact that large borrowers find it easy to tap alternative sources of credit so that a bank must offer as favourable terms as possible if it is to attract and retain their business.

The relation of collateral to rates charged by banks is somewhat ambiguous. Security loans, which consist chiefly of collateral loans to brokers dealing in securities, carry a low rate of interest. This is particularly true of call loans, which are subject to payment whenever the lender demands. Other types of collateral loans, on the other hand, are likely to carry a relatively high rate of interest. This may be explained largely on the grounds that where a borrower's credit position is weak added protection may be demanded in the form of collateral. It is not that collateral makes a loan weak, but that a weak loan may require the further strengthening which collateral affords. Somewhat similarly, loans bearing one signature ordinarily command a lower rate of interest than loans requiring a cosigner because only loans of the very highest credit standing are issued on a single signature.

Bank rates show considerable variation along regional and geographical lines. They are typically much higher on the average in rural areas than in cities, and are higher in the small cities than in the large. These differences are accounted for to a minor extent on grounds of differences in risks or degree of competition among lenders, but are chiefly attributable to differences in sizes of loans. It happens that geographical differences in rates tend to coincide with differences in average size of loans; loans are generally smaller in the country than in cities, and in small cities than in large. When allowance is made for the factor of size of loan, regional differences in rates charged by banks (within a particular country, of course) appear to be relatively slight.

C. Investment Practices

The form in which banks extend credit has always been influenced by the nature of the economy in which they operate, and especially by the apparent credit needs of the community and the methods of supplying those needs. It was natural that in England, where the traditional conception of commercial banking grew up during the 18th and 19th centuries, great emphasis should have been placed upon the short-term commercial loan. In a trading nation it was working capital that was chiefly needed and there was an abundance of foreign and domestic bills of exchange which could be used in providing such capital.

In other countries the same degree of concentration on commercial paper was never feasible, and other types of credit instruments played a correspondingly larger part in the operations of banks. Even in Great Britain and other Anglo-Saxon countries where the British conception of commercial banks exerted greatest influence, holdings of longer-term securities of the investment type came to occupy an important place in the portfolios of banks. The shift toward investments was stimulated by the great expansion in governmental financing which characterized World Wars I and II and the severe depression of the early 1930s. It was influenced, no doubt, by disturbances of world trade and changes in the financing methods of business which entailed a decline in the relative volume and availability of commercial paper.

Because real-estate mortgages are usually issued for fairly long periods of time and no general market for them characteristically exists, they were usually regarded as unsuitable for purchase by commercial banks. Accordingly, such investments were either prohibited or restricted. In the course of time, however, government guarantees, together with greater use of the amortization feature, tended to increase the popularity among banks of investments of this character.

Types of Investments.—Investment in mortgages may be limited to some prescribed ratio of capital and surplus or of time deposits. As in the case of other types of assets, such as common stocks or real estate itself, the limit may be exceeded temporarily if the asset is acquired to protect a loan or investment previously made. There is a tendency for certain types of restricted assets to constitute a larger proportion of the earning assets of banks in depressions than in good times. This is partly because commercial and other loans decline more rapidly than other types of assets in a period of falling business. It is also influenced by the fact that banks are likely to acquire, as a result of default, collateral which was pledged as security on loans granted earlier.

The principal types of investments held by banks are mortgages, government obligations and corporate bonds. In the United States ownership shares in corporations are ordinarily not held by banks except to the extent that they may have been acquired to protect a loan previously made, and when this has occurred it is expected that the security so acquired will be sold as soon as can be done without undue sacrifice.

Government obligations are by far the most important category of bank investments. They consist predominantly of securities of the federal government, but obligations of provincial or local units of government, sometimes called "municipals," may also be included. Investments in treasury obligations include a wide range

of securities. Typically they may be thought of as embracing short-term securities with maturities of from 3 months to a year, intermediate securities with maturities up to 5 years and bonds with maturities up to 25 years or even longer. While banks may hold a limited proportion of their assets in the issues having the longest maturities they tend to concentrate their holdings overwhelmingly in the shorter-term issues. It would be wholly erroneous, therefore, to regard the investments of commercial banks as being made up of relatively illiquid long-term issues.

Problems and Policies.—The holding of investments of a longer-term character gives rise to a number of distinctive problems and policies. Certain investments, such as mortgages, may possess little or no marketability so that the bank must ordinarily plan on retaining them until maturity. A bank can safely afford to hold a certain amount of illiquid earning assets since, even though all of its deposits may be payable on demand, it will not be required to liquidate more than a small proportion of its assets at any one time. Some of its other long-term assets may be shiftable to other lenders in case a bank requires greater liquidity. The disadvantage that at the very time when one bank wants to sell other banks may not be willing to buy is partially overcome in situations where the central bank undertakes to support the securities market; the lack of shiftability to other banks may then be made up by shiftability to the central bank.

One of the most important devices for counteracting the illiquidity inherent in long-term assets is that of spacing maturities. By regularly acquiring bonds having a maturity of five years, a bank will come to have in the course of time a block of securities averaging half that length of time to maturity. Even though all the securities had a maturity of five years at the time of purchase, one-fifth of them at any time will have a maturity of one year or less and none but those just bought will have a maturity as long as five years. Spacing permits the bank to realize the yield that goes with a longer maturity while achieving much of the liquidity that goes with a shorter maturity.

Ownership of relatively long-term investments exposes a bank to the risk of fluctuations in the market value of these securities as changes occur in the level of interest rates. A fall in the market price of a particular security would impair its liquidity but would not necessarily affect its safety. It follows that by holding until maturity a bank can avoid loss of principal on securities that experience a decline in market value, provided that that security is entirely safe. This consideration, and with it the presumption in favour of a policy of holding to maturity, is especially important in respect to investments of the highest quality; in the case of treasury obligations in particular, repayment in full at date of maturity is presumably never in question. It applies to other investments as well, in the sense that the possibility of loss is greatly influenced by the bank's own decision with respect to selling.

The possibility of a loss in market value on long-term investments in case interest rates rise implies also the possibility of a rise in their market value if interest rates decline. The shift from loans to investments serves not so much to increase the vulnerability of bank portfolios to market fluctuations as to alter the character of the instability to which they are subject. Experience has demonstrated that loans may be jeopardized by a decline in commodity prices; and investments, by a decline in security prices. In exceptional circumstances such as occurred during certain years in the 1930s, gains or losses resulting from the appreciation or depreciation of loans and investments were greater than the net income from banking operations.

From an operations standpoint the greatest single advantage of investments is that the bank is not dependent on borrowers coming to ask for loans. Whenever a bank has funds available for lending it can take the initiative by going out and purchasing securities in the open market. At the same time, changes in interest rates, analysis of security values and market psychology are matters of increased concern to banks. Larger banks maintain separate bond departments and carry out elaborate statistical and analytical investigations. In addition, banks in general make use of various statistical and advisory services which specialize in providing information bearing on the security market.

Maintenance of Liquidity and Solvency.—Some of the devices for maintaining liquidity have already been indicated. The first recourse when payment is demanded by depositors is the vault cash regularly carried by the bank. A bank may also draw upon its legal reserves, even reducing them below legal requirements, subject to certain limitations on its freedom (as, for example, to make loans or declare dividends) as long as reserves are deficient. Banks which have deposits with other correspondent banks may draw on these deposits to meet unexpected demands upon them.

These immediate cash resources may be supplemented by the liquidation of certain earning assets. Investments consisting of short-term treasury obligations are likely to be the most liquid assets, other than cash, which a bank possesses. They are the principal element in so-called secondary reserves. Largely because of the desire of banks to retain and increase their commercial loans, by reason both of their profitability and of their possible effect in bringing other business to the bank, commercial paper is not likely, in actual practice, to be treated as a secondary reserve. Methods also exist whereby funds may be temporarily shifted, on payment of a relatively small interest charge, from a bank with excess reserves to one with a reserve deficiency.

Securities in a bank's portfolio are ordinarily spaced in such a way as to provide a steady inflow of cash through the simple maturing of loans and investments. Certain loans, specifically loans to brokers secured by stock-market collateral, may be redeemable on call. It may be possible to sell short-term assets in the open market, to other banks or to the central banks with little or no sacrifice. Or a bank may elect to borrow from other banks or the central bank on its own promissory note, pledging certain of its assets as collateral for the loan. In general, tradition against borrowing by banks tends to hold borrowing to a minimum and to lead to the prompt repayment of loans by banks in case they are made.

As a safeguard not so much of liquidity as of solvency, loans to a bank's officers are likely to be strictly limited by law or custom. In the United States loans to a single borrower are restricted to 10% of the bank's capital and surplus, with some extension of the limit under certain conditions. In some jurisdictions provision is made for the segregation of assets held against time deposits. The purpose of this practice is to prevent the withdrawal of deposits which are payable on demand from leading to the exhaustion of the best assets. Otherwise, time deposits might be left with only inferior assets behind them when the time came that they were eligible to be paid.

Banks frequently accumulate what are known as concealed assets by writing down certain assets, such as the bank building, to an insignificant value by charge-offs against undivided profit. At a later time depreciation of loans or investments could then be equalized on the bank's books by writing up the value of the property to something closer to its actual worth. A similar result may be achieved by establishing contingency reserves to be used for writing off possible losses on loans and investments. Investments acquired at a premium, or other assets on which a future decline in value seems possible, may be written down to a lower figure by charging off certain amounts against current income. Under certain circumstances a considerable tax saving may be realized by following this practice.

D. Relations With Other Financial Institutions

In countries with a strong central bank the reserves of commercial banks are likely to consist largely of deposits at the central bank. In the United States the legal reserves of member banks take the form exclusively of deposits with the federal reserve banks. In other countries, and in the United States for nonmember banks, deposits with other banks may usually be counted as reserves. In some countries deposits in banks abroad may also, within certain limits, be included as reserves.

The clearing and collection of checks and other cash items necessarily involve close relations with banks and other institutions. Clearinghouses exist in most cities to facilitate the collection of checks among banks in the same city, with representatives of the

participating banks meeting two or three times a day for the interchange of checks and the settlement of balances. (*See* CLEARINGHOUSE.) Checks on banks at a greater distance may be collected through what are known in the United States as correspondent banks, through the central bank and its branches or through some other transfer organization. The federal reserve banks maintain a wire transfer system which enables banks to transmit large sums of money from one end of the country to another in a matter of minutes.

On the continent of Europe transfers are effected chiefly by what are often known as *Giro* accounts. Such accounts may be owned by individuals as well as by banks and usually operate through the postal system and the central bank and its branches. Special messengers may be employed for the purpose of saving time in the transfer of large checks between banks.

Banks perform many services for other banks. The central bank and even larger commercial banks may occupy the position of bankers' banks. In this capacity they may discount commercial paper, make advances in the form of loans and assist in the clearing and collection of checks. Correspondent banks frequently supply credit data and other financial information. They may act as agents in providing foreign exchange and in the purchase of securities for other banks or their customers. These are but a few of the services which banks may afford one another. They may also share in the granting of loans, as where a particular loan is larger than one bank would be able or willing to grant alone.

Banks may organize for mutual benefit into such national groups as the bankers' associations of the United States and Canada which sponsor exchange of information, research on operational and policy matters and extensive educational programs. The syndicate of banks in France goes so far as to set interest rates paid on deposits. In the United States county or regional clearinghouse associations may undertake to establish standards with respect to banking practices, as in the determination of service charges to be imposed by the member institutions. Upon occasion, members of clearinghouse associations have rallied to the aid of banks which were in difficulties or have taken other steps to meet conditions of crisis. In countries where banking is predominantly in the hands of a small number of large branch banking systems there is presumably less occasion for the organization of bankers' associations such as exist in the United States.

Conditions of Competition.—The nature and extent of competition among banks, and between banks and other financial institutions, are greatly influenced by the character of the financial organization of a country. Where banking is confined to a relatively narrow field of operations, as was long traditional in Great Britain, there are fewer points of contact, competitively speaking, with other types of lending institutions than where banks engage in a wide variety of lending activities.

Banks of the so-called "department-store" type, which are common in the United States, may find themselves in competition with trust companies, mutual savings banks, investment counselors, consumer finance companies and investment trusts, to name but a few. One effect of the extension of banking operations into a wider area was to bring about increased competition with other financial institutions. To some extent, increased competition resulted from the entry of other lending institutions into fields already occupied by banks.

Where there are a few large branch banking systems, competition is different, though not necessarily less keen, from what it is where there are a great number of unit banks. In relations with other banks, banks have tended to avoid such forms of competition as the payment of higher rates on deposits or the acceptance of lower rates on loans, and to rely more on providing special services or other accommodation.

In certain European countries, notably France, the German Federal Republic and the Netherlands, lines of demarcation between commercial and investment banking are not sharply defined. Assets may not only include securities of an investment character; banks in the Netherlands and Germany sometimes hold stock-market membership, while German banks may hold shares in business enterprises and participate in their management. Similar practices are followed in other countries, even to the extent of banks specializing in particular types of businesses.

The central banks of many countries deal directly with the public. Where this is the case banks are likely to find themselves in competition with the central bank. In the United States the federal reserve banks are authorized to lend to private borrowers but the field of such operations is so restricted and their amount so small that no significant competition can be said to have existed.

A more important type of competition is that which developed between banks and governmentally sponsored financial institutions. One of the first such undertakings was the postal savings system, which played an important role in the Netherlands and other European countries and also assumed substantial proportions in the United States. Extension of governmental activity into the field of private lending seems to have been inspired first of all by a belief that gaps existed in the structure of lending institutions with the result that certain borrowers, such as farmers, lacked adequate access to sources of credit. It was stimulated even more by the desire to provide relief or stimulate recovery during periods of business depression. A further impetus was given by the financial needs resulting from war. Some of the institutions established under these circumstances declined or disappeared with the passing of the emergencies which gave rise to them. Others seem to have become a permanent part of the financial structure. In general, governmental lending institutions assumed chief importance in the fields of agricultural credit and housing and real-estate credit.

Bankers are likely to feel that their interests are threatened by an expansion of the lending activities of the government. The probability of injurious competition from this source is presumably greatest in the fields of agricultural and real-estate credit. The amount of actual competition with banks cannot be judged precisely. In certain cases banks benefit directly or indirectly by the lending activities of the government. Perhaps the principal basis for the opposition of bankers to lending by governmental agencies is the danger they see in it of an unwarranted trend toward socialism.

Customer Relationships.—Banks maintain important customer relationships with other financial institutions. They are a major source of the credit employed by investment bankers, brokers, finance companies and others. The bill broker (*q.v.*), who occupies a particularly strategic position in the functioning of the London money market, relies heavily on commercial banks for the credit used in his business. Government lending agencies may be financed in part by securities sold to banks. Banks may be the purchasers of securities sold by investment bankers and brokers and of bills sold by commercial paper houses.

The sharing of loans with other banks has already been mentioned. Banks may lend on a participating basis whereby a governmental lending agency provides part of the loan. The guarantee by a governmental department of export credits or of a credit for military expenditures in time of war may enable a bank to undertake commitments that would otherwise be regarded as too risky. In the United States the guarantee of mortgages by the Federal Housing administration lifted this category of real-estate obligations into a class virtually as high as that of government bonds and so made them acceptable to banks and other conservative lending institutions. At times banks have found it advantageous to shift certain assets to government lending agencies, thereby increasing their ability to extend other kinds of loans.

Still another type of sharing transaction occurs where a bank and an insurance company participate jointly in extending a term loan. In such cases it is usual for the bank to take that part of the loan which involves a shorter commitment and for the insurance company to take the part having the longer maturity. Such an arrangement makes it possible for the borrower to obtain a single loan of the size and terms he finds appropriate and for each of the lenders to satisfy its particular requirements with respect to liquidity and yield.

Overseas connections may be maintained through relations with other financial institutions. Some banks, notably in the United States, have overseas branches. Leading dominion and colonial

banks have offices in London. Banks may carry on foreign business through foreign correspondents or affiliates. The British maintain a number of overseas banks which usually have their headquarters in London but conduct the bulk of their business in some foreign country or countries. *See* also Index references under "Banking" in the Index volume. (C. R. Wy.)

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BANK OF ENGLAND. One of the first commercial banking companies to be set up in England, the Bank of England subsequently became so much concerned with governmental business that it came to assume the position of the United Kingdom's central bank (*q.v.*). In this capacity, it performs seven main functions—acting as the note-issuing authority, as the government's banker, as banker to the commercial banks, as manager of the national debt, as the government's agent for operating the exchange-control machinery, as its agent for implementing monetary policies and as adviser to the government on all major monetary and currency issues. Although nationalized only in 1946, the bank has been operated during the greater part of its life on the principle that the national interest rather than profit-making should be its main consideration. (*See* also BANKING: *History of Banking.*)

Formation and Early History.—The emergence of the bank was basically the outcome of the rapid expansion in banking activity in England during the 17th century. By the early 1700s the goldsmiths, who had originally been primarily concerned with trading in gold and bullion, had come to dominate the money-exchanging and moneylending business. Before 1640, however, they had confined their operations to the lending of their own money. But in that year Charles I, unable to persuade parliament to vote the money needed for his army, seized the £200,000 of bullion City merchants had deposited with the mint for safekeeping. This led to an intensive search for storage places beyond the reach of the monarch. Since the goldsmiths with their strong rooms were able to offer the necessary facilities, the custom sprang up among the merchant community of entrusting to their care money, bullion and other valuables.

In acknowledgment of such deposits, the goldsmiths issued "notes accountable" which, being often equivalent to a specific sum of money, came to be accepted as money. The inauguration in this way of the bank note gave a powerful fillip to the development of the banking business of the goldsmiths. They realized that, as there was almost always a substantial money balance in their strong rooms, it would be reasonably safe to employ some of the wealth entrusted to them for safekeeping in developing the moneylending side of their business. Later they realized that there was nothing to stop them from issuing notes that were not specifically related to money held by them but simply contained their promise to pay on demand a given sum of money.

The great increase in commercial activity in the second half of the 17th century generated a considerable demand for credit and so encouraged the full exploitation by the goldsmiths of the new banking techniques. Although some continued to conduct their businesses in ways that were beyond reproach, others had no compunction about practising the most flagrant abuses to advance their profits. In consequence, the demand became more and more insistent in England for the establishment of a trustworthy national banking institution such as had been operating in many continental countries for several centuries.

A number of early schemes fell through, however. It was largely by chance that a plan put forward by a Scotsman, William Paterson, for the formation of a national bank was put into effect to bring about the foundation of the Bank of England in 1694. William of Orange approved the Paterson scheme because it offered him a way of circumventing the serious financial embarrassment in which he found himself as a result of the cost of his war against Louis XIV of France. The plan hinged upon the establishment, mainly by a group of merchants, of a joint-stock undertaking (that is, a concern with many shareholders) with a liability to its depositors limited to the amount of its uncalled capital. The capital subscribed was to be £1,200,000 and it was agreed that this sum would be immediately loaned to the king at 8% in return for a royal charter granting the new bank a number of privileges, including the right to issue notes payable on demand up to the amount of and against the security of the loan to the crown. The money needed was subscribed in ten days and the bank opened in the Mercers' hall in Aug. 1694, moving later in the same year to the Grocers' hall where it stayed until it was transferred to Threadneedle street 40 years later. Its first governor was a City merchant, Sir John Houblon. Apart from the governor, deputy governor and 24 directors constituting its court (or board), it had initially a staff of 17 clerks and two doorkeepers.

The establishment of such a powerful competitor naturally alarmed and annoyed the goldsmith bankers, partly because it caused them the loss of much patronage and partly because the bank's entry into the moneylending business was followed by a sharp fall in the rate of interest. However, a petition presented to parliament a few months after the bank's formation calling for the repeal of the Ways and Means act of 1694 (which had actually authorized its creation) on the grounds that the "said bank is ruinous and destructive to trade in general and is only a private advantage to the said corporation" was rejected, while attempts to set up rival institutions failed. With the government's continuing need of financial assistance, the bank was able to strengthen its position in the late 17th century, though it had to overcome a number of relatively serious teething troubles, including, early in 1696, its first serious run. The next major landmark in the history of the bank was the act of 1709 renewing its charter. This was the outcome of a new bargain with the government.

The new act stipulated that, while the bank endured, no corporation or partnership of more than six persons should borrow or take up any sums of money on their bills or notes payable at demand or within six months. This last clause, which modified limitations on other banks imposed by the 1697 renewal of the bank's first

charter, was most important for it effectively gave the bank a monopoly of joint-stock banking in England which lasted for almost a century, keeping all other banking activity in the hands of private individuals.

South Sea Bubble.—The bank narrowly escaped disaster in the wave of financial speculation that culminated in 1720 in the bursting of the South Sea Bubble (*q.v.*). The South Sea company had been formed in 1711, but at the outset did little business. In 1720, encouraged by the favourable response of the treasury in the previous year to its offer to convert an expensive 1710 lottery loan into South Sea stock, it put forward a plan for the conversion of all other outstanding government debt, except that owed to the Bank of England and the East India company. Fortunately for itself, its proposal was not acted upon, with the result that it was in a better position than many other commercial concerns to contend with the financial crisis that gripped the country when the South Sea company ran into serious difficulties in 1720.

The bank played a part in solving the numerous financial problems generated by the 1720 crash, raising its capital by £3,400,000 to £8,960,000 in order to take over some of the obligations of the South Sea company. To strengthen its own financial structure the reserve fund or "rest" was created in 1722. During much of the remainder of the 18th century the bank continued to develop its business energetically, though progress was impeded from time to time by runs and other crises. By the closing decades of the century it was managing the greater part of the national debt and when its charter was renewed in 1781 the prime minister, Lord North, described it as "from long habit and usage of many years a part of the constitution," adding that it was "to all important purposes the public exchequer."

Competitors.—Despite its favoured position, the bank was not wholly free from competition from other banking concerns. The private banks had soon discovered that their note issues could not stand up well to the notes of the infinitely more powerful and respected Bank of England. To overcome this difficulty they began to make increasing use from about 1730 of a new banking invention—the printed check. Once this had been introduced, the private bankers found that they could, without issuing notes, attract money which their depositors could draw upon on demand for themselves or for payment to other persons. The system worked so well that toward the end of the 18th century many private banks in London ceased to avail themselves of the right to issue notes in favour of complete reliance on the check system of deposit banking. This development, by enabling the private banks to lend more generously, helped greatly to ease the industrial financing problem generated by the Industrial Revolution. But the challenge to the bank's supremacy inherent in the growth of the check system caused it a good deal of concern.

In June 1780 the bank was the subject of an attack by an armed mob during the Protestant riots led by Lord George Gordon. This was repulsed with the aid of the military and it is from this incident that the bank's nightly military guard takes its origin.

American and Napoleonic Wars.—The financial upheaval produced in England by the American Revolution imposed severe stresses on the bank. But it came through the critical months by a narrow margin, its gold bullion reserve having fallen by the early months of 1783, to £1,321,000 against a note circulation of £7,675,000. After the opening of the war with France in 1793, the bank again found itself in serious trouble, partly because of withdrawals in bullion of funds by private banking houses and partly because of the heavy demands made upon the bank by the government for money to finance the cost of the war, including the granting of substantial loans to Britain's continental allies. A crisis was narrowly averted with government help in 1793. But an invasion scare caused a serious new run on the bank in 1797 and it had to seek official permission to suspend its obligation to repay its notes in gold. Although the bank's circumstances subsequently showed improvement, the suspension of payment was not in fact ended for more than 20 years.

Public concern about the fall in the purchasing power of the currency during the period of currency inconvertibility that had opened in 1797 led to the appointment of a house of commons bullion committee in 1810 "to consider the cause of the high price of gold bullion and the state of the circulating medium and the exchanges." The investigation was concentrated upon Bank of England notes, they having become, with the decline in note-issuing activity by other banking concerns, the national currency. The report drew attention to the danger of inflation, contending that the cause of the high price of bullion was mainly the overissue of bank notes. It argued that the exchanges could be set right only by fixing a date—but not nearer than two years—at which the suspension of cash payment by the bank must cease and that the bank should work toward this date and this cessation by curtailing its public and private advances, and so its note issues. However, with the commercial situation deteriorating, the recommendations of the report were not acceptable to the house of commons and inflation continued. It was not until after 1815 that economic conditions improved to a sufficient extent to create a situation wherein the recommendations of the 1810 committee could be put into effect. By 1821 the bank had returned to a full gold standard payment system on its original basis of 77*s.* 10½*d.* per standard ounce of gold.

19th Century Trends.—With industry and commerce progressing rapidly, the disadvantages from the national viewpoint of the bank's monopoly of joint-stock banking were becoming more and more apparent. In London the demand for banking facilities which the bank itself was not in a position to satisfy was met fairly competently by the private bankers. But in the provinces it was often traders and shopkeepers who filled this role, and as their qualifications were limited they were often in trouble. Yet as the demand for finance rose they became bolder, with the result that in the financial crisis of 1825 there were no fewer than 90 failures. It was then decided to organize the opening of a series of Bank of England branches in the main provincial centres. Still more important, it was decided that, in the future, joint-stock banks would be allowed to operate outside a radius of 65 mi. from London, while in 1833, despite some opposition from the bank and London private bankers, another act authorized the establishment of joint-stock banks within this zone provided they did not issue notes. As it had been realized that banking houses could develop their business without issuing notes, there now opened a period of rapid banking development all over the country and the relative importance of the Bank of England in the field of commercial banking began to decline.

Concern about the low level of the bank's bullion reserves in the early 1840s and a growing feeling that banking activity should be more strictly supervised led to a decision to separate the bank's note-issue functions entirely from its general banking business when legislation renewing its charter was introduced by Sir Robert Peel's government in 1844. The act also laid it down that, apart from a fiduciary issue of £14,000,000 which could be covered by government securities, every note issued by the bank would thenceforth have to be backed by gold. Provision was, however, made for this requirement to be lifted with government permission in an emergency—an operation known as suspending the Bank act.

On three occasions during the remainder of the 19th century, financial crises imposed such stresses on the bank that the Bank act had to be suspended. The first in 1847 was due to the aftermath of a wave of railway speculation and also of high grain prices and heavy importation of corn. This imposed tremendous pressures on country banks and, in endeavouring to limit the damage, the bank overstrained its own resources. The 1857 crisis arose from the spreading to England of a financial crisis in the United States resulting from overintensive development. The 1866 crisis was a sequel to the failure of the well-known London banking house of Overend Gurney, an event which was itself a product of the unhealthy growth of industrial speculation. On each occasion the suspension of the Bank act was successful in easing tension. The collapse of the banking company of Baring Brothers in 1890 caused another crisis involving the bank. But this time it got by with help from the Bank of France.

The Bankers' Bank.—The bank had already begun to act as a bank to other bankers in the 17th century. The rapid growth of other commercial banking houses after the termination of its

monopoly of joint-stock banking in England naturally acted as a powerful stimulus to this side of its business. It was further encouraged by the strengthening of the bank's structure by the act of 1844. This development inevitably had the effect of giving the bank a key position in the monetary field.

Its emergence as the focal point of the now rapidly developing London discount market accentuated this tendency. By the second half of the 19th century it had become essentially a central bank, though it continued to cater for all private customers that were willing to come to it and was accordingly to some extent in competition with other banks. The significance of the change in the bank's status was demonstrated to it in the works of Walter Bagehot and Viscount Goschen (*qq.v.*). They explained that the Bank of England's gold stock was the basis of the nation's credit structure, so that it had the main responsibility for maintaining a proper relationship between the gold stock and the credit supply (*see* BANKING; MONEY MARKET).

World War I.—With the country achieving a record level of economic prosperity, the early years of the 20th century were an uneventful period for the bank. Upon the outbreak of World War I, however, there was a major run, a four-day bank holiday was proclaimed and the Bank act was suspended. For a while the bank was technically in a position wherein it could have met its obligation to redeem its notes in gold, for during the closing months of 1914 the gold reserve was strengthened. But in view of the need to conserve the country's gold stocks for dealing with balance of payments stresses generated by the war, the suspension of the gold standard was eventually given permanent form. To meet the growth in the demand for currency that occurred as prices rose in response to inflationary pressures, the treasury introduced its own issue of inconvertible currency notes and these circulated side by side with the bank's issue, which also increased materially during the war, until late in the 1920s. During the war the government borrowed from the bank on a substantial scale and entrusted it with the responsibility for raising many loans from the public. Arrangements were also made for the whole of the country's gold stock to be concentrated in the bank.

A committee was appointed under the chairmanship of Lord Cunliffe, governor of the Bank of England, in 1918 to consider postwar finance and currency problems. In accordance with its findings the bank was instructed by the treasury that after the beginning of 1920 currency notes should not be issued in excess of a total of £320,600,000 except against gold or Bank of England notes and that subsequently the maximum fiduciary issue in any year should be the maximum actually attained in the previous year. This marked the opening shot in a deflationary policy which ended the boom of 1919 so effectively that markets collapsed and thousands of business concerns suffered ruinous losses on stocks.

Return to the Gold Standard.—The severe business recession in the early 1920s reduced the level of prices in the United Kingdom and, with other factors, notably the settlement of war debts, strengthened the pound, which had fallen far below its prewar parity of $4.86⅔ in terms of the U.S. dollar in the initial postwar period. After much discussion the proposal of Montagu Norman (later Lord Norman [*q.v.*]), who had become governor of the bank in 1920 (an office he continued to occupy until 1944), that the pound should be stabilized on a modified gold standard basis was accepted and put into effect in 1925. Because it was felt that the country could not afford to devote its reserves to the restoration of a gold currency for internal purposes, the move to stabilize the exchange at its prewar level entailed only the establishment of a gold bullion standard. Thus, while the bank was obliged to buy gold in any quantity, it was obliged to sell it only in multiples of 400 oz. or more, the broad effect being that the pound became convertible into gold only for external purposes.

It was recommended by the Chamberlain committee in 1924 that the country's internal currency arrangements should be tidied up by amalgamating the two note issues—the bank's and the treasury's—that had been circulating since early in the war, partly because it was thought that the continuance of this situation could in certain circumstances give rise to technical complications after the return to gold. This proposal was put into effect in 1928. The Currency and Bank Notes act of that year arranged for the gradual withdrawal of treasury notes, leaving the sole right of note issue with the bank. The bank was given power to issue notes backed only by government securities (the fiduciary issue) up to a limit of £260,000,000 with, however, the right to seek treasury permission to exceed this limit for six-month periods of not more than two years in all. At the same time, the bank's weekly return or balance sheet was made more informative. The item previously known as "other deposits" was split into bankers' deposits and other deposits, the former consisting of the balances of U.K. commercial banks and the latter of those of the bank's other customers. (Other customers had, since the early 1900s, been only those who had a special case for keeping an account with the bank, such as certain overseas organizations, the bank having been unwilling to take on new private business of a kind that would put it in competition with commercial banks.) The "other securities" item was divided into "discounts and advances," which includes money made available to the money market through loans or the rediscounting of bills, and "other securities." No other changes were subsequently made in the return except that for a number of years after 1948 a new form of deposit temporarily appeared in it—the treasury special account. This represented the unspent portion of the sterling counterpart of certain U.S. aid under the European Recovery program. In 1960, the "special deposit" (*see* below) made its appearance.

At first the return to the gold standard strengthened the pound by attracting foreign money to London. But the high value placed on the currency by the new exchange rate exposed Britain's balance of payments to severe stresses during the world-wide depression of the early 1930s. There was a serious outflow of gold from the bank's reserves. Reinforcements obtained by borrowing in New York and Paris proved insufficient, and in Sept. 1931 it was decided that the gold standard would have to be suspended at once and the exchange rate placed on a floating basis.

This decision, coupled with the fact that the fall in the pound that followed the freeing of the rate had left the currencies of many other countries materially overvalued in relation to the pound, led during the next few years to a strong revival of confidence in sterling. After the U.S. devalued its currency in 1933, sterling returned to its old parity of $4.86⅔ in terms of the dollar and stayed close to this figure until it was forced down by nervous selling before the outbreak of World War II. Moreover, with the country's trade position improving and capital flowing in from other countries, the gold reserves were materially strengthened. At the height of the 1931 crisis the bank's gold stock, valued at the old price of 77*s.* 10½*d.* per standard ounce, was worth £135,600,000. By June 1937 this reserve was worth £376,400,000 at the then current price of 140*s.* per fine ounce. In addition, the exchange equalization account had by that time accumulated a gold reserve of £537,600,000. The account had been formed by the government in 1931 so that the ebb and flow of gold arising from the floating of the exchange rate would not disturb the internal monetary situation as it would have been apt to do if such operations had been allowed to find a full reflection in the bank's own stock of bullion. The bank has managed the account throughout its life as the treasury's agent.

Meanwhile, to reverse the internal trade recession that had developed in the early 1930s and had resulted in widespread unemployment, the government adopted a cheap money policy. To implement this the bank rate was reduced to 2%. Advantage was taken of the resulting drop in the general level of interest rates to convert a substantial portion of the national debt into securities bearing a much lower rate of interest.

During 1938 fears that political developments on the continent might involve Britain in a major war caused a big outflow of funds from London and a corresponding drain on the gold holdings of the exchange account. To reinforce them, the bank sold £200,000,000 of its own gold to the account early in 1939, the resulting drop in the gold cover of the note issue being made good by raising the fiduciary issue to £400,000,000. Shortly afterward, a new act authorized the bank to value its gold stock in relation to the current market price of gold (hitherto it had been obliged to fix

its value on the basis of the 77*s*. 10½*d*. per standard ounce ruling before the abandonment of the gold standard), part of the "profit" being used to bring the fiduciary issue back to £260,000,000.

World War II.—As Britain's central banking institution, the bank naturally played a large part in devising and implementing official measures to deal with the financial and economic consequences of the country's war effort between 1939 and 1945. Immediately after the outbreak of war, it was decided that, in the future, the size of the country's gold stock would have to be kept secret and the remainder of the bank's stock, except for a trifling amount of gold coin, was transferred to the exchange equalization account which thereafter held the whole of the gold and foreign exchange reserve. No information about the size of the reserves was subsequently given until after the war when it was disclosed that at one time they had been almost exhausted. Thereafter figures were published first at three-month and later at one-month intervals. Other precautionary measures taken at the end of 1939 included the transfer of part of the bank's activities to Hampshire and the mobilization of privately held securities for safe custody and eventually for the purpose of providing collateral for government loans raised abroad. Subsequently, the bank had three main tasks to perform: to neutralize as far as possible the inflationary impact on the economy of heavy government spending; to issue war loans; and to enforce exchange control.

It had been decided that it would be necessary to keep interest rates at low levels throughout the war to keep down the cost of government borrowing for war financing. The bank rate, which had been raised in Sept. 1939 to 4% from the level of 2% at which it had been standing since the opening of the cheap money era in 1932, was therefore brought back within two months to the prewar level where it remained for the next 12 years. To neutralize the impact on the monetary system of government credit creation arising from heavy short-term borrowing from the banking system, the bank secured the approval of the treasury for the introduction of the treasury deposit receipt system. This provided for what were in reality compulsory six-month loans by the banks to the government. However, this and the other measures the bank took to restrict the creation of credit served only to slow down the growth of inflationary pressures, and by the end of the war the bank's fiduciary issue had been raised to £1,350,000,000 from the prewar £300,000,000.

The bank's issues of long-term stock to cover the government's wartime budget deficit took two main forms—a series of 2½% national war bonds maturing at various dates and, side by side with this, a series of 3% savings bonds also maturing at various dates. It was customary for the bank to issue both types of loans "on tap," that is, without any published limits on the amount or on the time that the lists remain open. But periodically the lists for one issue were closed and those for another issue with different dates opened. Thus the bank was kept active constantly in dealing with loan operations, while, by the early postwar period, the amount of debt managed on the government's behalf had risen to £14,492,000,000 from the 1939 level of £7,121,000,000.

The exchange-control system developed by the bank during the early stages of the war entailed the fixing of exchange rates, broadly speaking on the basis of the rate ruling at the outbreak of war. It also entailed the supervision, with the help of the commercial banking system, of all private exchange operations to ensure that they were in the national interest.

The Postwar Period.—After the war the bank turned its attention to the problem of rehabilitating the country's financial and economic machinery. In view of the government's feeling that the cost of borrowing should be kept down during the period of intensive capital development that was expected to follow the war, no major change was made for six years in the cheap money policy that had been pursued throughout the war. Financial restrictions of other kinds were employed in an effort to curb inflation. These included a request by the bank to the commercial banking system to grant loans only for purposes that could be shown to be essential from the national viewpoint and the control of capital issues. But the rise in the price level continued, calling for further big increases in the bank's note issue.

As a first step toward the restoration of normal commercial relations with other countries the government with the help of the bank concluded a series of payments agreements with many other countries providing for transactions between them to be settled in sterling or in some other suitable medium. In 1947, in accordance with the terms of the loan agreement concluded with the United States shortly after the war, an attempt was made to restore the pound sterling to the status of a fully convertible currency on the basis of the system of fixed exchange rates introduced shortly after the end of the war. But confidence in sterling abroad was still at a low level and in consequence there was a big rush by foreign holders to take advantage of this opportunity to convert their balances into dollars. The official gold and foreign currency reserves, which had been reinforced by drawings on the United States loan, was rapidly reduced and the convertibility experiment had to be promptly suspended.

Sterling having suffered the further indignity of a devaluation from $4.03 to $2.80 in terms of the U.S. dollar in 1949, the bank subsequently worked, with the government's approval, to bring about its rehabilitation more gradually. Exchange-control restrictions were dismantled in stages, while arrangements for allowing sterling to be used for financing transactions within specified regions—that is, a restricted form of convertibility—were introduced. In 1953 this transferability for sterling was extended by the bank to permit sterling to be transferred freely in connection with current or capital account operations between all nondollar countries, while two years later it was decided to assist the work of bringing the exchange rates quoted for the different varieties of sterling closer together by allowing the exchange equalization account to operate in overseas free markets instead of being restricted to dealing in the market handling authorized deals in London. By these means a considerable measure of informal convertibility was achieved early in the second half of the 1950s and the way cleared for the United Kingdom's participation in a general western European move to formal convertibility at the end of 1958. All sterling accruing to other countries from transactions with the pound area on current account was then granted the right to automatic conversion into dollars at rates falling within ¾% of the $2.80 parity. This time confidence in the pound was strengthened by restoring formal convertibility.

Even so, sterling was involved in a new crisis in 1961. Devaluation fears were aroused by a serious deterioration in the country's basic payments position, and the threatened re-emergence of inflationary pressures caused a sharp reversal of the inflow of short-term money from abroad that had been prompted in the previous

Bank of England Balance Sheet
(in £000,000)

Item	Sept. 1844	July 1914	Feb. 1920	March 1939	Oct. 1945	Oct. 1961
Issue department:						
Notes issued	28.3	55.1	126.1	526.0	1,350.2	2,325.4
Government debt*	11.0	11.0	11.0	11.0	11.0	11.0
Government securities*	...	...	...	287.8	1,338.4	2,313.0
Other securities*	2.9	7.4	7.4	0.4	0.6	0.8
Gold	12.7	36.7	107.7	226.0	0.2	0.4
Silver	1.7	...	...	0.8	...	0.3
Banking department:						
Capital	14.6	14.6	14.6	14.6	14.6	14.6
Rest	3.6	3.5	3.6	3.7	3.1	3.2
Public deposits†	3.6	12.7	26.3	28.6	21.4	13.8
Special deposits	...	...	...	...	...	230.3
Other deposits†	8.6	54.4	161.8	127.9	288.1	329.9
Seven-day bills	1.0	...	negligible	...	...	—
Government securities	14.6	11.0	87.1	99.4	288.6	481.7
Other securities	7.8	47.3	88.8	25.6	13.2	84.1
Notes‡	8.1	25.4	32.5	48.6	25.1	25.0
Gold and silver coin‡	.9	1.5	.8	1.1	0.3	0.9

*Represents fiduciary issue. †Represents "liabilities." ‡Represents "reserve."

year by high London money rates. The bank arranged for continental central banks to furnish large-scale temporary assistance in combating the resulting run-down of reserves under what was known as the Basel agreement. This was replaced in midyear by help to the value of $2,000,000,000 (including both cash and stand-by credit facilities) from the International Monetary fund, granted in support of the economic rehabilitation program simultaneously launched by the U.K. authorities.

The New Monetary Policy.—The Conservative government which took office at the end of 1951 decided that traditional instruments of credit control, such as the manipulation of interest rates, should be brought into play in the battle against inflation. The bank was consequently much more active thereafter in the monetary policy field, for the task of implementing the new monetary policy was to a large extent left in its hands. As a first move the bank rate was raised to 2½% and subsequently to 4%. It was reduced to 3% in 1954, the general economic situation of the country having shown some improvement, but there were further increases when the fall in the purchasing power of the pound caused by inflationary stresses brought sterling under pressure in the exchange markets in the mid-1950s, and a level of 7% was reached in 1957. As the new policy had had only a limited success, in 1957 the government appointed a committee under Lord Radcliffe to inquire into the functioning of the money and credit systems. The committee had a number of recommendations to make when it reported in mid-1959, the most important of which was that greater use should be made of the official power to manipulate long-term interest rates in economic management. But the government did not take the view that the results of its investigations called for substantial changes in monetary policy procedures; in particular it resisted the committee's proposal that the bank's technical control should be shared more fully with government departments functioning in the economic field.

But while the committee was still sitting the bank had, at the treasury's request, shaped a new instrument of monetary control. Thus when the directive method of influencing the commercial banks' lending activities was discontinued in mid-1958 as part of a general easing of economic policy aimed at combating recession tendencies, the bank devised a system requiring the commercial banks to make special deposits with itself that would reduce the availability of funds for lending. This system was to be held in reserve for use in the future if existing instruments proved inadequate. The new control was first used in mid-1960 when a rapid rise in bank loans was thought likely to generate inflation. But it proved only partially effective, and when the bank rate was raised to 7% at the height of the crisis a year later, the directive form of control was re-introduced, the banks being instructed to keep their loans from rising beyond existing levels during the remainder of 1961 irrespective of their liquidity circumstances.

Domestic Affairs.—Among changes in staff arrangements made by Lord Norman during his 24 years in office was the inauguration of the practice of appointing a number of full-time directors.

The Labour government, which came to power in 1945, took the view that the bank, previously owned by private stockholders who had the duty of electing the directors, should be brought under full government control. The bank was therefore nationalized in 1946, stockholders being compensated through an issue of government stock at a rate of £400 of government stock for each £100 nominal of bank stock. Apart, however, from the fact that the court (or board) was widened to include representatives of industry and the trade unions (previously it had been largely composed of bankers), the bank continued to operate on much the same lines as before. The court was, however, deprived at least nominally of some of its power as a result of the government's decision late in 1959 that it should cease to have responsibility for formulating bank rate policy, this matter becoming the concern only of the governor and deputy governor. This step was a sequel to recommendations made by the Radcliffe committee after examining the implications of the report of a judicial investigation early in 1958 into allegations, which proved to be unfounded, of prior leakage of the raising of the bank rate to 7% in the previous year. Lord Catto, who had succeeded Lord Norman in 1944, continued as governor until 1949 when Cameron Cobbold was elected. He was succeeded in 1961 by Lord Cromer, a merchant banker formerly of Baring Brothers and Company.

The act that nationalized the bank gave it power to request information from and make recommendations to other banks and, if authorized by the treasury, to turn these recommendations into directions with the force of law. But as the bank retained its prenationalization influence with the banking system, it managed to obtain their voluntary co-operation in carrying out any plans affecting their interests which it considered necessary on national grounds. It was in addition decided, in the late 1950s, that the bank should keep the country as a whole better informed about its activities. The departure from the traditional silence manifested itself at first in periodic public speeches by the governor and later in the inauguration of a much more informative annual report and the introduction of quarterly bulletins, as well as in the preparation of a film for public distribution. *See* also Index references under "Bank of England" in the Index volume.

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(C. G. T.)

BANK OF ISSUE: *see* CENTRAL BANK.

BANKRUPTCY is the status of a debtor who has been declared by judicial process to be unable to pay his debts. The terms bankruptcy and insolvency, although sometimes used indiscriminately, have distinct legal significations. Insolvency, as the term is used in the equity receivership courts in the United States, in state insolvency laws and in the English and most European bankruptcy laws, means inability to meet debts as they mature, but in England, for example, there is no special procedure relating to one who is merely "insolvent." Insolvency as it is defined in the U.S. federal bankruptcy act means that the aggregate of the debtor's property, at a fair valuation, is insufficient to pay his debts. A debtor may be insolvent without becoming a bankrupt.

Conversely, since proof of insolvency is not required where the debtor files a voluntary petition in bankruptcy or where an involuntary petition filed by his creditors alleges the commission of certain acts of bankruptcy, a debtor may become a bankrupt without being insolvent. A bankruptcy adjudication is merely a legal declaration that the debtor has filed a proper voluntary petition or that creditors have filed and supported a proper involuntary petition against him and the adjudication initiates a statutory proceeding for the administration of the debtor's property, which is thereby taken out of his personal control.

The primary objects of bankruptcy legislation are to obtain justice while not pressing unduly on debtors, to discriminate between involuntary inability to meet obligations and willful refusal or neglect and to secure to creditors an equitable share of the debtor's assets available for the payment of his liabilities. Another object has marked modern legislation, namely, the fostering of a higher tone of commercial morality and the protection of the trading community at large from the evils arising through the reckless abuse of credit and unnatural trade competition. Since creditors have conflicting interests and are therefore incapable of acting together as a homogeneous body, it is necessary to obtain the aid of professional assignees or trustees, solicitors and other agents, who make it their special business to deal with such matters, exercising both administrative and quasi-judicial functions, in return for the remuneration which they receive out of the property for their services.

BANKRUPTCY IN THE UNITED STATES

History.—In the United States control over the administration of insolvent estates is divided between the federal and state governments. The constitution (art. i, sec. 8) gives to congress power to establish "uniform Laws on the subject of Bankruptcies throughout the United States." But the supreme court has held that the states have power: (1) to establish and administer their own bankruptcy or insolvency laws in the absence of any regulation of the subject by congress and subject to certain restrictions on impairing the obligations of pre-existing contracts; and (2) to

enact insolvency, assignment or stay laws that do not conflict with any statute which congress may have enacted.

In exercise of its constitutional grant, congress has enacted four different statutes. The first was passed by the Federalists in 1800 during the John Adams administration. Its repeal in 1803 by the incoming Jeffersonians was an expression of the farmers' view that it favoured the merchant class and of Republican opposition to extension of federal powers. The second statute was passed during the John Tyler administration in 1841, took effect in 1842 and was repealed in 1843, in part as a manifestation of the then-common view that debtor relief was "immoral."

The third statute was a product of economic crisis following the Civil War; it was enacted in 1867 and repealed in 1878, partly because of administrative defects and partly because of creditors' opposition to new benefits conferred on debtors. The last statute was enacted in 1898 in belated response to demands for debtor relief originating in the panic of 1893, and has apparently become a permanent institution. It has been frequently amended and was extensively revised in 1938; there has been no agitation for its repeal.

These statutes and amendments reveal a constant expansion of the federal power. The act of 1800 was confined to merchants and traders, made no provision for voluntary proceedings and put severe restrictions on discharging the debtor from his obligations. In 1841 provision was made for voluntary proceedings by nearly all persons, involuntary proceedings against merchants and traders were retained and the provisions for discharge were liberalized. The act of 1867 included corporations within its coverage, made voluntary and involuntary proceedings applicable to traders and nontraders alike, provided for compositions (arrangements to pay made between the bankrupt and his creditors) and made discharge still more easily obtainable. Each of these changes was opposed or contested on constitutional grounds and each was finally approved or acquiesced in by the supreme court.

The present act is more comprehensive than any of its predecessors. It authorizes liquidation proceedings for all individuals and all corporations except municipalities, railroads, insurance companies, banks and building and loan associations, and it provides reorganization or rehabilitation proceedings for the municipalities and railroads excluded from its liquidation provisions. With these exceptions, the statute of 1898, augmented by amendments adopted prior to 1939, offers voluntary liquidation proceedings to all debtors and provides for involuntary liquidation proceedings against all debtors owing debts of $1,000 or over except farmers, wage earners whose rate of compensation does not exceed $1,500 per year and such noncommercial enterprises as social, religious, educational and charitable institutions. Discharge and composition provisions are more liberal than those of any previous act.

The most extensive innovations appear, however, in amendments adopted after 1932. By these amendments, compositions and extensions of payment are authorized for the unsecured debts (those debts which are not covered by any assurance of payment such as a mortgage or other lien) of individual or corporate debtors (ch. xi), for debts secured by real property (ch. xii), for all debts of municipalities (ch. ix) and for all debts of wage earners whose total income does not exceed $5,000 per year except debts secured by real property (ch. xiii). Moreover, sec. 77 offers a procedure for reorganization to railroads engaged in interstate commerce, and ch. x offers a somewhat similar procedure to corporations and to railroads not engaged in interstate commerce.

Insolvency administration of national and federal reserve banks is governed by other federal statutes, and the insolvencies of insurance companies, building and loan associations and state banks are left to administration by state courts or departments. A 1935 decision (294 U.S. 211) of the supreme court impairs effective state administration where the debtor's business transcends state lines. The court held that while an Iowa "statutory successor" to an insolvent Iowa insurance corporation took "title" to assets in Montana, judgment creditors in Montana could be allowed to seize and sell such assets in satisfaction of their individual judgments. This makes necessary expensive ancillary proceedings in all states where the debtor has property. But in its determinations of what state statutes "conflict" with the national act, the supreme court has been generous to the states. A state insolvency or assignment statute is in conflict only if it supplies a discharge for the debtor; and to determine whether or not a statute supplies a discharge the court promises to look to the "interpretation" of state courts (287 U.S. 527). Finally, in theory equity receiverships in the state courts remain available to all classes of corporations; in practice ch. x is likely to deprive the state courts of this business.

Liquidation.—The liquidation sections of the Bankruptcy act —designed to secure an equal distribution of assets among creditors and a discharge of the debtor—set up administrative machinery that is fairly simple, but offer rules for administration that are exceedingly complex. The proceedings are begun by a petition filed either (1) by the debtor; or (2) against a debtor by (*a*) three or more creditors whose provable claims aggregate $500 or more in excess of security; or (*b*) by a single creditor with a provable claim of such amount if the creditors are less than 12 in number. When the petition is involuntary, adjudication does not follow as a matter of course but only on a showing that the debtor has committed an act of bankruptcy within four months of the filing of the petition.

The statute proscribes as acts of bankruptcy: (1) fraudulent conveyance of the debtor's property to put it beyond the reach of creditors; (2) payments which prefer some creditors while the debtor is insolvent; (3) suffering or permitting a creditor to obtain a lien by legal proceedings on the debtor's property while he is insolvent; (4) transfer of the debtor's property to an assignee for liquidation for the benefit of creditors; (5) procuring, suffering or permitting the appointment of a receiver while insolvent or unable to pay debts as they mature; and (6) an admission in writing of inability to pay debts and willingness to be adjudged a bankrupt. By special statutory definition applicable only to the liquidation provisions of the Bankruptcy act, a debtor is insolvent whenever the aggregate of his property, excluding that fraudulently conveyed, is not at a fair valuation sufficient in amount to pay his debts.

The petition must be filed in the federal district court of a district where the debtor has had his principal place of business, resided or had his domicile for the preceding six months or for a longer portion thereof than in any other district. When a voluntary petition is filed, the debtor is given an opportunity to appear and has the right to a jury trial on the question of the commission of an act of bankruptcy and on the issue of his insolvency, where it is relevant. The court after a hearing either makes an order of adjudication or dismisses the petition. If an order of adjudication is made, the court normally refers the case to a referee.

Under 1946 amendments to the act, referees are appointed by the bankruptcy courts for terms of six years. Their salaries within a fixed statutory maximum are prescribed by the judicial conference of senior federal circuit judges. They have broad judicial and administrative powers over allowance of claims and collection of assets. Their orders, however, are always subject to review by the bankruptcy courts.

The referee, when a case is referred, secures from the debtor a statement of assets and liabilities and calls a meeting of creditors. At this meeting a trustee is usually elected, a majority vote in number and amount of allowed claims of all the creditors present being necessary to elect. If the creditors are unable to agree, the court or referee may appoint a trustee.

The trustee is an executive officer whose fee is fixed by the bankruptcy court within a statutory maximum. It is his duty to take possession of the property of the bankrupt and convert it into cash. Creditors are given six months after the first creditors' meeting to file proofs of claims against the estate. Claims duly proved are allowed by the referee unless objected to by the trustee or other creditors. Secured creditors are allowed to prove for the amount of their claims in excess of the value of the security. The valuation of the security is made under court supervision.

To facilitate liquidation the trustee is given title to all of the bankrupt's nonexempt property as of the date the bankruptcy petition is filed and to all such property bequeathed to or inherited by the bankrupt within six months thereafter. He is also given power to set aside liens acquired by judicial proceedings while the debtor was insolvent and within four months of the filing of the petition, preferential payments made by the debtor within four months of the filing of the petition, fraudulent conveyances made by the debtor within one year of the filing of the petition and transfers made by the debtor which any creditor with a provable claim could have set aside under state law. Finally, he is empowered to take over assets held by a liquidating receiver or an assignee for the benefit of creditors where the receiver was appointed or the assignment was made within four months of the filing of the petition.

Limitations.—The actual distributive process does not effect complete equality of distribution. The act prescribes five classes of claims which are to be paid in full before any dividends are paid to general creditors. These claims, in the order of their priority, are: (1) costs of administration and of preserving the estate, together with certain filing fees and attorneys' fees; (2) wage claims of the debtor's employees, not exceeding $600 each, earned within three months before the filing of the bankruptcy petition; (3) costs incurred by creditors in successfully opposing the discharge of the bankrupt, or in adducing evidence of certain criminal offenses committed in the bankruptcy proceeding, where a conviction results; (4) taxes due to the federal government or to any state or subdivision thereof; (5) debts which have priority under any other federal law (principally claims due the United States) and claims for rent which accrue within three months before the petition is filed, where such rent claims are entitled to priority under state law.

A limitation from the debtor's point of view is that he is not entitled to a discharge on claims not paid in the bankruptcy proceeding as a matter of right. If the trustee or creditors do not object, and if the bankruptcy court does not request a federal district attorney to investigate, the discharge is granted. But the trustee, district attorney or creditors may successfully object by proving that the bankrupt has violated certain provisions of the federal criminal code; or destroyed, falsified or failed to keep books of account or records; or obtained money, property or credit by making false written statements concerning his financial condition; or made a fraudulent conveyance within 12 months of the filing of the bankruptcy petition; or received a discharge or secured a composition or extension of his debts in a prior bankruptcy proceeding initiated within 6 years of the filing of the petition; or refused to obey a lawful order of the referee or court; or failed to explain satisfactorily any losses or deficiencies of assets. But this limitation is more apparent than real since lethargy of creditors has produced a situation where nearly all bankrupts, save those who have received a previous discharge in a proceeding initiated within six years or who are guilty of the most flagrant dishonesty, are granted discharges. The power given the bankruptcy court by the 1938 amendment to the act to request an investigation by a federal district attorney is rarely invoked.

Another limitation from the debtor's point of view is that even though a discharge is granted all debts are not thereby released. Only provable claims are eligible to participate in the bankruptcy distribution and are dischargeable. What debts are provable has been a question of extended litigation because of the ambiguous wording of the statute; but for the most part contract claims incurred before the filing of the petition are provable and thus dischargeable, and claims for personal injury or property damage not reduced to judgment before the bankruptcy proceeding begins are not. Among the provable debts, specific exceptions in the act exempt the following from discharge: (1) taxes levied by the federal government or by any state or subdivision thereof; (2) liabilities for certain fraudulent acts, willful and malicious injuries or immoral conduct; (3) alimony and support orders; (4) claims for wages earned within three months of the filing of the petition; and (5) claims of creditors not notified of the bankruptcy proceeding in time to prove their claims.

Reorganization, Compositions, Extensions.—The later amendments to the Bankruptcy act are designed not to produce liquidation (*i.e.*, distribution of the debtor's assets among his creditors) but to permit the debtor to retain control of assets after liabilities have been reduced in amount or time for payment extended. This is accomplished by giving the bankruptcy court power to confirm plans of reorganization, composition or extension that bind dissenting minorities of each class of creditors. These amendments are often defended upon the ground that creditors will ultimately receive more from such capitalization of a debtor's future earning power than they would receive from liquidation at forced-sale prices, but as applied to individual debtors and small corporations they are primarily designed for the relief of distressed debtors.

The amendment of most practical importance is ch. x, which supplies a procedure for the reorganization of all corporations subject to a voluntary or involuntary petition in bankruptcy and for all railroads not engaged in interstate commerce. This procedure is similar to that of the creditor-initiated equity receivership previously developed by the federal courts. But substantial changes have been made. The debtor is permitted to file a petition without first arranging for a friendly creditor to begin the proceedings for him. Ancillary receivers are no longer necessary; the bankruptcy court is given exclusive jurisdiction of the debtor and its property wherever located. Cash is not always required for the payment of dissenters nor a judicial sale for determining the amount of payment to dissenters; the court may on certain conditions confirm a plan by decree. The conditions for confirmation without sale or payment of dissenters in cash are that the court find the plan to be fair and equitable and feasible; that creditors holding two-thirds in amount of each class of claims allowed accept the plan, or, as to any class which does not so accept, that adequate provision be made for protection of the value of its claims against property dealt with by the plan; and that, if the corporation is not found insolvent, a majority of the stockholders of each class allowed accept the plan, or, as to any class which does not so accept, that adequate provision be made for the protection of the value of its interest in the property dealt with by the plan. Before confirmation the court may submit the plan to the Securities and Exchange commission for examination and advisory report, and if the debts of the corporation exceed $3,000,000 the court must submit the plan. To obtain the benefits of this chapter a corporation need not allege that it is insolvent, as that term is defined in liquidation sections of the act, but only that it is unable to pay its debts as they mature. Three or more creditors with claims amounting to $5,000 or more, secured or unsecured, may file a petition against the corporation.

The procedure under sec. 77 for the reorganization of railroads engaged in interstate commerce is generally similar to that under ch. x, although there are some differences. Where ch. x requires acceptance by a majority of the stockholders of each class, sec. 77 requires acceptance by two-thirds, and under sec. 77 all reorganization plans must be first approved by the Interstate Commerce commission.

Proceedings for compositions and extensions under ch. ix, xi, xii and xiii may be initiated only on the debtor's voluntary petition, which must allege that the debtor is either insolvent or unable to pay his debts as they mature. Before confirming the plan the court must find that it is fair and equitable and feasible, and under ch. ix and xii the plan must have been accepted by creditors holding two-thirds in amount of each class of claims affected or, as to any class which does not so accept, provision must be made for protection of its interests. Under ch. xi the plan must be accepted by a majority in number and amount of each class of creditors affected, and under ch. xiii it must be accepted by a majority in number and amount of unsecured creditors and by all secured creditors affected.

A 1933 amendment to the act also added, in sec. 75, special proceedings for composition and extension of secured and unsecured debts of farmers. In 1934 sec. 75 was amended to provide that when a farmer was unable to get the necessary acceptance of a

majority in number and amount of creditors, or when he was dissatisfied with the composition or extension, he could get a court order allowing him to remain in possession of his property under a five-year moratorium from the claims of mortgagees, upon payment of a reasonable rent. The 1934 amendment was held unconstitutional by the supreme court as a violation of the due process clause (295 U.S. 555). It was then revised to restrict the moratorium period to three years, with some discretion in the bankruptcy court to restrict it further, and as revised was held constitutional (300 U.S. 440). Sec. 75 was originally enacted as a five-year emergency measure, was four times extended and, under the terms of the last extension, expired in 1949. There has been some agitation for its revival as a permanent part of the Bankruptcy act.

Chapter ix, providing compositions and extensions for municipal indebtedness, was also held unconstitutional in its original form as an impairment of state sovereignty (298 U.S. 513), but a revised version was found to be "carefully drawn so as not to impinge upon the sovereignty of the States" and was sustained (304 U.S. 27).

In a 1934 decision (294 U.S. 648) the supreme court gave its approval to the reorganization provisions of sec. 77, by likening them to the composition procedures in the act of 1867, and remarked upon the striking capacity of the bankruptcy power to expand to meet new conditions.

By a 1948 amendment to the Interstate Commerce act, congress provided for railroads an alternate method for adjustment of secured and unsecured debts upon consent of three-fourths in number and amount of each class of creditors and stockholders affected, and approval by the Interstate Commerce commission. There is no requirement that the commission find the plan "fair and equitable" and no provision for judicial review. (V. Cn.)

BANKRUPTCY IN ENGLAND

Bankruptcy is entirely a matter of statute law. The earliest English statute on the subject, 34 and 35 Henry VIII, ch. 4 (1542), like the statute of 13 Elizabeth I, ch. 7 (1571), was directed against fraudulent debtors and gave power to the lord chancellor and other high officers to seize their estates and divide them among the creditors, but afforded no relief to the debtor from his liabilities. The objects of modern bankruptcy legislation are to provide, in the case of a person who has no reasonable prospect of meeting his debts, for (1) distribution of the debtor's property among his creditors in an orderly and economical manner; and (2) a new start in life for an honest debtor, freed from the demands of his creditors. These laudable objects are susceptible of abuse by dishonest and cunning individuals, so that provision has to be made for those who have culpably contributed to their insolvency or have concealed their assets dishonestly or are otherwise guilty of abuses of the system.

The courts exercising jurisdiction originally consisted of commissioners appointed by the lord chancellor. But as a result of legislation in 1831 and 1869 the bankruptcy laws are now administered by certain of the judges of the chancery division specially appointed by the lord chancellor, with bankruptcy registrars, who deal with the ordinary judicial routine of bankruptcy procedure in the London district, while similar duties are performed by the county-court judges and their registrars throughout the country (with certain exceptions). The high court also exercises appellate jurisdiction on appeals from county courts.

The Act of 1883.—A feature of the act of 1883 was the separation it effected between the judicial and the administrative functions, which had previously been exercised by the court, and the transfer of the latter to the board of trade as a public department of the state directly responsible to parliament. Under the powers conferred by the act a new department was subsequently created under the title of the bankruptcy department of the board of trade, with an officer at its head called the inspector general in bankruptcy. This department exercised, under the direction of the board of trade, a general supervision over all the administrative work arising under the act. It had extensive powers of control over the appointment of trustees, and conducted an audit of their accounts; and it might, subject to appeal to the court, remove them from office for misconduct, neglect or unfitness. A report upon the proceedings was annually presented to parliament by the board of trade, and although the department was practically self-supporting, a nominal vote was each year placed upon the public estimates, thus bringing the administration under direct parliamentary criticism and control. The act also provided for the appointment and removal by the board of trade of a body of officers entitled official receivers, with certain prescribed duties having relation both to the conduct of bankrupts and to administration of their estates, including the interim management of the latter until the creditors could be consulted. These officers acted in their respective districts under the general authority and directions of the board of trade, being also clothed with the status of officers of the courts to which they were attached. The main objects of the measure were to secure: (1) an independent and public investigation of the debtor's conduct; (2) the punishment of commercial misconduct and fraud in the interests of public morality; (3) the summary and inexpensive administration of small estates where the assets did not exceed £300 by the official receiver, unless a majority in number and three-fourths in value of the creditors voting resolved to appoint a trustee; (4) full control in other cases by a majority in value over the appointment of a trustee and a committee of inspection; (5) strict investigation of proofs of debt, with regulations as to proxies and votes of creditors; (6) an independent audit and general supervision of the proceedings and control of the funds in all cases. Besides amending and consolidating previous bankruptcy legislation, the measure also contained special provisions for the administration under bankruptcy law of the estates of persons dying insolvent, and for enabling county courts to make administration orders for payment by installments in lieu of immediate committal to prison, in the case of small judgment debtors.

An amending act, under the title of the Bankruptcy act, 1890, was passed in that year, more particularly with regard to the conditions under which a bankrupt should be discharged or schemes of arrangement or composition be approved by the court. These two acts were supplemented by a large body of general rules made by the lord chancellor with the concurrence of the president of the board of trade, which may be added to, revoked or altered from time to time by the same authority. These rules are laid before parliament and have the force of law.

Besides these general acts, various measures dealing with special interests connected with bankruptcy procedure have from time to time been passed since 1883, the chief of which are as follows: the Bankruptcy Appeals (County Courts) act, 1884; the Preferential Payments in Bankruptcy act, 1888, regulating the priority of the claims of workmen and clerks, etc., for wages and salaries; and the Bankruptcy (Discharge and Closure) act, 1887, dealing with unclosed bankruptcies under previous acts. In 1906 the board of trade appointed a committee to inquire into and report upon the effect of the provisions of the laws in force at the time in relation to bankruptcy, etc.

The Law in the 20th Century.—The English law of the bankruptcy in force at the beginning of the 1960s is contained principally in the Bankruptcy act, 1914, a consolidating act which repealed and re-enacted the provisions of the amending act of 1913. That act had made considerable changes in the law and had introduced a number of provisions relating to bankruptcy offences. These provisions have since been amended by the act of 1926. The act of 1914 authorized the making of rules which regulate the practice in bankruptcy. The rules in force in the early 1960s were made in 1952 and were slightly amended in 1956.

Who May Be Made Bankrupt.—Generally speaking any person who is a debtor owing not less than £50, may be made bankrupt in England and Wales. The term debtor as used in the act of 1914 (unless the context otherwise implies) includes any person, whether a British subject or not, who at the time when any act of bankruptcy was done or suffered by him (1) was personally present in England; or (2) ordinarily resided or had a place of residence in England; or (3) was carrying on business in England, personally, or by means of an agent or manager; or (4) was a

member of a firm or partnership which carried on business in England. It will be seen from this that a foreigner may in certain circumstances be subject to the English bankruptcy laws. Every adult may be made bankrupt, whether engaged in trade or not; but an infant cannot usually be made bankrupt although he is engaged in trade and obtains credit in the course of his business. If he can be made bankrupt at all, it can be only in respect of a judgment debt for "necessaries"—a phrase which has a special meaning among lawyers. An infant may be made bankrupt, however, if the petition is based on an enforceable debt. With regard to a married woman, although she could not formerly have been made bankrupt at all, by virtue of the Law Reform (Married Women and Tort-feasors') act, 1935, she is subject to the law relating to bankruptcy and to the enforcement of judgments and orders in all respects as if she were a single woman. A lunatic can be made bankrupt, but the trustee takes subject to the title of the appointed receiver in lunacy.

Peers and members of the house of commons although having "privilege of parliament" may be made bankrupt. Although a corporation or limited company is for some purposes a "person," a receiving order (the order which leads to adjudication) cannot be made against any such body. Such bodies are dealt with under the Companies acts.

Petition and Receiving Order.—Any court exercising bankruptcy jurisdiction in the district in which a debtor resides or carries on business in England or Wales may make a receiving order against the debtor, whether a trader or not, either on his own petition or on that of a creditor or creditors whose claims aggregate not less than £50.

In the case of a creditor's petition proof must be given of the debt (unless the debtor admits it at the hearing of the petition) and of the commission of an act of bankruptcy within three months preceding the date of the petition. An act of bankruptcy is most commonly committed if the debtor fails to satisfy the creditor's claim upon a bankruptcy notice; also if he makes an assignment for the benefit of his creditors generally; if he absconds or keeps house (*i.e.*, refuses to see creditors); if he gives notice of suspension of payments; if his goods are sold or seized under execution; if he files in court a declaration of inability to pay his debts; if he grants a fraudulent preference or conveyance; or if, upon an application being made to commit him under the Debtors act, a receiving order is made in lieu of an order to commit. In such a case the judgment debtor is deemed to have committed an act of bankruptcy. By a bankruptcy notice is meant a notice by a judgment creditor or creditor who has obtained an order for payment calling upon his debtor to pay, secure or compound for the debt to the satisfaction of the creditor or the court. Such a notice must be in the prescribed form, must state the consequences of noncompliance and must be served in the prescribed manner. Failure to comply with the notice within seven days (if the debtor is in England) constitutes an act of bankruptcy upon which a petition is founded.

Bankruptcy notices are constantly used by the judgment creditor as a means of enforcing his judgment, since most debtors whose credit is at stake will make every effort to pay rather than face the consequences of a petition in the bankruptcy court. A bankruptcy notice may be founded on an order to pay a water rate.

An assignment for the benefit of creditors generally is a fairly common act of bankruptcy and it is none the less so because it is registered as a deed of arrangement. Such a deed, however, cannot be relied on as an act of bankruptcy by any creditor who is a party to or assents to it, or by any creditor who does not present a petition founded on the execution of the deed within one month after receiving notice of its execution from the trustee. In default of such notice, the deed is available as an act of bankruptcy for three months from the date of its execution.

Bankruptcy proceedings are initiated by a petition, which may be presented by a creditor or by the debtor himself. Any body or person who can take proceedings to recover a debt at law or in equity may present a bankruptcy petition. A man may take an assignment of a debt for the express purpose of founding a petition upon it. But a creditor may not present a petition unless the debt is a liquidated, or determined, sum amounting to £50 or more payable immediately or at some future time.

The act of bankruptcy on which the petition is founded must have occurred within three months of the date of the petition and the debtor must be domiciled in England or must have ordinarily resided or had a dwelling place or place of business in England; or (except in the case of a person domiciled in Scotland or Ireland, or a firm or partnership having its principal place of business in Scotland or Ireland) he must have carried on business in England by means of an agent or manager; or (except as aforesaid) he must have been within the said period a member of a firm or partnership of persons which has carried on business in England by means of a partner or an agent or manager. The petition, if successful, results in a receiving order being made against the debtor, but this is not made until eight days after the service of the petition. If presented by a creditor who has been party to a deed of assignment for the benefit of creditors generally, the petition will normally be dismissed. The court, however, will usually have regard for the wishes of the creditors, though an order may be made against their wishes. Another creditor may be substituted for a petitioning creditor who does not show diligence.

At any time after the presentation of a bankruptcy petition any action, execution or other legal process against the property or person of the debtor may be stayed. The general rule, however, is that there will not be restraint proceedings to which the discharge of the debtor from his bankruptcy would be no defense. For example, a claim in tort against a debtor for fraudulent breach of trust would not be restrained, nor a committal order for nonpayment of rates or local taxes.

A receiving order does not divest a debtor of his property; it merely protects it by placing it in the control of the court through the official receiver. No creditor may then commence legal proceedings against the debtor without the leave of the court. If a receiving order is made on a debtor's own petition, adjudication follows as a matter of course, unless a composition or a scheme of arrangement is accepted by the creditors. It may be rescinded if the court is satisfied that the debtor has paid all his debts since it was made. Where there is an estate or business to be managed, the official receiver may appoint a special manager, who receives such remuneration as the creditors or, failing them, the board of trade may determine.

Statement of Affairs.—As a consequence of the receiving order the debtor must make out and submit to the official receiver within a prescribed period (seven days in case of creditor's petition) a statement of his affairs. The statement must be verified by affidavit, and must show the particulars of the debtor's assets, debts and liabilities, the names, residences and occupations of his creditors, the securities held by them respectively, the dates when the securities were respectively given and such other information as may be prescribed or as the official receiver may require. The official receiver supplies the bankrupt with a form of statement and may employ someone to assist him to prepare it. Failure to furnish it may involve adjudication; and the omission of material facts may render the bankrupt criminally liable.

The statement of affairs is open to the inspection of creditors and may be used against the bankrupt in any proceeding connected with his bankruptcy. The debtor must also in every case submit to a public examination in court, in which the official receiver, the trustee and any creditor who has proved his debt may take part. His evidence may be used against him. The examination may be adjourned from time to time at the discretion of the registrar. He must attend the first meeting of creditors, wait upon the official receiver, trustee and special manager and give all necessary information and generally do all acts which may reasonably be required of him with the view of securing a full investigation of his affairs.

He may be arrested if there is reasonable ground for believing that he is about to abscond, destroy papers or remove goods, or if he fails without good cause to attend any examination ordered by the courts. The court may also for a period of three months order his letters to be readdressed by the post office to the official receiver or trustee.

First Meeting of Creditors.—This meeting is summoned by the official receiver not less than 14 days after the receiving order, notice being given in the *London Gazette* and in a local paper and sent by post to each creditor. A summary of the statement of affairs should accompany the notice, with any observations by the official receiver which he may think fit to make.

The object of the meeting is to decide whether any proposal for payment of a composition or for a scheme of arrangement submitted by the debtor is to be entertained, or whether an application should be made to the court to adjudicate the debtor bankrupt. In the latter case the meeting may by an ordinary resolution appoint a trustee with or without a committee of inspection. It may also give any directions as to the administration of the estate.

The meeting is presided over by the official receiver or his deputy, who, subject to appeal to the court, admits or rejects proofs for the purpose of voting. For the transaction of business three creditors qualified to vote, or all the creditors if fewer than three, must be present or represented. Broadly speaking, a creditor may not vote unless the debt owing to him is a liquidated sum. Only persons who have proved their debts are entitled to vote, and detailed regulations respecting proofs and the valuation of securities are laid down in the act of 1914.

One of the chief features of the law on this point is the condition imposed on creditors on bills of exchange to deduct from their claims the value of the liability of prior obligants before voting, thus canceling the power of controlling the proceedings previously possessed by persons who had no real interest in the estate. Votes may be given in person or by proxy.

The creditors entitled to vote may, at their first or any subsequent meeting, appoint from among the creditors generally, or the holders of general proxies, or general powers of attorney from such creditors, a committee of inspection to superintend the trustee in his administration of the bankrupt's property. A person may also be appointed subject to his subsequently becoming the holder of a general proxy or general power of attorney, but he must not act until he has obtained this power. The committee must not consist of more than five or less than three persons. It generally includes the more important creditors.

A creditor who is appointed a member may not act until he has proved his debt and his proof has been admitted, and he must not, except by leave of the court, become a purchaser of any part of the estate, nor may he, except with like permission, receive any payment out of the estate for services rendered by him in connection with the administration of the estate. One of the functions of the committee is to audit the trustee's accounts, and certain functions of the trustee can be exercised by him only with the sanction of the committee.

If the creditors so resolve, or if a composition or scheme of arrangement is not proposed by the debtor or entertained by the creditors, or if entertained is not approved by the court, or if without reasonable excuse the debtor fails to furnish a proper statement of his affairs, or if his public examination is adjourned sine die (without assigning a day for a further hearing) the court adjudicates the debtor bankrupt and thereupon his property vests in a trustee, and, subject to the payment of the costs and fees of administration, is divisible among his creditors until all his debts are paid in full with interest at the rate of 4% per annum.

An order may also be made on the application of the official receiver where the debtor has absconded, or where the court is satisfied that the debtor does not propose a composition or scheme. Notice of every order of adjudication stating the name, etc., of the bankrupt is published in the *London Gazette* and advertised in a local paper.

Duty of a Bankrupt and Bankruptcy Offenses.—A debtor adjudged bankrupt must aid in the realization of his property to the utmost of his power, and in the distribution of the proceeds among his creditors. He must also, at the request of the official receiver, furnish trading and profit-and-loss accounts and a cash-and-goods account for a period not exceeding two years before the date of the receiving order. If required, he must also attend and be cross-examined as to the whereabouts of his property, and may be arrested on a warrant if he refuses to attend.

The onus of proving that he is not guilty of any intent to defraud is, generally speaking, placed upon the debtor. If he fails to make full discovery of or to deliver up his property or books, conceals his property or debts, prevents production of books, etc., or conceals, mutilates or falsifies his books he may be guilty of a misdemeanour unless he proves that he had no intent to defraud.

He is also liable to be found guilty of an offense if he removes property worth more than £10 after or within six months before the date of the petition, or if he fails to disclose the fact that a false debt has been proved by anyone in the bankruptcy. Other offenses are the fraudulent parting with or alteration of books; declaration of fictitious losses; obtaining credit by false representations within six months before or after the date of a petition.

Again, a bankrupt is guilty of an offense if, having been engaged in any trade or business and having outstanding at the date of the receiving order any debts contracted in the course and for the purpose of such trade or business, he has within two years before the date of the petition materially contributed to or increased the extent of his insolvency by gambling or speculation. A prosecution for this offense, however, cannot be initiated save by order of the court. Failure by a man who has once been bankrupt or who has compounded with his creditors to keep books of account within two years before a second bankruptcy may also be an offense.

An undischarged bankrupt cannot sit or vote in the house of lords. He cannot be elected to sit or vote in the house of commons, or be elected or act as a justice of the peace, or mayor, alderman or councilor. Nor can he be a guardian or an overseer of the poor or member of a county council. He cannot be a member or chairman of a parish council, rural district council or board of guardians if he has within five years before his election or since his election been adjudged bankrupt or compounded with his creditors.

These disqualifications disappear on the annulment of the bankruptcy, or if the court grants a certificate to the effect that the bankruptcy was caused by misfortune without any misconduct on the part of the debtor.

Discharge.—The court may at any time after the conclusion of the bankrupt's public examination, and after hearing the official receiver (who renders to the court a report as to the bankrupt's conduct and affairs), the trustee and any creditor, to all of whom previous notice of the application must be given, grant the bankrupt, on his application, a discharge either absolutely or under conditions, but subject to the following qualifications:

1. If the bankrupt has committed (*i.e.*, has been tried and convicted of) a criminal offense connected with the bankruptcy, the application must be refused unless for special reasons the court determines otherwise.

2. If the assets are not equal in value to 10*s.* in the pound of the unsecured liabilities (unless the bankrupt can show that he is not responsible); or if proper books have not been kept; or if the bankrupt has traded after knowledge of insolvency; or has contracted debts without reasonable probability of payment; or failed to account for his deficiency; or contributed to the bankruptcy by rash speculation, gambling, culpable neglect, or by unjustifiable expenses; or has taken or defended legal proceedings on frivolous grounds; or has within three months preceding the receiving order given an undue preference; or has increased his liabilities with the view of making his assets equal to 10*s.* in the pound; or has previously been bankrupt or made an arrangement with creditors; or has been guilty of any fraud or fraudulent breach of trust; then the court shall, on proof of any of these facts, either (*a*) refuse the discharge; or (*b*) suspend it for a period of not less than two years, or until a dividend of not less than 10*s.* in the pound has been paid; or (*c*) qualify the order by the condition that judgment is entered up against the bankrupt for payment of any unpaid balance of his debts, or of part of such balance out of his future earnings or property. Assets are deemed to be equal to 10*s.* in the pound when the court is satisfied that the property of the bankrupt has realized, or is likely to realize, or with due care in realization might have realized an amount of 10*s.* in the pound on his unsecured liabilities. If of the facts referred to the only fact proved

is that the assets are not of a value equal to 10*s.* in the pound the discharge may be suspended for a period of less than two years.

The bankrupt may, however, after two years apply to the court to modify the conditions if he is unable to comply with them. An order of discharge releases the debtor from all his obligations except debts due to the crown and other obligations of a public character which can be discharged only with the consent of the treasury, debts incurred by fraud and judgment debts in an action for seduction or as a corespondent in a matrimonial suit or under an affiliation order, which are released only to such extent and subject to such conditions as the court may expressly order. Debts incurred by fraud insofar as they are the subject of actions of tort are not provable and are not therefore affected by an order of discharge.

The discharge of the bankrupt does not operate as a release of any partner or co-obligant with him, and it does not release him from liabilities incurred since the date of the receiving order to persons who did not prove in the bankruptcy. Neither does it release the bankrupt from liability to criminal prosecution. Notwithstanding his discharge a debtor is still bound to help the trustee to distribute the assets. The discharge does not revest in the bankrupt his property.

Composition or Scheme of Arrangement.—After a receiving order has been made the debtor may submit a proposal for the payment of a composition or for the liquidation of his affairs, by a trustee or otherwise, with adjudication. The proposal must be lodged with the official receiver in sufficient time to allow notice, together with a report by that officer, to be sent to the creditors before the meeting is held at which it is to be considered. A person who has a contingent or future claim is not a creditor. If the proposal is entertained at the meeting by a majority in number and three-fourths in value of all the creditors who have proved their debts, and if it is thereafter approved by the court, it becomes binding upon all creditors who would be bound by an order of discharge had the debtor been adjudicated bankrupt. A similar proposal may be made after adjudication, and if entertained by the creditors and approved by the court the adjudication may be annulled.

The debtor's release will be subject to the terms of the scheme, but his future acquired property will not pass to the creditors unless there is an express stipulation to that effect.

Property Divisible Among the Creditors.—No part of the law of bankruptcy is more intricate or has been the subject of more litigation than this, and any detailed view of the effect of legal decisions can be gathered only by a perusal of the cases; but the following general principles may be stated. The term property includes not only property of which the bankrupt is the true owner, but property in his possession, order or disposition in his trade or business with the consent of the true owner, in such circumstances that he is the reputed owner thereof. The application of the doctrine of reputed ownership is restricted by trade customs, in accordance with which property is frequently lent under a contract of "hire and purchase" or otherwise; and by the decisions of the courts that where such custom is sufficiently proved the doctrine does not apply. Further, the trustee's title not only includes property in the actual possession of the bankrupt, but relates back to the date of the first act of bankruptcy committed by him within the three months preceding the presentation of the bankruptcy petition, and thus invalidates all payments and assignments to creditors made during that period with knowledge on the part of the creditor or assignee of the commission of the act of bankruptcy.

In such cases the trustee may, therefore, require the money or property to be restored to the estate. And even where no prior act of bankruptcy is proved, any payment made to a creditor with the view of giving such creditor a preference over the other creditors, within the three months preceding the presentation of the petition on which the payer is made bankrupt, is rendered void as against his trustee. In practice this provision is difficult to apply by reason of the necessity of proving the debtor's intention to prefer. Settlements of property within the two years preceding the bankruptcy, unless made before and in consideration of marriage, or made in good faith for valuable consideration, are also void, as are similar settlements within ten years, unless it is proved that the settlor was (independently of the settled property) solvent at the date of the settlement and that the interest in the property passed to the trustees on the execution of the deed.

Certain settlements made in consideration of marriage are also made void or voidable against a trustee in bankruptcy. Thus any covenant or contract by a settlor in consideration of marriage for the future payment of money for the benefit of wife or child, or for future settlement on wife or children of property in which the settlor had no interest at the date of the settlement is void against his trustee in bankruptcy, if it has not been executed at the date of the bankruptcy. This is subject to the exception that beneficiaries may claim dividends in the bankruptcy, such claims, however, being postponed until the claims of the settlor's other creditors have been satisfied. Settlement by other persons may make the interests of a bankrupt determinable on bankruptcy under what are known as "protective trusts," with discretionary trusts for maintenance of the bankrupt and others.

Executions by a creditor not completed at the date of the receiving order are also void, and the proceeds of an execution in the hands of the sheriff must, with certain exceptions and subject to deduction of costs, be handed over to the trustee. Monies paid to a creditor who has levied execution in part satisfaction may, however, be retained by him as against the trustee. But all property held by the bankrupt on trust, and tools of trade, wearing apparel and bedding to a total value not exceeding £20 are excluded from the property divisible among the creditors. With respect to property acquired by the bankrupt, whether by gift or legacy, or consisting of accumulations of business or other profits after the commencement of the bankruptcy and before he obtains his discharge, the trustee's title also prevails; but the bankrupt has a right of possession until the trustee intervenes and so bona fide transactions by the debtor for value, other than transactions relating to freehold property, appear to be valid. Where the bankrupt is in receipt of a salary, income or pension, etc., the court may order any part thereof to be paid to the trustee; but where he is an officer of the army, navy or civil service such order is to be made only with the consent of the chief of the department concerned.

When a banker has ascertained that a person having an account with him is an undischarged bankrupt, it is his duty to inform the trustee or the board of trade of the existence of the account, and thereafter the account cannot be operated on except under the order of the court.

When a bankrupt who owns the copyright of a work is liable to pay royalties or a share of profits to the author, the trustee may not sell copies of or perform the work, except upon terms of paying the royalties due to the author. Nor can he assign or license the copyright without the consent of the author or the court except upon terms which will secure to the author payments not less than those which the bankrupt was liable to pay.

Claims of Creditors.—In the distribution of the debtor's property certain claims are entitled to priority over others. Thus the landlord, although not entitled to a preference out of the funds in the hands of the trustee, can distrain for unpaid rent on the goods and effects of the debtor remaining on the landlord's premises; but where the distraint is levied after the commencement of the bankruptcy this right is limited by the act of 1890 to six months' rent due before adjudication, the remainder of his claim ranking for dividend with the claims of other creditors. The gas board and water companies have powers of distraint under special acts, but the policy of recent legislation has been to discourage any extension of such privileges. Where the bankrupt holds an office of trust in any savings bank or friendly society, any balance in his hands due to such bank or society has been held under the acts relating to those bodies to be payable in preference to any other claim against the estate. Contributions payable by a bankrupt under the National Insurance act, 1946, are also entitled to preference. Other preferential claims are regulated by the Bankruptcy acts and include taxes, parochial and other local rates for not more than one year, wages and salaries (whether of clerks and servants or labourers or workmen) for four months, but not exceeding £200

(Bankruptcy act, 1914 s. 33, as amended by the Companies acts, 1947 and 1948) and agricultural labourers' claims not exceeding one year's wages, if hired by special contract for payment of a lump sum at the end of a year. These claims are entitled to preference not only over funds in the hands of the trustee, but also over the proceeds of any distraint levied by the landlord within the three months prior to the receiving order, the latter in that case becoming a preferred creditor for the amount so paid. Articled clerks and apprentices may also be allowed repayment of a proportion of the premium on their unexpired agreements. On the other hand, usual trade discounts (exceeding 5%) must be deducted from traders' proofs, and the following claims are postponed until the general creditors are paid in full, namely, claims by a married woman for loans to the husband for the purposes of his business, claims for loans advanced to any person in business at a rate of interest varying with the profits and claims for interest in excess of 5% per annum.

Where a married woman has been adjudged bankrupt, her husband cannot claim any dividend in respect of money lent to her for her trade or business until all claims of her other creditors have been satisfied. Subject to these exceptions all debts proved in the bankruptcy must be paid *pari passu* (without preference). Any surplus after payment of 20*s.* in the pound and interest at the rate of 4% per annum, from the date of the receiving order, is payable to the bankrupt.

All claims and liabilities present or future, certain or contingent, arising out of obligations incurred before the date of the receiving order are provable in the bankruptcy, an estimate of the liability in the case of contingent debts being made by the trustee subject to appeal to the court. But demands in the nature of unliquidated damages arising otherwise than by reason of a contract, promise or breach of trust are not provable, nor are gaming debts or debts barred by the statutes of limitation.

A secured creditor if he proves must either surrender his security or value the security and prove for the balance, and the trustee can thereupon, subject to the creditor's power in certain circumstances to amend the valuation, take over the security by paying the amount of the valuation or may require it to be realized. He may be required by the creditor to elect which of these courses he will adopt, failing which the equity of redemption will vest in the creditor.

After payment of costs of administration and preferential debts it is the duty of the trustee to distribute the estate with all convenient speed—the first dividend within four months after the first meeting of creditors and subsequent dividends at intervals of not more than six months; but the declaration may be postponed for sufficient reason by the committee of inspection.

Trustee's Administration.—While the interim preservation and management of the estate is conducted by or under the direct supervision of officers appointed by and responsible to the board of trade, the ultimate realization and distribution of the assets devolve upon the trustee appointed by the creditors. But besides acting as receiver prior to the first meeting of creditors, the official receiver also becomes trustee by operation of law on the making of an order of adjudication.

He vacates the office when a trustee is appointed by the creditors and certified by the board of trade, but again becomes trustee on the creditors' trustee being released, dying, resigning or being removed from office. As the bankrupt's property vests in the trustee for the time being, and passes from trustee to trustee by operation of law, and without any formal act of conveyance, the continuity of the office is thus secured.

The trustee is required to take immediate possession of the bankrupt's property, including deeds, books and accounts, and has the powers of a receiver in the high court for the purpose of enforcing delivery. After payment of the costs of administration it is his duty to distribute the estate in dividends as speedily as possible. Property vests in the trustee subject to any restrictions under which it was held by the bankrupt. So if a lessee who is under covenant not to assign or underlet without the consent of his landlord is made bankrupt, his trustee is bound by the covenant.

Where any part of the property is held subject to onerous obligations, such as the payment of rent, etc., the trustee may disclaim the same, subject in certain cases to the leave of the court, and the disclaimer operates to determine all interest in or liability in respect of the property on the part of the estate. The trustee is required to keep a record book (which is commenced by the official receiver), containing minutes of the proceedings in the bankruptcy, and a cash book in the prescribed form, in which all receipts and payments by him must be entered. All monies received must forthwith be paid into an account at the Bank of England, entitled the "bankruptcy estates account," which is under the control of the board of trade, unless where in special circumstances the sanction of that department is obtained to open a local banking account, but in no circumstances must estate monies be paid to the trustee's private account. When monies are required for the purpose of the estate, special checks or money orders are issued by the board of trade on the application of the trustee.

The trustee's remuneration is fixed by the creditors or by the committee, if so authorized by them. A trustee receiving remuneration is not allowed the costs of any other person for duties which ought to be performed by himself. All bills of solicitors and other agents employed must be taxed before payment, as being in accordance with the prescribed scales of costs; and the taxing master must satisfy himself that the employment has been properly authorized before the work was done.

All bills of costs must be delivered to the trustee within seven days after request; otherwise, the estate may be distributed without regard to such costs.

When the property, so far as it is capable of realization, has been realized and distributed, the trustee must apply to the board of trade for his release, forwarding to each creditor a notice of his having done so, together with a copy of his final accounts.

Small Bankruptcies.—When the official receiver reports, or the court is otherwise satisfied that the debtor's property is not likely to realize more than £300, the court may make an order for the summary administration of the estate; in which case, if the debtor is adjudged bankrupt, the official receiver in the ordinary course becomes and remains trustee and certain other modifications are effected with the view of simplifying and accelerating the procedure.

BANKRUPTCY IN SCOTS LAW

In Scots law the term bankruptcy is not capable of any exact definition. Indeed, it has no technical legal meaning and may refer to any one of the three stages in the process of divesting a debtor of his property for the benefit of his creditors—insolvency, notour bankruptcy or sequestration.

Insolvency is the condition of a debtor who is unable to meet his debts and obligations. Two tests of its existence are possible. It may be either "absolute" or "practical." Absolute insolvency arises when at a particular time a debtor's liabilities exceed his total assets; practical insolvency, when a debtor cannot pay his debts as they fall due although he may not be insolvent in the absolute sense, for his assets when realized may exceed his liabilities. Absolute insolvency is considered in questions relating to the validity of dispositions made by the debtor; practical insolvency, in questions between the debtor and his creditors.

Creditors are chiefly interested in obtaining payment of their debts, and consequently it is practical insolvency which is considered in ascertaining insolvency as an ingredient of what is called "notour bankruptcy," a state of insolvency which has attained publicity, as evidenced by definite statutory indications. This situation is often that indicated by the use of the word "bankruptcy," but most commonly the term is used to denote the condition of a debtor's affairs under the process of sequestration, involving diversion of the bankrupt's estate for distribution among his creditors.

Unlike the bankrupt in English law, a notour bankrupt is not deprived of his property but is restricted only as to his capacity to deal with it. The object is to prevent him from disposing of his assets to favoured creditors and to preserve his property for the whole body of his creditors.

Sequestration is the process corresponding to an adjudication

in English law whereby a debtor is divested of his property for the benefit of his creditors.

In Scotland (as in England) the law of bankruptcy arose as a remedy against the frauds of debtors. By an act of the Scottish parliament (1621) all gratuitous alienations made by a debtor at a time when he was "absolutely insolvent" to "conjunct and confident persons" (*i.e.*, near relations or confidential friends and servants) are annulled in the interests of prior creditors. The onus of showing that value has been given or that the debtor was in fact solvent at the time of the alienation lies upon the person who received the property.

The act of 1696, ch. 5, defined a notour bankrupt and struck at preferences to creditors. Under it all voluntary dispositions made at or after notour bankruptcy or within 60 days before to any creditor by way of security for prior debts may be set aside at the instance of prior creditors. No proof of fraud or collusion is necessary and it is immaterial whether the debtor was or was not insolvent at the time of the disposition. This act does not affect any payment to a creditor made in the ordinary course of business.

Notour Bankruptcy.—The matter is now regulated by the Bankruptcy (Scotland) act, 1913, which repealed the Bankruptcy act, 1856, and the Debtor's act, 1880, and consolidated the law of bankruptcy but left in force the acts of 1621 and 1696. By this act "Notour bankruptcy shall be constituted by the following circumstances:—(1) By sequestration or the issuing of an adjudication of bankruptcy or the granting of a receiving order in England or Ireland; or (2) By insolvency (*i.e.*, practical insolvency) concurring (*a*)—(i) with a duly executed charge for payment when a charge is necessary, followed by the expiry of the days of charge without payment; (ii) where a charge is not necessary, with the lapse without payment of the days which must elapse before poinding or imprisonment can follow on a decree or warrant for payment of a sum of money; (iii) with a poinding or seizure of any of the debtor's movables for nonpayment of rates or taxes; (iv) with a decree of adjudication of any part of his heritable estate for payment or in security; or (*b*) with sale of any effects belonging to the debtor under a sequestration for rent" (s. 5).

Notour bankruptcy continues in case of a sequestration till the debtor obtains his discharge and in other cases until practical insolvency ceases (s. 7). The notour bankrupt is not divested of his property, for, as has been stated above, the object of notour bankruptcy is not to transfer the debtor's property to his creditors but to preserve it in his hands for their benefit.

The effects of notour bankruptcy on preferences to creditors under the act of 1696 have already been noted; in addition notour bankruptcy has the effect of equalizing diligences (*i.e.*, executions of all kinds). Arrestments and poindings used within 60 days prior to the constitution of notour bankruptcy or within four months thereafter are ranked *pari passu* as if they had all been used of the same date (s. 10).

Sequestration.—Sequestration of the estate of any person may be awarded in the following cases: (1) in the case of a living debtor subject to the jurisdiction of the supreme courts of Scotland: (*a*) on his own petition with concurrence of creditors for not less than £50; (*b*) on the petition of a creditor or creditors for not less than £50, provided the debtor be notour bankrupt and has within a year before the date of the presentation of the petition resided or had a dwelling house or place of business in Scotland; (2) in the case of a deceased debtor who at the date of his death was subject to the jurisdiction of the supreme courts of Scotland: (*a*) on the petition of a mandatory; (*b*) on the petition of a creditor or creditors for not less than £50 (s. 11).

A petition for sequestration may be made either in the court of session or in the sheriff court (s. 16), and a petitioning or concurring creditor must lodge with the petition an oath as to the verity of his debt (s. 20 and 21). When the debtor presents or concurs in the petition, sequestration must be awarded forthwith, the court having no discretion in the matter (s. 28). The interlocutor (*i.e.*, order of the court) awarding sequestration declares that the debtor's estate belongs to his creditors for the purposes of the act. The election of a trustee must be confirmed by an interlocutor of the sheriff, and this interlocutor—called the "act and warrant"—vests the property of the debtor in the trustee for the benefit of the creditors (s. 70). Instead of electing a trustee, the creditors may decide to have the estate wound up by a deed of arrangement. This requires the support of a majority in number and three-fourths in value of the creditors present and must be approved by the lord ordinary or the sheriff (s. 34).

Sequestration is declared by s. 104 of the act to be equivalent to an arrestment in execution and decree of forthcoming and to an executed and completed poinding. No arrestment or poinding (*i.e.*, no process of execution) executed of the funds or effects of the bankrupt on or after the 60th day prior to the sequestration is effectual, and any funds or effects attached must be given up to the trustee.

After the trustee's appointment has been confirmed, the sheriff names a day for the public examination of the bankrupt (s. 83) and may order that the bankrupt's family and confidential servants be examined also (s. 86). Creditors lodge claims for ranking and must value and deduct their securities (s. 61). The trustee may require the creditor to hand over the security at the valuation he (the creditor) has placed on it. S. 118 contains a list of debts which are entitled to preference. The first dividend is paid at the end of six months from the date of the sequestration (s. 126); the second, ten months from the sequestration (s. 128); and subsequent dividends, if any, at three-month intervals (s. 129).

Discharge.—The bankrupt may be discharged either on composition or without composition with his creditors. An offer of composition may be made at the "meeting for election of trustee" or at any subsequent meeting, and if it is to be accepted it must be approved by a majority in number and three-fourths in value of the creditors present and finally by the lord ordinary or sheriff (s. 134 to 142).

No discharge can be given whether with or without composition unless it is proved to the lord ordinary or the sheriff that a dividend of 5*s.* in the pound has been paid or that the failure to pay such a dividend is caused by circumstances for which the bankrupt is not responsible (s. 146). The debtor is freed by the discharge from all debts except those due to the crown and certain other obligations. After a final division of the funds the trustee is entitled to his discharge whether the bankrupt has been discharged or not (s. 152).

The Scots law thus resembles that of England, where the debtor can apply for discharge after administration.

(W. V. B.; Ds.)

COMPARATIVE LAW

Irish Bankruptcy Law.—The Government of Ireland act, 1920, provided that all laws in force in Ireland at the date of the act should remain in force unless modified by the parliaments of either the Irish Free State or Northern Ireland or in certain other specified ways. Art. 73 of the "constitution" of 1922 also provided that the laws in force in the Irish Free State at the date of the coming into operation of that constitution should continue to be of full effect until any or all of them should have been repealed or amended by enactment of *oireachtas* (the parliament). No modifications in the law relating to bankruptcy had been made by the early 1960s, so that branch of the law remained unaffected by the passing of the act or the constitution.

The law is regulated by the two leading statutes of 1857 and 1872, together with the Irish Debtors act, 1872, and corresponds in its main features to some of the older English enactments, with modifications adopted from the English act of 1869. A special act was passed in 1888 for establishing local bankruptcy courts in certain districts in Ireland, and an act of 1889 applied the main provisions of the English act of 1888, relating to preferential payments in bankruptcy, to Ireland.

In 1897 the court of bankruptcy was abolished and its jurisdiction was vested in the queen's bench division of the supreme court of judicature in Ireland.

The Deeds of Arrangement act, 1887, though repealed with regard to England by the Deeds of Arrangement act, 1915, is still in force in Ireland and is supplemented by the Irish Deeds of Ar-

rangement Amendment act, 1890. This last-mentioned act requires the registration of all petitions for arrangement under the Bankruptcy act, 1857.

Northern Ireland.—Having adhered to the Government of Ireland act, 1920 (referred to above), the law of bankruptcy in Northern Ireland is very similar to that in force in England. But the Bankruptcy (Northern Ireland) act, 1929, amended the law in certain important particulars. It provides, among other things, that where there is a deed of arrangement in operation, a creditor who is party to the deed cannot present a petition in bankruptcy against the debtor.

It also modifies the law as to compositions; provides for the "relation back" of the trustee's title in certain cases; repeals and re-enacts, with amendments, certain existing sections of Irish bankruptcy acts as to the effect of bankruptcy on antecedent transactions; regulates dealings with undischarged bankrupts; and provides for the administration in bankruptcy of the estates of persons dying insolvent.

It also provides specially for the bankrupt who is guilty of gambling, or who fails to keep proper accounts. It should be mentioned that in Northern Ireland a married woman can be made bankrupt only if she carries on a trade or business.

Commonwealth of Nations.—Great progress has been made in the consolidation of the law in the various parts of the commonwealth and especially with regard to the laws of bankruptcy. In Australia a consolidating act was passed by the commonwealth parliament in 1924 (Bankruptcy act, 1924, no. 37 of 1924), but the law on the subject is now to be found in what is called the Bankruptcy act, 1924–32. In New Zealand the law is consolidated by the Bankruptcy act, 1908 (Consolidated Statutes, 1908, no. 12).

All these statutes follow closely the English bankruptcy acts. In Canada the dominion parliament passed the Bankruptcy act of 1919, subsequently amended by acts of 1920, 1921, 1922, 1923, 1925, 1927 and 1931. The last-mentioned act conferred upon a workman the right to recover from the insurance company in case his employer went bankrupt. It also gave the workman a right to preferential treatment in the bankruptcy of his employer. As regards Alberta, the Fraudulent Preference act, 1922, ch. 224, to all intent assimilates the law on that subject to that which operates in England.

India and Pakistan.—There were two systems in insolvency law in force in India before July 18, 1947, one applicable to the presidency towns and the other to the rest of the country. The first depended on the Presidency Towns Insolvency act, 1909 (act iii of 1909), as amended by acts x of 1914, xi of 1921, ix and xxxiv of 1926 and xi and xix of 1927, and the second on the Provincial Insolvency act, 1920 (act v of 1920), as amended by acts xix of 1925, ix, xxxiv and xxxix of 1926 and xi and xii of 1927. Here again the English law was the model. The Indian Independence act, 1947 (10 and 11 Geo. VI, ch. 30), made special provision for the continuance of existing laws. By s. 18 (3) it was enacted that, save as expressly provided in the act, the law of each of the new dominions and the several parts thereof "shall, so far as applicable and with the necessary adaptations, continue as the law of each of the new dominions" until other provision was made by the separate legislatures.

British Colonies, Protectorates and Trust Territories.—The Indian Provincial Insolvency act was used as a convenient code of bankruptcy law for colonies or territories. In Kenya protectorate, for example, the Indian Provincial Insolvency act, 1907, was adopted as law by an ordinance of 1910 (ch. 106) and continued in force, although a separate code superseding the Indian act was set out in the Bankruptcy ordinance, 1926 (no. 1 of 1926).

In other parts of the commonwealth, English law is adopted specifically. For example, in Tanganyika, by the Bankruptcy ordinance no. 8 of 1920, English bankruptcy law as at the date of the ordinance was declared to be the law of the territory. In British Guiana, Gambia, Jamaica, Hong Kong, Mauritius, Grenada, Trinidad, Tobago and the Straits Settlements the law was modeled on the English pattern.

France.—Bankruptcy in France is regulated by the Commercial code of 1807, amended and supplemented by the law of June 9, 1838. By art. 437 of the code, bankruptcy is defined as the state of a trader who is unable to meet his commercial engagements. Simple insolvency of this kind is known in France as *faillite*. Insolvency attended with circumstances of misconduct or fraud is known as *banqueroute simple* or *banqueroute frauduleuse*. Only a trader can become bankrupt. The debt, too, for obtaining adjudication must be a commercial debt, the laws regulating bankruptcy being designed exclusively for the protection of commerce. To be made a bankrupt a trader need not be insolvent; it is sufficient that he has suspended payment. Commercial companies of all kinds are liable to be declared bankrupt in the same manner as individual traders. A trader-debtor can be adjudicated bankrupt upon his own petition, or upon the petition of a creditor, or by the court itself by its own motion. A petitioning debtor must within 15 days file at the office of the tribunal of commerce of the district a declaration of suspension, with a true account of his conduct and of the state of his affairs, showing his assets, debts, profits and losses and personal expenses. On adjudication the tribunal of commerce appoints a person, called a *syndic provisoire*, to manage the bankrupt's estate, and a *juge commissaire* is also named to supervise the syndic. A bankruptcy terminates by an ordinary composition (*concordat*), a sale of the debtor's assets (*union*) or a composition by relinquishment of assets. It is a striking feature of the French system, and highly creditable to French commercial integrity, that a discharge in bankruptcy, even when accompanied by a *declaration d'excusabilité*, leaves the unpaid balance a debt of honour.

At the time of the French Revolution the National Convention passed a resolution that any man who contracted a debt should never be free from liability to pay it. The spirit of this resolution still survives, for until a trader has paid every penny that he owes he is not rehabilitated and remains under the stigma of various disabilities; he has no political rights, he cannot hold any public office or act as a stockbroker or sit on a jury. *Banqueroute simple* is the condition wherein the bankrupt has been guilty of grave faults in the conduct of his business, such as extravagance in living, hazardous speculation or preferring creditors. *Banqueroute frauduleuse* involves the worse delinquency of fraud. Both *banqueroute simple* and *banqueroute frauduleuse* are punishable—the latter with penal servitude which may range from 5 to as many as 20 years.

Germany.—Bankruptcy of a person in Germany does not cause his property to be vested in a trustee as in England, but it has the effect of transferring its possession and management (except as to certain kinds of property) to an administrator, who has to apply the proceeds for the benefit of creditors in the same way as an English trustee in bankruptcy. Before World War II the law was to be found in a code passed in 1877, as amended by a supplementary law dated May 17, 1898. The same distinction is drawn in Germany as in France between mere commercial failure and bankruptcy, simple or fraudulent. Simple bankruptcy is established by such offenses as gambling, dealing in "futures," disorderly bookkeeping or extravagance in living; fraudulent bankruptcy, by offenses of a deeper nature—the concealment of property, the falsifying of books, the manufacture of fictitious debts and the giving of illegal preferences.

Both kinds of bankruptcy are punishable, fraudulent bankruptcy by penal servitude or, in case of mitigating circumstances, by imprisonment for not less than three months. Accessories in fraudulent bankruptcies (for instance, a creditor who conspires with the debtor to secure an advantage to the prejudice of the other creditors) are liable to penal servitude. The creditors are called together within one month from the date of adjudication, and at their meeting they may appoint a committee of their number to advise with the trustee. It is the duty of the court to see that the trustee performs his functions. Estates are liquidated with great rapidity. In order that the creditors may receive dividends at the earliest moment it is customary to sell the assets by auction. The creditors by a majority in number and three-fourths in value may accept a composition, but such an arrangement must have the approval of the court. The fees are very moderate: in an

ordinary bankruptcy the attorney's fees do not, it is said, exceed £5. An insolvent estate may be administered in bankruptcy on petition by the heir.

Italy.—Bankruptcy in Italy is regulated by the Commercial code of 1883 (part iii). Only traders can pass through the bankruptcy court. Traders are defined by the code as those who, as a habitual profession, engage in commercial business. This definition includes merchant companies. Bankruptcy proceedings may be taken either by the debtor or by a creditor for a commercial debt, or may be ordered by the court. The amount of the debt is immaterial; a small sum will suffice, provided its nonpayment is proof of insolvency. Bankruptcy can be declared only where there is insolvency.

The judgment adjudicating a debtor bankrupt deprives the bankrupt of the right to administer his affairs and nominates a trustee to realize the property under the superintendence of a judge and a commission of creditors. All the property of the bankrupt, movable and immovable, is sold by auction and distributed in dividends. This is one way of closing the bankruptcy, but it may also be closed by an arrangement.

No minimum percentage is required for such arrangement, but it must have the assent of creditors representing three-fourths of the bankrupt's indebtedness. Composition before bankruptcy is not recognized by Italian law.

Spain.—The law of bankruptcy in Spain is to be found in the 4th book of the commercial code, ss. 870 *et seq.*, as modified by the law of June 10, 1897.

See also DEBTOR AND CREDITOR LAW; CORPORATION; COMPANY; and Index references under "Bankruptcy" in the Index volume.

(W. V. B.)

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BANKS, SIR JOSEPH (1743–1820), English explorer-naturalist, noted principally for his patronage and promotion of science rather than for his own researches. He was born at London on Feb. 2, 1743, and after schooling at Harrow and Eton attended Oxford from 1760 to 1763. In 1761 he inherited an ample fortune from his father.

Banks traveled to Newfoundland and Labrador (1766), around the world with James Cook (1768–71) and to Iceland (1772). In 1778 he became president of the Royal society. The order of knight commander of the Bath was bestowed upon him in 1795, and two years later he was admitted to the privy council. He died on June 19, 1820, at Isleworth.

Banks's herbarium was one of the most important in existence and is now at the British museum, as is also his library, which consisted chiefly of unrivaled holdings of works on natural history and transactions of learned societies. He was interested in economic plants and their introduction into countries that might benefit from them, was the first to suggest (1805) the identity of the wheat rust and barberry fungus. Either at his own expense or in his capacity of honorary director of the Royal Botanic gardens at Kew, he sent out many botanical collectors to various countries. His house was for many years a centre for the meeting of scientists and the exchange of ideas. As president of the Royal society he raised the state of science in Britain and was successful in cultivating friendly relations with scientists of other nations.

See J. H. Maiden, *Sir Joseph Banks* (1909); A. Arber, "Sir Joseph Banks and Botany," *Chron. Bot.*, vol. ix, pp. 94–106 (1945).

(J. W. Tr.)

BANKS, NATHANIEL PRENTISS (1816–1894), U.S. political leader and Civil War general, was born at Waltham, Mass., on Jan. 30, 1816. After being admitted to the bar, he entered politics, serving in the Massachusetts legislature from 1849 to 1853 and as president of the state constitutional convention in 1853. He entered congress in 1853, holding the support of Democrats and of Free Soilers for a time, and later of the Know-Nothing party. He joined the newly formed Republican party in 1855, and in that year was elected speaker of the house of representatives. He served in congress until elected governor of Massachusetts in 1858.

His military career began in 1861 when he was named a major general of volunteers. He served in the campaigns of early 1862 in the Shenandoah valley, and later in the year was in command of the department of the gulf in New Orleans. Forces under his command eventually captured Port Hudson, La. In 1863 and 1864 he was in command of expeditions in Texas, but proved unsuccessful as a tactician. Mustered out of the army at the end of the war, Banks re-entered politics and was a member of the house of representatives 1865–73 and again 1875–77, as a Democrat. He was returned as a Republican in 1877–79. He served for a time (1879–88) as U.S. marshal for Massachusetts; in 1888 he was re-elected to congress for the term 1889–91. He died at Waltham, Sept. 1, 1894. (E. E. R.)

BANKSIA, an Australian genus of over 40 species of evergreen shrubs and trees (family Proteaceae; *q.v.*), with leathery leaves often deeply cut, and handsome, bracted, spikes of yellowish flowers, followed by a woody, conelike cluster of fruits. It is named after the naturalist Sir Joseph Banks.

Over 20 species are cultivated for ornament, mostly in the greenhouse where they need a porous, lime-free soil and a temperature of 50°–60°. They need plenty of water, but suffer as badly from overwatering as drought. A few are cultivated outdoors along the Gulf coast and in California. They are known in Australia as honeysuckle trees. (N. Tr.)

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FLOWERS OF AUSTRALIAN HONEYSUCKLE TREE (BANKSIA COCCINEA)

BANKURA, a town, headquarters of Bankura district in the Burdwan revenue division of West Bengal, India, lies on the north bank of the Dhaleswari river about 96 mi. N.W. of Calcutta, on the Adra to Midnapore branch of the South Eastern railway. Pop. (1961) 62,673. The population is engaged mainly in trade and silk weaving. There are four colleges, including a medical college. The collector's residence is an imposing building with fine gardens surrounded by the other public buildings.

BANKURA DISTRICT covers 2,658 sq.mi. and its population was 1,319,259 in 1951 and 1,667,527 in 1961. The eastern part is a low alluvial plain, fertile and densely populated; on the west the district occupies the eastern fringe of the Chota Nagpur gneissic plateau of Archaean Age, clothed with patches of sal forest and scrub jungle and dotted with isolated hills of which Susinia (1,450 ft.) and Biharinath Parbat (1,483 ft.) are the most conspicuous, the former being the only hill in West Bengal bearing a rock inscription of Asoka; across the middle from north to south runs a belt of older alluvium of Pleistocene Age covered with lateritic soils and very sparsely populated. The district is drained by the Damodar in the north, Silai in the middle and Kangsabati in the south. Rainfall is insufficient and irregular, necessitating irrigation of arable land from wells and storage tanks. The Damodar valley schemes provide irrigation water to 79,000 ac. of land, and a hard-surfaced road over the Durgapur barrage. Rice and sugar cane are the main crops. Laterite, china clay and building stones are quarried, and shellac, silk fabrics and brassware are manufactured. Vishnupur (pop. [1961] 30,952), a former capital, is noted for its fine temples, picturesque lakes and a fort. Sonamukhi (15,045) is a silk-weaving town. (S. P. C.)

BANN, the largest river in Northern Ireland, falls into two distinct parts. The upper Bann rises in the Mourne mountains in the south of County Down and flows northwest to Lough Neagh

(*q.v.*). The lower Bann runs northward through Lough Beg and carries the waters of Lough Neagh to the sea below Coleraine, a small port and linen town. The total length is 85.5 mi. The lower river occupies a depression in the basalt flows which form the plateaus of Antrim and north Derry. It is floored with glacial drift and with postglacial deposits including, besides extensive bogs, a layer of diatomaceous earth which is worked commercially in several places. The river has valuable eel and salmon fisheries, and is a classic archaeological site for remains of the Mesolithic and Neolithic periods. The chief town on the upper Bann is Portadown (*q.v.*), near Lough Neagh, a linen town in a district known especially for apples and roses. Farther upstream the water power of the river played an important part in the industrialization of the Ulster linen industry. (E. E. E.)

BANNATYNE, GEORGE (1545–?1608), compiler of an important collection of 15th- and 16th-century Scottish poetry, was born at Newtyle in Angus, and became a prosperous Edinburgh merchant. His anthology of verse, known as the *Bannatyne Manuscript*, was "writtin in tyme of pest" in 1568. It contains many of the best-known poems of Robert Henryson, William Dunbar and Sir David Lyndsay; it preserves work by poets such as Alexander Scott who would otherwise be no more than a name; and it also has much interesting anonymous verse. It influenced the 18th-century Scottish revival, when Allan Ramsay reprinted many of the poems (though often in doctored form) in his *Ever Green* (1724).

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BANNERET, a knight privileged to display in the field a square banner (as distinct from the tapering pennon of a simple knight). The term, used in countries of French and English speech, first occurs in the 13th century. In late 13th-century England, commanders of troops of ten lances and of larger formations, who were not earls, were usually bannerets. During the next two centuries, the style of banneret ceased to be the normal accompaniment of military command: "banneret" became a select title of honour conferred for distinguished services (especially military). Creations continued until the middle of the 16th century. In France, the term seems to have evolved in the same direction and according to a similar chronology, though there the title was sometimes annexed to a fief, and heritable. The banneret was expected to possess means superior to those of an ordinary knight, as befitted his superior status.

Some English bannerets received individual writs of summons to parliament, though their heirs were not usually summoned. There is no connection between bannerets and the English order of baronets established by James I.

See J. Selden, *Titles of Honor*, 3rd ed. (1672); J. E. Morris, *Welsh Wars of Edward I* (1901); T. F. Tout, *Chapters in Mediaeval Administrative History* (1920–33). (Er. S.)

BANNOCKBURN, a town of Stirling, Scot., lies 2 mi. S.S.E. of Stirling on the burn (stream) from which its name is derived, the Bannock (Gaelic, *ban oc*, "white, shining stream"), an affluent of the Forth. Pop. (1951) 4,759. It has textile manufactures including carpets, though at the beginning of the 19th century it was only a village.

The Bore stone, in which according to tradition Robert the Bruce planted his standard before the battle, is preserved by an iron grating. Bannockburn house was Prince Charles Edward's headquarters in Jan. 1746.

The Battle of Bannockburn.—The battle of Bannockburn was fought on June 23–24, 1314. By that time all Scotland had been cleared of English troops with the exception of Stirling castle, which the governor, Alexander Mowbray, had promised to surrender if not relieved by St. John the Baptist's day. To meet the large army which Edward II collected for this purpose Bruce assembled his smaller force at the Torwood, about 4 mi. N.W. of Falkirk.

On learning of Edward's approach, however, he moved to the new park, a mile or two south of Stirling, where the trees would hamper attack by the superior English cavalry. He had taken up his position there when the English vanguard appeared on June 23. On the dry ground, between the park and the swamps to the east, where the enemy must pass on the way to the castle, he had pits dug, a foot broad and knee-deep, and covered with sticks and grass. He sent his nephew, Thomas Randolph, earl of Moray, to block the way by St. Ninian's church, but a small force under Robert de Clifford almost slipped past Moray before he effected its repulse.

Meanwhile the earls of Gloucester and Hereford advanced to reconnoitre the main Scottish position. With them was Hereford's cousin, Henry de Bohun, who, catching sight of Bruce mounted on a palfrey and without a sword, rode at him, hoping to win victory in single combat, only to be slain by the king's battle-ax, while Gloucester was unhorsed nearby. Thus worsted in two preliminary skirmishes, the English army halted for the night, probably behind the Bannock burn.

The main battle, of which the exact site is disputed, was fought next day. Edward began at dawn to draw up his force for assailing the Scots, but the ground proved too restricted for their deployment, so that Bruce, seeing their disorder, decided, contrary to his usual practice, to attack. Sending out three "battles" of pikemen under his brother Edward, the earl of Moray and Sir James Douglas (with Walter Stewart), respectively, he kept the fourth in reserve under himself. Hard fighting ensued. "Sic a frusching of speris wair," wrote John Barbour, "that fer away men mycht it her." For a time the Scots were harassed by the English archers, until these were dispersed by a charge of 500 horse under Robert Keith, the marischal. In their cramped position the rear ranks of the English could not reach the fighting, while they hampered the retreat of those in front. At length Bruce led in his reserve to win the day. The rout was completed by the charge—whether of light armed troops or camp followers is uncertain—of those who had been watching the fight from the Gillies hill to the west and now rushed down, shouting "Sla, sla."

Many of the English, unharmed by the enemy, perished in the Bannock and the morasses beyond. Edward II, seeking refuge in Stirling castle, was refused admission by Mowbray on the ground of its imminent surrender and escaped by a circuitous route around the new park to Dunbar and thence to England. Exact estimates of the numbers engaged are impossible, but the English had probably about 3,000 horse and 20,000 foot, the Scots perhaps 10,000 altogether, or even as few as 5,000. English losses in killed and prisoners included the earls of Gloucester and Hereford, more than 60 barons and bannerets and many scores of knights; the Scots claimed to have lost only two knights but numerous pikemen. Sir Charles Oman, who gives high praise to Bruce's conduct of the battle, calls it "the most lamentable defeat which an English army ever suffered." Scotsmen regard it as the culmination of the War of Independence. For evolution of English tactics *see* also Falkirk; Dupplin, Battle of.

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BANNS OF MARRIAGE, the public legal notice made in a church proclaiming an intention of impending marriage with the object that persons aware of any impediment to the marriage may make their objection known. The church in earliest days was forewarned of marriages (Tertullian, *Ad uxorem, De pudicitia*, ch. 4). The first canonical enactment on the subject in the English church is that contained in the 11th canon of the synod of Westminster in London (A.D. 1200), which orders that "no marriage shall be contracted without banns thrice published in the church, unless by special authority of the bishop." It is, however, believed that in France the practice is as old as the 9th century. The Lateran council of 1215 made the publication of banns compulsory. In early times it was usual for the priest to betroth the pair formally in the name of the Blessed Trinity. In England, under the

canon law and by statute, banns are the normal preliminary to marriage; but a marriage may be solemnized without the publication of banns by authority of a special licence granted by the archbishop of Canterbury, or of a common licence granted by a competent ecclesiastical authority, or by a superintendent registrar's certificate. The legal position in England is now governed by the Marriage act, 1949. Banns remain valid for three months after their complete publication on three Sundays prior to the marriage during morning or evening service. If any persons knowingly intermarry after the expiration of the banns, or in any place other than a place where banns may be published, or without the due publication of banns, or after joint and intended concealment of the true name of one or of both of the parties, the marriage is void. In the United States there is no statutory requirement, and the practice of banns (though general in the colonial period) is almost entirely confined to Roman Catholics. *See* BETROTHAL; MARRIAGE, LAW OF. (W. T. Ws.)

BANNU, a town and military station in West Pakistan, lies on an upland plain near the west bank of the Kurram river 93 mi. S.W. of Peshawar. Pop. (1961) 31,623. Being of military origin it has wide streets laid out in gridiron pattern and is enclosed by a 12-ft. earth wall, with ten iron gates which are closed daily at sunset. It is at the junction of hard-surfaced roads running north to Peshawar, east and south to the Indus valley and west into the frontier country of Waziristan; and is at the end of a metre-gauge railway from Kalabagh and Mari Indus on the Indus. These communications make it the chief market town of the area. It is also the headquarters of the Bannu administrative district and the seat of Government college affiliated to Peshawar university. Local industries include the making of *chappals* (sandals) and wooden articles, and there is a large woolen mill.

Bannu was founded in 1848 by the British officer Lieut. (later Sir) Herbert Edwardes as a base for military operations, a bazaar for his troops and a refuge against the Pathans for local Hindu and Sikh communities. It was at first known as Dhulipshahar after Dhulip Singh, the last Sikh ruler of the Punjab, and its fort was called Dhulipgarh. In 1869 it was renamed Edwardesabad, but in 1903 this was changed to Bannu after the district, only the fort keeping the name Edwardes.

BANNU DISTRICT is a circular alluvial plain or basin hemmed in by low hills. Pop. (1961) 432,000, mainly Pathan or Afghan tribespeople (*see* NORTHWEST FRONTIER). Area 1,696 sq.mi. The plain slopes gradually southeastward and is watered by mountain torrents and drained by the Kurram and its tributary the Tochi or Gambila. The narrow Bannu or Kurram-Gambila doab (the area between the two rivers) in the centre is the district's most highly irrigated, cultivated and populated area, with wheat, maize and barley as the chief crops. The rest of the district is largely sandy, growing winter wheat and grain. Fields are embanked to hold the floodwaters. The Kurramgarhi project, completed in 1960, with dams on the Kurram and Baran rivers, provides irrigation for 270,000 ac. and generation of 4,000 kw. of electricity.

In ancient and medieval times the Kurram-Bannu route afforded one of the ways into India for invaders and colonizers from the northwest. The Akra mounds, 7 mi. from Bannu, probably represent the ruins of a regional capital of the Bactrian or "Indo-Greek" rulers of the 2nd century B.C.—1st century A.D. Bannu was traversed by the raids of Mahmud of Ghazni in the early 11th century A.D.; and in the century of chaos which followed was colonized by the Afghan tribe called Bannuchi or Bannuwal, who still occupy part of the district to which their name was given. Timur (Tamerlane) is said to have crossed Bannu in his massive raid on the Punjab and Delhi in 1398. During the Muslim period in India the wild tribal Bannu was but nominally subject to central authority. By 1838 it had fallen to the Sikh kingdom of Ranjit Singh, but 11 years later the second Sikh War brought it under British control. Bannu district was formally constituted in 1861.
(K. S. AD).

BANQUE DE FRANCE. Founded on Jan. 18, 1800, as a limited company, on the instigation of Napoleon Bonaparte, the Banque de France began operations on Feb. 20 of the same year. Because it had been called to help to finance the war, the new institution had to face certain difficulties as early as 1806 which caused its statutes to be recast; the modified statutes were put into force in 1808, and their main provisions still remain valid. Napoleon declared: "The bank does not belong to the shareholders only; it also belongs to the state, since the state has entrusted to it the privilege of issuing money. I wish the bank to be in a sufficient measure in the hands of the state, but not too much so."

According to a law of April 14, 1803, the privilege of issue had been granted to the bank for the Paris area only. The privilege was extended to metropolitan France in 1848, after the economic and financial upheavals which had led to the disappearance of the local banks of issue, and subsequently renewed at intervals up to 1945, in which year the bank was nationalized. The bank has 259 agencies in metropolitan France (namely, 159 branches [*succursales*] and 100 offices [*bureaux auxiliaires*]) and maintains correspondents in 1,130 ancillary towns (*villes rattachées*). It has no agency in the French dependent overseas territories.

A governor and two deputy governors appointed by the government manage the bank's business. Otherwise it is administered by a general council of 12 persons, of whom 4 are ex-officio members (namely, the general manager of the Caisse des Depots et Consignations, the governor of the Crédit Foncier de France, the general manager of the Crédit National and the general manager of the Caisse Nationale de Crédit Agricole). Seven other members are appointed by the minister of finance; one member is elected by the staff of the bank. After nationalization the former shareholders received in 1945 fixed interest securities of a par value of 7,000 fr. at 3%; one old share was exchanged for four new securities, plus a cash bonus of 29 fr.

The Banque de France functions as a central bank (*q.v.*), acting as a bankers' bank. Although it is authorized to deal directly with private persons and firms, the volume of its transactions with the general public substantially decreased after World War II. Such transactions were originally intended to give greater efficiency to the discount rate policy. Since 1945, however, this has been achieved through the bank's ability to control the credit operations of the banking system. Because the provisions of the original statutes were strict, it was at first unnecessary to limit the note issue. Between 1848 and 1850, however, the bank having been relieved of the obligation to redeem its notes in specie, the government fixed a maximum limit for the note issue. A ceiling was enforced once more in 1870 and was increased periodically. This system was abandoned in 1928, when the law of June 25, 1928, which restored the franc convertibility suspended since the outbreak of World War I, obliged the bank instead to keep a gold reserve of at least 35% against its sight liabilities (namely, the amount of the note circulation and of credit balances on current account). In 1936 the bank was again relieved of the obligation to redeem its notes in specie, and at the outbreak of World War II all provisions governing the note issue were repealed.

Up to 1938 the bank could influence the volume of credit and, consequently, the amount of the note issue only through changes in its discount rate. After 1938 it was empowered to regulate the working of the money market through its open-market operations.

One of the objectives of the nationalization law of Dec. 2, 1945, was to tighten control over the note issue through the supervision of credit distribution. Although this function was entrusted to a new organization, the Conseil National du Crédit, the Banque de France nevertheless plays an important part in this field, because its governor is ex-officio vice-president of the Conseil National du Crédit and because it surveys the application of the measures agreed upon by the Conseil. This permits the bank to promote a credit policy through quantitative as well as selective control of credit facilities granted by the whole banking system. According to the provisions of the original statutes, the operations that gave rise to the issue of notes were to be limited to gold transactions and to the discount of commercial paper. The Banque de France was subsequently empowered to grant advances upon gold or securities as collateral, to buy and sell foreign exchange and to engage in open-market dealings. It was also called upon, especially after World War I, to grant advances to the government. As a result, note circulation remained at very high

levels. Gold dealings between the Banque de France and the general public were suspended in 1936, as far as purchases and sales or advances upon gold collateral are concerned. These transactions were later entrusted to the French Exchange Stabilization fund.

Bills of exchange and other commercial paper, and warrants, checks and short-term treasury maturities are acceptable for discounting by the bank. Except in the case of short-term treasury maturities, the paper offered for discount must bear three signatures of persons of standing (a collateral in the form of securities or goods may replace the third signature). The maturity must not exceed three months. To meet special needs (credits to cattle breeders, or the financing of purchases of cereal crops) the bank extends its facilities up to nine months through quarterly renewals of the relevant paper. Moreover, in order to overcome capital shortage the bank finances certain investments and foreign operations by discounting short-term paper issued on medium-term credits having a maturity not exceeding five years.

For open-market operations to regulate the working of the money market, the Banque de France was empowered by a decree of June 17, 1938, to purchase and to sell short-term commercial and government paper eligible for rediscount. In fact, the bank's purchases and sales mainly concern treasury bills, banker's acceptances, promissory notes issued by the nationalized railways, and acceptances of the Crédit National. On Dec. 31, 1960, the above-mentioned credit operations totaled 22,680,000,000 new fr. (1 new fr. = 100 old fr.) and the notes in circulation 39,320,000,000 new fr. The gold and foreign assets were 10,066,000,000 new fr.

Before World War I, the advances of the Banque de France to the government reached only 180,000,000 old fr. Since then the government has increasingly applied to the bank for assistance. The permanent advances totaled, at the end of 1959, 6,500,000,000 new fr. The temporary advances, granted to enable the government to meet exceptional expenditures, amounted to about 901,000,000 new fr. or 90,000,000,000 old fr. on Dec. 31, 1960. The Banque de France puts its technical facilities at the disposal of the public treasury for the movement of public funds between the treasury and the treasury's local agencies as well as for the subscription and servicing of the loans issued by the state and by local authorities. The bank accepts deposits on current account from the public. It also holds securities on deposit and is prepared to handle purchase or sale orders for such securities. Finally, the bank rents strong rooms and safes to its customers. *See* also BANKING: *History of Banking.* (HI. L.)

BANSHEE (Irish, *bean sidhe;* Gaelic, *ban sith,* "woman of the fairies"), a supernatural being in Irish and other Celtic folklore whose mournful "keening" or screaming at night was held to foretell the death of one of the household visited. In Ireland banshees were believed to warn only families of pure Irish descent: the Welsh banshee, the *gwrach y Rhibyn* ("witch of Rhibyn") only visited families of old Welsh stock. Sir Walter Scott mentions belief in a kind of banshee or household spirit in certain Highland families (*Letters on Demonology and Witchcraft,* p. 351, 1830).

BANSKA BYSTRICA, an ancient town of western Slovakia, Czechoslovakia, scene of the Slovak national rising in 1944, lies in the valley of the Hron river at the confluence of the Bystrica with the Hron, 1,188 ft. (362 m.) above sea level. Pop. (1957 est.) 19,126. The valley is between the Low Tatra ranges to the north and the Slovak Ore mountains to the south. The site at the sharp bend of the Hron river to the south was historically of strategic importance, as is shown by the castle (now a museum) on its limestone rock. Upstream the Hron valley is well watered, wooded and fertile. The traditional importance of Banska Bystrica was that of a mining town, profiting from the near and good supplies of gold, copper and iron. The late medieval German church, distinct from the 15th-century Slovak church, recalls the importance of the immigrant mining group. There has been great development of local industry, housing and cultural activities since World War II. (H. G. S.)

BANSTEAD, an urban district, constituted in 1933, in the Carshalton parliamentary division of Surrey, Eng., on the North Downs, 14 mi. S. of Hyde Park Corner, London, by road. Pop. (1961) 41,573. Area 20 sq.mi. The district, which is mainly residential, comprises Banstead, Chipstead, Kingswood, Walton-on-the-Hill and Woodmansterne, where the Oaks became Lord Derby's seat in the 18th century and gave its name to the horse race run on the Epsom racecourse west of Banstead. In 1243 Hubert de Burgh (*q.v.*), lord of the manor, died at Banstead. In 1952 excavations for a housing site at Preston Hawe led to the discovery of the plan of a medieval manor.

BANSWARA, a town and headquarters of a district of the same name in the former state, now division, of Udaipur (*q.v.*), Rajasthan, India, is situated about 80 mi. S.E. of Udaipur city. Pop. (1951) 15,558.

BANSWARA DISTRICT, pop. (1951) 356,559 (1961) 474,192; area 1,946 sq.mi., comprises the former princely state of the same name (pop. [1941] 258,760; area 1,606 sq.mi.) absorbed into Rajasthan on April 18, 1948, and additional territory.

The Banswara prince, or maharawal, was a Sisodhyia rajput of the Dungarpur family. During the decline of the Delhi empire Banswara passed under the Marathas. Wearied by their oppressions, its chief in 1812 petitioned for English protection. By a treaty of 1818 the British guaranteed the prince against external enemies and refractory chiefs; he, on his part, pledged himself to be guided by a British representative. The state was subsequently controlled through the Southern Rajputana subagency. Kushalgarh state, to the southwest, was feudatory to Banswara.

(S. M. T. R.)

BANTAM, a former city of Java, Indon., lying on Bantam bay at the extreme northwest of the island. Now in ruins, Bantam was once the capital of the powerful kingdom and sultanate of Bantam, which was converted to Islam in the 16th century and flourished until the following century when the Dutch reduced it to a state of vassalage. Bantam was the most important Javanese port for trade with Europe and an entrepôt for pepper and other spices. By the end of the 18th century, however, alluvial deposits had silted up the harbour, and by mid-20th century the site of the city was several kilometers from the sea. Its trade meanwhile had shifted to Jakarta (Batavia). There are ruins of buildings of Javanese and Dutch origin, such as the Pakuwonan palace, built in 1680 and surrounded by a bastioned wall, Fort Speelwijk, and several mosques, the oldest and largest of which, built between 1562 and 1596, has detached minarets.

Under Dutch occupation Bantam was the westernmost residency of Java, comprising the districts of Pandeglang, Serang and Lebak, with the capital at Serang. The area produces rice, coconuts, maize and rubber, and gold mines have been developed in the south.

BANTENG (BANTING), *Bibos* (*Bos*) *sondaicus,* the oftendomesticated wild ox of southeast Asia (especially Borneo and Java). The white patch on the rump distinguishes the banteng from its ally the gaur (*q.v.*). Adult bulls of the banteng are completely black except for the white rump and legs, but the cows and young are reddish brown. In Burma the species is represented by the tsine, in which the bulls are reddish fawn. *See* BOVIDAE.

BANTING, SIR FREDERICK GRANT (1891–1941), Canadian scientist, who, with Charles H. Best, was the first to extract the hormone insulin, was born in Allison, Ont., on Nov. 14, 1891, and was educated at the University of Toronto. He served in World War I and then practised medicine in London, Ont., until May 1921, when he and Best began a search at the University of Toronto, in J. J. R. Macleod's laboratory, for the internal secretion of the pancreas. In the autumn of 1921 it was announced that Banting and Best—who worked alone from May to November —had succeeded in preparing insulin, which proved to be a specific in the treatment of diabetes. Banting became the first head of the Banting and Best department of medical research created by the government of the province of Ontario at the University of Toronto in 1923. Together with Macleod he received the Nobel prize for medicine in the same year; Banting divided his share of the prize equally with Best. In 1923 the Canadian parliament voted an annuity of $7,500 to enable Banting to carry

on his investigations. In 1924 the Banting Research foundation was established, and in 1930 the Banting institute was opened at Toronto. Banting was created knight of the British empire in 1934. He was killed in an airplane accident on Feb. 21, 1941, in Newfoundland. *See* also INSULIN. (C. H. B.)

BANTING, WILLIAM (1797–1878), known for the slimming diet named after him, was a cabinetmaker and undertaker in St. James's street, London. He was only 5 ft. 5 in. tall, but suffered from such increasing fatness that before he was 60 he was unable to tie up his shoes and had to go downstairs backward. On medical advice he took up long-distance walking and rowing, frequented Turkish baths and consumed "gallons of physic." These measures only improved his appetite and added to his weight. In 1862, when he weighed 16 st. 6 lb. (230 lb.), he consulted William Harvey, an aural surgeon, for deafness. Harvey, believing that obesity was the cause of the trouble, placed him on a diet composed mainly of flesh meat, fish and dry toast. Bread, butter, milk, sugar, beer, soup and potatoes were forbidden. As a result Banting's weight decreased by 46 lb. and he greatly benefited in health. In 1863 he published a *Letter on Corpulence,* setting out in simple language the method which had brought him such relief. The pamphlet sold in thousands, and "Bantingism" and "to bant" became household words. He died in London on March 16, 1878. (W. J. BR.)

BANTOCK, SIR GRANVILLE (1868–1946), English composer whose works are remarkable both for their colourful and imaginative expression and the grandeur of their conception, was born in London, Aug. 7, 1868. After preparing for the Indian civil service, he studied at Trinity College of Music and the Royal Academy of Music, and, during these years, developed a sympathy with eastern culture and philosophy which had a lasting influence on his work. He served a lengthy apprenticeship, as editor of a musical magazine (1893–96) and conductor and concert promoter, before his appointment in 1900 to the directorship of the Birmingham School of Music. In 1907 he succeeded Sir Edward Elgar as Peyton professor of music at University of Birmingham. This was a productive period: his massive masterpiece, *Omar Khayyam,* for solo voices, chorus and orchestra was performed in three parts (1906, 1907 and 1909) and a series of compositions for unaccompanied voices culminated in *Atalanta in Calydon* (1912) and *Vanity of Vanities* (1914), which are outstanding examples of his feeling for vocal tone colour.

Bantock's range was wide and he was as inspired in his songs for children as in his large-scale works. His invention was unflagging, although he was forced to abandon the use of lavish resources, which endangers the survival of *Omar Khayyam* as a regular part of the concert repertory in England. His orchestral works range from the impressive *Hebridean Symphony* (1916) and the large tone poems—*Fifine at the Fair* (1912), *Dante and Beatrice* (1911)—to small concert pieces such as *The Pierrot of the Minute* (1908) and *Helena Variations* (1901). His output of songs, part songs and instrumental music was as vast as it was varied.

Bantock also found time to advance the competitive festival movement, and through his wide sympathies English audiences were introduced to many contemporary works. He remained at Birmingham until his retirement in 1934, and was knighted in 1930. He died in London, Oct. 16, 1946.

See H. Orsmond Anderton, *Granville Bantock* (1915); complete catalogue of his compositions in the article in Grove's *Dictionary of Music and Musicians,* 5th ed. (1954). (C. ED.)

BANTRY (BEANNTRAIGHE), a town of County Cork, Republic of Ireland, 57 mi. W.S.W. of Cork by road. Pop. (1956) 2,211. Bantry bay, an inlet made by a drowned river valley, is 22 mi. long and 3 to 6 mi. wide. In this fine bay, which gives anchorage to the largest ships, an indecisive battle took place in 1689 between an English fleet under Adm. Arthur Herbert, later earl of Torrington, and a French fleet; troops were at different times landed there by both sides during this period. In 1796 an abortive attempt at invasion was made by a French fleet. The ancient thriving pilchard fishery has declined; tweeds are made, but the main industry is catering for tourists. Bantry house has a rich art collection.

BANTU (INTERLACUSTRINE), a group of Bantu-speaking peoples of east central Africa, so called because they inhabit the highlands between Lakes Victoria, Kyoga, Albert, Edward, Kivu and Tanganyika. In Uganda, the group includes the Soga, Ganda, Nyoro, Toro, Nkole and Chiga; in the Republic of the (former Belgian) Congo and Ruanda-Urundi, the Ruanda, Rundi, Bashi and Hunde; in Tanganyika, the Haya, Zinza, Ha, Kerewe and, for some purposes, the Sukuma and Nyamwezi. Excluding the latter, the Interlacustrine peoples number about 8,000,000. They fall into three linguistic subgroups: one formed by the Ganda and Soga; a second made up of the remaining Uganda and Tanganyika tribes; excepting the Ha; and a third consisting of the Ha and the Congo and Ruanda-Urundi groups. The Sukuma and Nyamwezi are not linguistically part of the Interlacustrine cluster (though they are Bantu), but they share important cultural features with the latter.

AREA INHABITED BY THE INTERLACUSTRINE BANTU OF AFRICA

Besides their linguistic unity, these peoples share a tendency to form powerful states ruled by hereditary kings. In most African states, effective political authority was widely diffused, the ruler sharing it with fellow aristocrats or with hereditary commoner chiefs who could effectively assert the interests of their kinsmen. In the Interlacustrine states, however, rulers could often assert personal authority over appointment to chieftainship and thus secure hierarchies of quasi-bureaucratic officials personally loyal to themselves. Kinship groups existed in these societies but, particularly in the more powerful kingdoms, lacked the ability to act as effective political units, being confined to such domestic functions as the control of inheritance and exogamy. The two strongest kingdoms in the last half of the 19th century were the Ganda and Ruanda. In each case the king ruled with almost despotic authority, appointing most major officials and often assigning to them overlapping jurisdictions to encourage them to compete for his favour and to prevent their combining against him. The power of the kingdoms was enhanced by the prosperity of their economies, which combined cattle keeping with the cultivation of plantains, millet and sweet potatoes. In many areas the

basic food supply was so completely provided by women's labour that many men could regularly be spared for military service and labour on public works.

Not all Interlacustrine peoples created powerful kingdoms. The Chiga, for example, although closely akin to the Nkole linguistically and culturally, achieved no political integration wider than the local community. However, the Chiga shared with the peoples of the kingdoms a common basic culture which underlay local variations in political structure. A prominent feature of this common culture was the magico-religious complex centring upon spirit possession. The spirits of ancestors, kings, hero gods and natural phenomena were believed to influence the lives of men, and communication with these spirits was held through mediums who became possessed by them. Among all tribes the word *mandwa* (or some phonetic variant) was used to denote the medium or the process of possession. Among the Nyoro subgroup, as well as the Sukuma and Nyamwezi, the most important spirits were the *bacwezi*, a dynasty of legendary kings. Among the Ganda and Soga, some of the same figures appear as hero gods, called *balubaale*. One of the Nkole *bacwezi*, Mugasha, is recognized by the Ganda as Mukasa, while Ndahura, the first of the bacwezi kings of the Nkole, appears as Ndawula in the Ganda royal genealogy.

These legends, and the occurrence among some Interlacustrine peoples of castelike distinctions between pastoralists and cultivators, suggested to earlier ethnologists that the kingdoms had resulted from the conquest of indigenous agricultural Negroes by invading Hamitic pastoralists. The physical differences between pastoralists and agriculturalists are real enough in some areas. J. Hiernaux, for example, found very significant differences between the two groups in Ruanda-Urundi in mean stature and certain other features. However, detailed social anthropological studies have not yielded specific evidence of Hamitic influence in either language or culture, though they have in some cases revealed traditions relating the Nilotic origin of reigning dynasties. Among the Ganda and Soga there is neither physical nor social differentiation into castes, and in the Nyoro subgroup the differentiation is very attenuated. While Hamites may have contributed to the area's population, clearly its history has been more complex than was previously believed. (*See* HAMITE; NILOTES.)

The Interlacustrine peoples were discovered by Europeans, and came under colonial rule during the second half of the 19th century. The Ganda became the nucleus of the British protectorate of Uganda, while the peoples to the west of Lakes Albert, Edward, Kivu and Tanganyika were incorporated into the Congo Free State, later the Belgian Congo. Germany ruled Tanganyika and Ruanda-Urundi until World War I, after which the former passed to Great Britain, becoming independent in 1961, and the latter to Belgium under League of Nations mandate. The Interlacustrine peoples generally prospered in the 20th century. Their high, well-watered and fertile lands enabled them to grow profitable cash crops and their political cohesiveness prevented large-scale alienation to European settlers, though Ruanda-Urundi developed severe overpopulation. Both Britain and Belgium ruled through indigenous political institutions and these institutions responded with flexibility to the demands of modernization, but the individual kingdoms' strong sense of separate identity made them difficult to absorb into wider political units. *See* also GANDA; HAYA; NKOLE; NYAMWEZI; NYORO; RUANDA; RUNDI; SOTHO; UGANDA: *The People.*

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BANTU LANGUAGES. Of the African languages (*q.v.*), those which constitute the Bantu group are spoken throughout most of the southern projection of the continent. The western limit of the area in which they are spoken is the borderland of Cameroon and Nigeria. The area extends southward and eastward across the continent, and lies, except at one point in the centre, south of the 5th parallel of north latitude. The area reaches approximately to the centre of South-West Africa, in the hinterland of Walvis bay, at its southwestern extremity; it reaches the eastern and northern portions of Bechuanaland protectorate and the fringes of the Kalahari desert, at the centre of its southern boundary; and its southeastern extremity continues around the southern edge of the continent as far west as the neighbourhood of Port Elizabeth, in the eastern Cape of Good Hope Province. Bantu is the speech of by far the greatest number of inhabitants in every political division on the equator and southward. Bantu is spoken on the islands of Pemba, Zanzibar, Mafia, Ibo, and the Comoro Islands, in the east, and Fernando Po, in the west. There is said to be some Bantu also in northwestern Madagascar.

The number of distinct languages that are spoken over this vast area cannot be stated with accuracy.

Some Bantu languages have become basic means of communication among African groups, and are employed by Europeans, Arabs and Indians in their relations with Africans. Notable among such languages is the Swahili language (*q.v.*), which is an efficient lingua franca along the eastern coast and in southern Republic of the Congo. Lingala, in northwestern Republic of the Congo, and Nyanja, in Northern Rhodesia and Nyasaland, are less widely used.

Swahili has for a long time been a written language. Under the stimulus and encouragement of the International African institute, increasing numbers of Africans are writing in their native languages, and a Bantu literature is developing, particularly in the southern and eastern parts of the continent. Over a wide area, Bantu languages are employed in missionary and government schools.

"Bantu" is a frequently occurring plural form of the word meaning "person," consisting of the plural prefix *ba-* and the stem *-ntu*. Wilhelm Bleek proposed the word as a designation for these languages in 1856; their affinity, or that of a number of them, had been previously established. It should be recognized that *bantu* is not a constant form, for the prefix and the stem may vary phonologically in different languages. Compare the following:

Language	Singular	Plural
Chewa	*mu-nt^{h}u*	*βa-nt^{h}u*
Ganda	*omu-ntu*	*aba-ntu*
Herero	*omu-ndu*	*ova-ndu*
Kwena	*mU-t^{h}U*	*ba-t^{h}U*
Lamba	*umu-ntu*	*aβa-ntu*
Luba	*mu-ntu*	*ba-ntu*
Lembwe	*mu-ntu*	*ba-ntu*
Nyanja	*mu-nt^{h}u*	*a-nt^{h}u*
Shona	*mu-nhu*	*βa-nhu*
Swahili	*m̀-tu*	*wa-tu*
Umbundu	*omu-nu*	*oṃa-nu*
Zulu	*umu-nt'u*	*aba-nt'u*

(Note: *t^h*, aspirated *t; t'*, glottalized *t; β*, bilabial fricative; *b̂*, implosive *b; m̀*, syllabic *m; U*, open *u*. Tones and stress are not indicated.)

The stem *-ntu* occurs with other prefixes in different meanings. In Chewa, *chi-nt^{h}u* "thing" (pl. *vi-nt^{h}u*); *ka-nt^{h}u* "anything," "something" (pl. *tu-nt^{h}u* "serious trouble"); *u-nt^{h}u* "humanity." In other languages there are similar forms based on this stem.

Classification.—Diedrich Westermann first demonstrated that the connection of Bantu with the languages of west Africa is genuine, and Joseph Greenberg has provided evidence which shows clearly that Bantu has membership in a major linguistic family extending entirely across western Mali as far north as the Senegal river. Greenberg christened this family Niger-Congo, making use of the names of two of the great rivers that flow through the territory over which it is spread, and he divided it into eight subfamilies, although there is some probability that the number may be reducible to seven. Bantu thus has the status of a sub-subfamily. It is a member of the subfamily called by Greenberg the Central branch of Niger-Congo. The Central branch consists of 22 language groups, including Bantu; the other members are distributed over the drainage of the Cross and Benue rivers, from southern

Nigeria and the Cameroun Republic to central Nigeria. The closest affinities of Bantu, according to Greenberg, are Batu, Bitare, Jarawa, Munshi (Tiv), Mambila and Ndoro.

These genetic relations suggest that Bantu probably had its origin in this region and subsequently spread eastward and southward, becoming differentiated into the great number of languages which are its present-day representatives.

There has been no equally satisfactory division of the Bantu languages. All classifications so far presented are primarily based on geographic propinquity or gross typological resemblances and do not seem to merit repetition.

Phonology.—The evolution of Bantu has resulted in a greater diversification in phonology than morphology. A few words and phrases suffice for the identification of almost any Bantu language, although there may be a great variation in the sounds represented. Open *ɛ* and open *ɔ* have a wide distribution, and *a*, similar to English *a* as in "father," is also common to most of the languages. Consonantal clusters, except those involving a nasal or lateral, are rare; the syllable terminates in a vowel or sometimes in a nasal (thus *ba-ntu*). Syllabic nasals seem to have universal occurrence. The labiovelar sounds, *kp* and *gb*, occur in the Bantu languages that neighbour west African languages, where these sounds are frequent. In some of the languages of the south, clicks (*q.v.*), said to be borrowed from Khoisan, are found. The sounds of Proto-Bantu as reconstructed by Carl Meinhof are *p, t, k, β, l, ġ* (voiced velar fricative), *m, n*, possibly *ŋ* (as *ng* in "song"), *w, y*. Palatalized *ṭ, l̩, k̩* and *g̩* were early secondary developments within the Proto-Bantu period; *a, I* (open), *i* (close), *U* (open), *u* (close), with *ɛ* (open) and *ɔ* (open) and possibly the close varieties of *i* and *u* developed from vocalic coalescence, also during this period.

Tone seems to be an important feature in the phonology of all Bantu languages, with the possible exception of Swahili. Tone is not as significant lexically as it is in west Africa, but no analysis of a Bantu language can be complete if the tonal phonemes are neglected, as they so often are. In Kwena, for example, the difference between the singular forms of the second and third person in most forms of the verb is expressed only by a difference in tone.

Greenberg has shown that in Proto-Bantu there were two level tones, low and high. The latter seems to have been replaced in Swahili by a primary stress accent. In Swahili phrases there is an overlying intonation pattern somewhat resembling that in English.

Morphology.—The principal morphological classes into which Bantu words are grouped are nouns, pronouns, verbs and adjuncts (or qualificatives), including numerals. There also are various particles and other words that fill syntactic roles but are not included in distinctive formal classes.

A noun usually consists of a stem preceded by a prefix which changes according to number. Some nouns are limited to a singular or a plural form. In Proto-Bantu, all nouns contained prefixes, but some of these prefixes have been lost. There are certain stems to which suffixes as well as prefixes are attached and on which both nouns and verbs are built. In some languages, diminutives are formed by suffixation. The prefixes are part of the system of inflection in Bantu syntax. Noun suffixes have a derivational function.

Bantu nouns are arranged in several categories, or noun classes, on the basis of their prefixes and the morphemes that are employed for expressing their syntactic relationships to verbs, qualificatives and other forms. These morphemes, together with the noun prefixes, where they exist, make systems of concordances that are partially alliterative. In the Kwena sentence, *mUnwana wáxáxwí Utswá madi* "his finger is bleeding," the noun prefix *mU-*, possessive prefix *w-* (from *U-*) and verb prefix *U-* are the syntactical concordances. In the Swahili expressions, *kidɔlɛ kirefu kinaɔñeša* ("finger long it is pointing") "the long finger is pointing" and *vidɔlɛ virefu vinaɔñeša* "the long fingers are pointing," the concordances form perfect alliterations, but such precise alliteration is exceptional in Swahili and in other languages.

Following is a transliteration of Meinhof's reconstruction of the noun prefixes for Proto-Bantu, with the classes regrouped:

Class	Singular	Plural
1.	*mU-*	*βa-*
2.	*mu-*, (*mU-*)	*mI-*, (*mi-*)
3.	*lI-*	*ma-*
4.	*kI-*	*βI-*, (*βi-*)
5.	*nI-*	*linI-*
6.	*lU-*	*linI-*, (*tU-*)
7.	*ka-*	*tU-*, (*βU-*)
8.	*βU-*	—, (*mI-*), (*ma-*)
9.	*kU-*, (*ġI-*)	—
10.	*pa-*	—
11.	*mU-*	—
12.	*pi-*	*tU-*
13.	*ġU-*	—, (*ga-*)
14.	*ġi-*	—

It is probable, as Meinhof and others have recognized, that additional prefixes existed in Proto-Bantu. In some of the languages, noun prefixes are reduplicated partially, as in Zulu *umu-, aba-* or Ganda *omu-, aba-*. The first elements of the reduplicated forms have been called preprefixes and are shown in some reconstructions of Proto-Bantu.

The use of concordances as a syntactical system embraces the first and second persons. The divisions of noun classes are for the third person. This syntactical system, then, rather than the noun prefixes, which are merely a part of it, is the essential characteristic of this type of formalism, and is one of the principal morphological features of the languages. The functional interrelationship of the morphemes outweighs the significance of their formal resemblance.

The formative elements that are employed in the structure of Bantu verbs include characteristically these prefixed concordances, without which, with few exceptions (as in the imperative), no finite verb form is complete. Since the verb infinitive also bears a prefix and is a noun (class 9, above), it follows that the great majority of Bantu verbs always include one or more prefixes. Thus the systems of concordances rather than merely the noun prefixes are the outstanding badge of Bantu syntax. These languages, therefore, might be called more appropriately "prefixed-and-suffixed-concordance-using" in preference to "noun class denoting."

Although with few exceptions the concordances are prefixed in verb forms, as in nouns, they may occur as suffixes and even as stems, as in possessive pronouns and demonstratives. The complete syntactical systems are the classes, and each contains prefixes and other concordances, the former predominating.

According to an oft-repeated historical hypothesis, this formal grouping once corresponded to a classification of all aspects of life (objects, acts, ideas, etc.) in the Proto-Bantu world. This hypothesis is not verified by the data which the present-day languages furnish. There is a tendency for nouns that refer to human beings to come under the class conventionally allotted the first number (class 1) and it is possible to assign meanings to other classes, the locatives, for example. Since in most instances the exceptions are more numerous than the assumed norms, it must be concluded that these categories are formal rather than semantic. They are simply cultural products, patterns of speech, and constitute genders comparable to the so-called sex genders of Indo-European languages. The imposition of a semantic classification on either kind of gender results in some regularity, but much arbitrariness. The essential characteristic of all languages is the high degree of formal congruity which gives each of them its distinctive grammar. Bantu prefixed concord, like Latin suffixed concord, is neither a naturalist's nor a logician's response to the world of concrete experience.

Conjugation.—The verb in Bantu languages is made of a stem, to which are attached at least one prefix, except in the imperative, and one or more suffixes. There are a few irregular verbs which in some forms have doubtful suffixation. The concordances that are employed in verb forms express the categories of person and number or, in the locative classes (numbers 9, 10, 11, above), local relations. Other prefixed elements, not connected with the system of concordances, symbolize such categories as tense-aspect,

negation, voice and mood. Verb suffixes are associated primarily with mood, voice and tense; some are associated with negation, person and number. In the infinitive and in most finite forms, the terminal verb suffix is *-a*. In its singular form, if no object is expressed, the simple imperative consists of the stem and suffix *-a;* some negative, imperative, and perfective forms have the final suffix *-i, -I, -e* or *-ɛ*; and derivative suffixes usually come next to the stem.

The following Kwena forms are built on the stem *-rút-* (Proto-Bantu *-tund-*, from *-tunl-*) and illustrate some categories of the verb and the role of derivative suffixes: *xU-rút-a* "to teach"; *xU-rút-án-á* (reciprocal form); *xU-rút-ís-á* "to cause to teach," "to help teach"; *xU-rút-êl-á* "to teach for"; *xU-rút-ɨw-á* "to be taught"; *xU-rút-éx-á* "to be teachable." The future is *xU-tla-rút-a*, with prefix *-tla-*, from *xU-tl-a* "to come"; the reflexive is *xU-i-tʰút-a*, with object pronoun *i-*. Nouns are *mU-rút-i* "teacher"; *mU-rút-ís-i* "drillmaster"; *mU-rút-iw-á* "student"; *mU-rút-w-aná* "pupil," with diminutive suffix *-aná;* and *tʰút-ɔ* "education" or "learning."

Principal Features of Bantu Morphology.—(1) There is a relative high degree of synthesis, forming somewhat elaborate words. (2) The morphemes of a word are joined in a manner which preserves their formal identities and generally shows clearly their grammatical functions. Partial concealment of a form may result from phonological modification. (3) There is a tendency for the same word to include both inflectional and derivational elements.

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BANVILLE, (ÉTIENNE CLAUDE JEAN BAPTISTE) THÉODORE (FAULLAIN) DE (1823–1891),

French poet who linked Romanticism and Symbolism, was born at Moulins (Allier) on March 14, 1823. His first book of verse, *Les Cariatides* (1842), showed him to be a disciple of Victor Hugo, whom he admired all his life, and also reflected the Hellenistic revival of the 1840s. Interest in Greek mythology grew in *Les Stalactites* (1846; critical ed. by E. M. Souffrin, 1942) which, with its plastic imagery, was to make Banville a leader of the Parnassian school. *Les Exilés* (1867) deplored the passing of the Homeric gods. Technical problems were of paramount importance to Banville: according to his *Petit Traité de poésie française* (1872), the most important element in French verse is rhyme, which should preferably be double. This was criticized by Paul Verlaine who, nevertheless, learned much from Banville's experiments with all sorts of metres, including the rhythms of folksong. Banville pleaded for a return to fixed forms, not merely to the sonnet, already rediscovered by Sainte-Beuve—Banville wrote a sonnet cycle, *Les Princesses*, in 1874—but to those forms practised by François Villon, Charles d'Orléans and Clément Marot which had been banned by the Pléiade, and used them in *Trente-six ballades joyeuses* (1873) and *Rondels* (1874).

Unlike Leconte de Lisle's, Banville's poetry is full of wit and gay fantasy, a feature which appealed to Stéphane Mallarmé and other Symbolists, like Jules Laforgue. Banville was fascinated by the characters of the *commedia dell'arte*, particularly Pierrot, and by acrobats and clowns, who inspired his famous poem, "Le Saut du Tremplin," and also the title of his collection *Odes funambulesques* (1857). In this work, the Parisian scene of the second empire, which Banville also drew in prose—in *Esquisses parisiennes* (1859), *Les Camées parisiens* (1866), etc.—furnished the subject matter for a new type of humorous verse in which comic effects were obtained through rhyme. Banville aimed at poetic drama, but of his 16 plays only *Gringoire* (1866), a one-act historical play with two ballades, is still performed. He prepared the posthumous edition of the works of his friend Charles Baudelaire, whom he recalled in *Mes Souvenirs* (1882). He died in Paris on March 13, 1891.

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BANYAN a species of fig (*Ficus benghalensis*) that assumes a remarkable form as a tree; in a spectacular fashion, aerial roots emanate from its branches, descend and take root in the soil to become new trunks. The banyan, native to tropical Asia, reaches

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AERIAL ROOTS AND TRUNKS OF THE BANYAN TREE (FICUS BENGHALENSIS)

tremendous proportions: a height up to 100 ft. and an indefinite lateral spread by means of its aerial roots. One tree may in time assume the appearance of a very dense thicket as a result of the tangling of stems and trunks.

At the botanical gardens in Sibpur, near Calcutta, India, there is a banyan tree having a main trunk, 12 ft. in diameter, and 200 additional trunks, the whole encompassing an area 900 ft. in circumference. The tree is regarded as sacred in India. Originally the name was bestowed by Europeans on a specific tree of this species on the Persian gulf; beneath the tree some Hindu merchants, or banians, had built a pagoda.

"Banyan" once was used as a term for all Hindus in western India. "Banyan days" was a term used to describe the two days in each week when meat was excluded from the men's rations in the Royal Navy, "banyan" being an allusion to the vegetarian diet of the Hindu merchants. *See* also Fig; Moraceae.

BAOBAB, a tree, *Adansonia digitata* (family Bombacaceae), native of tropical Africa, remarkable for its barrellike trunk, which in some cases reaches 30 ft. in diameter, though the height is not great. It has a large gourdlike, woody fruit, containing a pleasant, cool-tasting mucilaginous pulp in which the seeds are buried. The bark yields a strong fibre used locally for ropes and cloth. The wood is light and soft, and the trunks of living trees are often excavated to form houses.

So queerly shaped is the baobab that an Arabian legend has it that "the devil plucked up the baobab, thrust its branches into the earth, and left its roots in air." It is grown as a curiosity in Florida and elsewhere in warm climes. A related species, *A. gregorii*, occurs in Australia, where it is called baobab or bottle tree (however, the latter name is more correctly applied to swollen-base trees of an entirely different family, Sterculiaceae). *See* also Bombacaceae; Sterculiaceae.

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THE AUSTRALIAN BAOBAB, OR BOTTLE TREE (ADANSONIA GREGORII)

BAPTISM, CHRISTIAN. Baptism, the initiatory rite of the Christian church, has been observed well-nigh universally by all who call themselves Christian. The meaning and effect of baptism, however, have been the subject of considerable controversy among Christians, especially since the 16th century.

Ceremonies and symbols of ritual washing have appeared in the religions of mankind at so many different times and in so many different places that some sort of baptism probably may be regarded as a universal element in the history of religions. In those religions that have no ceremonial washings as such, there are other rites with a parallel significance. From such sources as the Dead sea scrolls it is evident that at the time of Jesus Judaism was in possession of various baptismal rites, none of which, however, had replaced circumcision as the rite of initiation into the community. Christian contact with these rites came through the work of John the Baptist, who, according to the New Testament, not only heralded the coming of Jesus Christ, but baptized him as well. John apparently confined his baptizing to the Jordan river and made the rite an integral part of his call for repentance and for a break with the sinful past.

Early Church.—When the writers of the New Testament gave this description of the baptism of John, they were trying to distinguish it from their own baptismal practice. Although some critical scholars have been inclined to dispute the claim that Christian baptism was instituted by Jesus himself, such was the unanimous claim of the early church. There is no actual account of the institution of baptism, but the Gospel of Matthew portrays the risen Christ issuing the "Great Commission" to his followers: "Go therefore and make disciples of all nations, baptizing them in the name of the Father and of the Son and of the Holy Spirit, teaching them to observe all that I have commanded you." Other passages in the New Testament substantiate the impression that Jesus had instituted baptism earlier. Around this basic rite a wealth of imagery and meaning was centred, as the epistles of the New Testament, especially those of Paul, indicate. Baptism was likened to the deluge in the time of Noah—an analogy that achieved wide circulation among early Christian writers. Paul's epistle to the Romans says that baptism grants a share in the death and resurrection of Christ. Through it men were to obtain the forgiveness of their sins. Like the baptism of John, Christian baptism required repentance; but unlike the baptism of John, it was associated with the gift of the Holy Spirit, as is especially evident from the Book of Acts. On the basis of these and similar declarations by the writers of the New Testament it may be concluded that in the Christian community of the 1st century baptism occupied a place of great importance and was regarded as essential to the new birth and to membership in the Kingdom of God. The Gospel of John claims the authority of Jesus Christ himself for this interpretation of baptism: "Unless one is born of water and the Spirit, he cannot enter the kingdom of God."

A study of the New Testament, supplemented by the testimony of archaeology and of tradition, provides some conception of the baptismal customs observed by the early church. It seems that the irreducible minimum for a valid baptism were the use of water and the Trinitarian invocation, although the conclusion has repeatedly been drawn from the Book of Acts that a baptism in the name of the Lord Jesus was current at some places during the 1st century. The candidate, after being instructed in the Christian faith, was required to prepare for the rite by prayer and fasting. He abjured the power of the devil and confessed his sins, and thereupon he was usually immersed three times; there are, however, references to baptism by pouring as well. Most of those baptized were undoubtedly converts from Greco-Roman paganism, and therefore adults. The earliest Christian literature makes no explicit reference to the custom of baptizing infants. Both the New Testament and the Church Fathers of the 2nd century make it clear that the gift of salvation belongs to children as well as to adults, and the apostle Paul draws a parallel between baptism and circumcision. On the basis of such evidence it has been argued that infant baptism was a custom that had come down from the apostles themselves, as Origen seems to have been the first to maintain. On the other hand, Tertullian seems to have been the first to object to infant baptism; this suggests that by the end of the 2nd century it was already a practice of the church, and indeed one over which there was no serious controversy.

What did produce controversy in the early church was the question whether baptism by heretics was valid and whether, consequently, those who came over to orthodox Christianity from the heretical groups were to be baptized a second time. During the 3rd century the north African church was enforcing such a requirement, and thus it provoked a controversy with the church of Rome, which argued for the objective validity of baptism even when it was administered by a heretical priest. The same question came up, though in a different form, two centuries later, in the controversy of St. Augustine against the Donatists (*q.v.*). The Catholic answer to the question, as formulated by St. Augustine, was that not the "who" but the "what" in baptism determined its validity. If, therefore, a heretic or even a pagan baptized according to the prescribed form and intended his act to be the baptism of the church, this would be a valid baptism—such is the position Roman Catholic, Orthodox, Anglican and Lutheran theologians have taken on the basis of these early controversies. St. Augustine likewise made use of baptism in his controversy with the Pelagians, arguing that baptism conferred supernatural grace upon those who received it, whether infants or adults, and that it thus expunged the stain of original sin from them. In these teachings Augustine summarized the doctrine of baptism that had developed during the first several centuries in the Christian west.

In the east the doctrinal development did not contradict these western emphases, but it did manifest emphases of its own. One of the favourite motifs of the Greek fathers was the idea that baptism prepared the Christian for the resurrection. Connected with this idea was the "seal of the Spirit," which was said to impart to the candidate a character that set him off from other men. Another favourite metaphor was the notion of "illumination" through baptism. In the eastern churches baptism is accompanied by confirmation (*q.v.*); thereafter the candidate received Holy Communion even as an infant. The baptismal formula of some eastern churches was (and still is): "This servant of Christ is baptized in the name of the Father and of the Son and of the Holy Spirit," instead of the "I baptize you, etc." employed in the west. Despite some theological conflict over the propriety of the eastern formula, the western church finally approved it; it also took over into its piety and its theology many of the emphases that characterized the baptismal thought of the Greek Christians. The so-called Nicene creed spoke for all of Christendom when it declared: "We acknowledge one baptism for the remission of sins." (*See* Creed.)

Middle Ages.—Drawing upon both the biblical and the traditional themes of baptismal theology, medieval scholasticism gave to this doctrine a precision it had not always had in the earlier writers of the church. This precision was accomplished by at least two means. First, scholasticism refined the terminology of theology with the aid of philosophy, and thus it was able to relate the various themes of the tradition to one another by the use of Aristotelian distinctions such as form and matter, principal and

instrumental cause, etc. Second, scholasticism incorporated its teaching about baptism into a comprehensive sacramental system, in which the doctrine of baptism both contributed to and received from the church's definition of what constituted a sacrament. The careful and lucid presentation of the doctrine of baptism near the end of St. Thomas Aquinas' *Summa Theologica* took advantage of both these means to put the doctrine into the form which, except for relatively minor points of clarification, it still possesses in Roman Catholic theology. Baptism is a means of grace in which, through the use of water and of the divinely instituted formula, the neophyte is admitted to membership in the visible church; sin, both original and actual, is forgiven, an indelible character is implanted, and the gift of the Holy Spirit is conferred. This is, in summary, the baptismal doctrine of both Roman Catholicism and Eastern Orthodoxy.

Reformation and After.—This doctrine of baptism was not a primary target of Reformation criticism. Here as elsewhere, most of the Anglican reformers took a position that manifested considerable continuity with the medieval teaching. Baptism was regarded as a means of grace, and it worked both regeneration and forgiveness, even in infants. Luther taught that baptism granted forgiveness of sins, life and salvation. Calvin also acknowledged that baptism effected regeneration, but only in the predestined; in general, there was less room in Calvin's system than there was in Luther's for a doctrine of the means of grace. Zwingli took a more extreme position than either Calvin or Luther in his stand against Roman Catholic sacramentalism. The logical outcome of Zwingli's position was to question not only the sacramental definition of baptism, but the very necessity of baptism at all.

This logical outcome was not drawn by the reformers. But another group of reformers alongside the "magisterial" leaders at Wittenberg, Zurich and Geneva introduced a radically new outlook into the doctrine and practice of baptism. These were the Anabaptists (*q.v.*). The hostility of the Anabaptists to the union of church and state caused them to look for a pure church, into which one would come, not automatically by birth and infant baptism, but consciously by the decision of faith. This view of the church and of the individual represented a fundamental break with the baptismal tradition sketched above. Instead of infant baptism the Anabaptists insisted upon believers' baptism, *i.e.*, a baptism that followed faith and was not thought to create faith. Although the lines of descent from Anabaptism to more recent Protestant denominations are not easy to draw, this insistence did set the pattern for several denominations to formulate doctrines of baptism that differed from the medieval doctrine much more sharply than the teachings of the reformers had. Because they hold that the church is composed of true believers who have made personal confession of their faith, these denominations, among whom the Baptists and the Disciples of Christ are the most prominent, argue that the decision of faith may be neither anticipated nor taken away from the child by its parents and the church. Therefore baptism must be postponed until such a time as the child becomes capable of making this decision personally. This shift in baptismal teaching was of a piece with the more general revision of traditional sacramentalism by Protestant theology.

For further information about the baptismal practices and teachings of the various Protestant denominations *see* the appropriate sections of main articles such as BAPTISTS; DISCIPLES OF CHRIST; etc. Despite the confusion which a study of this material may suggest, most Christians are agreed as to the necessity of baptism; they are not agreed as to why baptism is necessary. *See* also references under "Baptism" in the Index volume.

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BAPTISTE (BAPTISTE AÎNÉ; stage name of NICOLAS ANSELME) (1761–1835), French actor, was born in Bordeaux on June 18, 1761. After two provincial engagements he went to Paris in 1791. His first success came when he played the principal part in *Robert, chef de brigands* (1792 at the Théâtre du Marais). In 1793 he joined the Théâtre de la Republique and in 1799 the Comédie Française, from which he retired in 1828. In tragedy Baptiste was not successful. Among his comedy parts the title role of Destouches' *Le Glorieux* remained his greatest achievement. The Parisians of the Napoleonic era, however, associated Baptiste primarily with the *pères nobles* for which Beaumarchais in his *Eugénie* and Diderot in his *Père de famille* had set up the more or less lachrymose pattern. Baptiste *aîné* died in Les Batignolles near Paris on Dec. 1 (or Nov. 30), 1835. He was survived by a younger brother, PAUL EUSTACHE ANSELME, called Baptiste *cadet* (1765–1839), who had made a name for himself as a comedian. (A. M. N.)

BAPTISTERY, the hall or chapel connected with a church, in which the sacrament of baptism is administered. Baptisteries were among the most symbolic of all Christian architectural forms. Originally they were small rectangular chambers with an apse containing the font (*q.v.*; the receptacle for the water used in baptism) at one end. From the 4th century they were customarily roofed with a dome, the symbol of death to sin and of that heavenly realm toward which baptism is the first step (*see* DOME). The baptistery was commonly octagonal in plan, eight being that number which marks a new beginning (following the "complete" number, seven) as the sacrament of baptism marks the beginning of the Christian life. Similarly fonts were usually octagonal and set beneath a domical ciborium or canopy. These were characteristics of what is probably the earliest baptistery extant, that of the Lateran palace in Rome (dating largely from the time of Constantine), and with a few exceptions (notably in Syria) remained constant thereafter.

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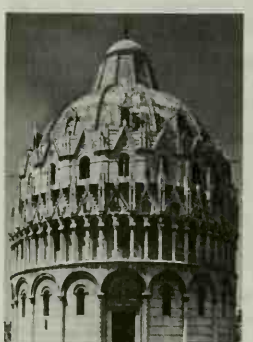
INTERIOR OF OCTAGONAL BAPTISTERY AT ALBENGA, ITALY; 5TH-CENTURY EARLY CHRISTIAN

Up to the 11th century, baptisteries were commonly separate buildings, often large and richly decorated, but they were gradually reduced to the status of small chapels inside churches, or omitted entirely. In most modern churches, the font alone serves for baptism; something of earlier symbolism survives, however, in its location near the church door, in allusion to entering the Christian life. Doctrinal emphasis on immersion results in prominent baptisteries located usually behind the chancel (*e.g.*, modern Baptist churches). (AN. G.)



G. E. KIDDER SMITH

EXTERIOR OF THE BAPTISTERY (1153–1278) AT PISA, ITALY; DESIGNED BY DIOTISALVI

BAPTISTS are members of a religious denomination that originated within English Puritanism in the 17th century as an offshoot of Congregationalism (*q.v.*). The name was derived from the denomination's insistence that baptism be administered only to adult believers. In the early 1960s there were more than 23,000,000 Baptists throughout the world, the vast majority concentrated in the United States where they constitute the largest Protestant community. There are 27 Baptist bodies in the United States with an inclusive total of slightly more than 20,500,000 members. Of these 90% are in-

cluded in four major conventions: the Southern Baptist convention with nearly 10,000,000 members; the National Baptist convention, U.S.A., Inc., with 5,000,000 members; the National Baptist Convention of America with over 2,500,000 members; and the American Baptist convention with over 1,500,000 members. The multiplicity of Baptist groups in the United States is accounted for by the 19th century controversy over slavery; by racial and nationality differences; and by divergence of opinion on questions of doctrine and organization.

Outside the United States, major Baptist communities are to be found in the British Isles (325,000 members), the U.S.S.R. (500,000), India (400,000), Burma (180,000), Congo (135,000), Brazil (134,000) and Canada (170,000).

HISTORY

Origins.—There were two major currents in early Baptist life: the Particular Baptists adhered to the doctrine of a particular atonement and were strongly Calvinist in orientation; the General Baptists held to the doctrine of a general atonement and represented the more moderate Calvinism of Jacobus Arminius (*see* ARMINIANISM).

The two currents also were distinguished by a difference in churchmanship, which was related to their respective points of origin. The General Baptists emerged from among the English Separatists, whereas the Particular Baptists had their roots in non-Separatist independency. Both the Separatists and the non-Separatists were congregationalist. They shared the same convictions with regard to the nature and government of the church. They believed that church life should be ordered according to the pattern of the New Testament churches, and to them this meant that churches should be self-governing bodies composed of believers only.

The point at which they differed was with regard to their attitude toward the Church of England. The Separatists took what is commonly described as a sectarian position; they contended that the Church of England was a false church and insisted that the break with it must be complete and uncompromising. The non-Separatists, more ecumenical in spirit, sought to maintain some bond of unity among Christians. While they believed that it was necessary to separate themselves from the corruption of parish churches, they also believed that it would be a breach of Christian charity to refuse all forms of intercourse and fellowship with them. While the parish churches were sufficiently disfigured, when viewed from the perspective of the New Testament model, to cause many of the non-Separatists to withdraw and to establish a purer worship of their own, the non-Separatists would not go so far as to assert that the parish churches were utterly devoid of the marks of a true church.

Most scholars find no evidence of decisive influence having been exerted upon the English Baptists by the continental Anabaptists, but they acknowledge that the General Baptist wing of the English Baptists exhibits Anabaptist influence at several minor points.

Growth in England and Abroad.—Although the Particular Baptists were to represent the major continuing Baptist tradition, the General Baptists were first in the field. In 1608 religious persecution had induced a group of Lincolnshire Separatists to seek asylum in Holland. One contingent settled in Amsterdam with John Smith (or Smyth), a Cambridge graduate, as minister; the other contingent moved on to Leyden under the leadership of John Robinson. The group at Amsterdam soon was debating the meaning of church membership, and the question of baptism arose. Smyth came to the conclusion that, if the Separatist contention that "the churches of the apostolic constitution consisted of saints only" was correct, baptism should be restricted to believers only. This, he contended, was the practice of the New Testament churches, for he could find no scriptural support for the baptizing of infants. Smyth published his views in *The Character of the Beast* (1609), and in the same year proceeded to translate them into action by baptizing first himself and then 36 others who joined him in forming a Baptist church. Shortly thereafter, Smyth became aware of the existence of a Mennonite (Anabaptist) community in Amsterdam, and he began to question his procedure in baptizing himself. Such an act could be justified, he concluded, only if no true church existed from which a valid baptism could be obtained. After some investigation, Smyth arrived at the conviction that the Mennonites did constitute a true church and he recommended union with them. This was resisted by Thomas Helwys and other members of the group, who returned to England in 1611 or 1612 and established a Baptist church in London. The parent group in Amsterdam soon disappeared.

The Particular Baptists stemmed from a non-Separatist church that was established in 1616 by Henry Jacob at Southwark across the Thames from London. In 1638 a number of its members withdrew under the leadership of John Spilsbury to form the first Particular Baptist church.

The two decades from 1640 to 1660 constituted the great period of early Baptist growth, for the Baptist preachers found their great opportunity to win adherents around the campfires of Oliver Cromwell's army. The greatest gains were made by the Particular Baptists, the General Baptists suffering numerous defections to the Quakers. After the Restoration of the Stuarts in 1660, both groups were subjected to severe disabilities, being forced to go underground until the Act of Toleration of 1689 granted them a measure of relief.

During the following decades, the vitality of the General Baptists was drained away by the inroads of skepticism, and their churches generally dwindled and died or became Unitarian. The Particular Baptists took an opposite course, retreating into a defensive, rigid hyper-Calvinism that prevented any effective evangelism. Among the Particular Baptists in England, renewal came as a result of the influence of the Evangelical Revival, the new surge of growth being initiated by the activity of Andrew Fuller, Robert Hall and William Carey. The latter formed the English Baptist Missionary society in 1792—the beginning of the modern foreign missionary movement in the English-speaking world—and became its first missionary to India. A New Connection General Baptist group, Wesleyan in theology, was formed in 1770; and a century later, in 1891, it united with the Particular Baptists to form the Baptist Union of Great Britain and Ireland.

By this time, Baptists, together with the other Nonconformist churches, were reaching the peak of their influence in Great Britain, numbering among their preachers several men, such as C. H. Spurgeon, Alexander Maclaren and John Clifford, with international reputations. Baptist influence was closely tied to the fortunes of the Liberal party, of which the Baptist David Lloyd George was a conspicuous leader. After World War I English Baptists began to decline both in influence and numbers.

Baptist churches were first established in Australia (1831) and New Zealand (1854) by missionaries of the English Baptist Missionary society. In Canada, Baptist beginnings date from the activity of Ebenezer Moulton, a Baptist immigrant from Massachusetts, who organized a church in Nova Scotia in 1763; Baptist work there was nurtured by the Philadelphia Baptist association as it was in the other 13 Atlantic seaboard colonies (*see* below). In Ontario, the earliest Baptist churches were formed by United Empire Loyalists who crossed the border following the American Revolution, while other churches were established by immigrant Baptists from Scotland and by missionaries from Vermont and New York. The Baptists of Canada are united in the Baptist Federation of Canada.

Development in the United States.—Baptist churches in the English colonies of North America were largely indigenous in origin, being the product of the leftward movement that was occurring among the colonial Puritans contemporaneously with that in England. While some migrated to the new world as Baptists, more typical was adoption of Baptist views after arrival in the colonies, as represented by Henry Dunster, the first president of Harvard, and Roger Williams.

Colonial Period.—The first Baptist church in the American colonies was established by Roger Williams (*q.v.*) at Providence in 1639, shortly after his banishment from the Massachusetts Bay colony. While Williams' general Calvinist theological position was roughly analogous to that of Spilsbury, prior to becoming a Baptist, he had adopted the narrower Separatist view of the

church. Williams soon came to the conclusion that all existing churches, including that newly established at Providence, lacked a proper foundation, and that this defect could be remedied only by a new apostolic dispensation in which new apostles, divinely commissioned, would appear to re-establish the true church.

The defection of Williams left the church with no strong leadership, and this made it possible for it to be reorganized on a General Baptist platform in 1652. There was scattered General Baptist activity throughout the colonies, but the only real cluster of General Baptists was in Rhode Island, where the churches formed themselves into an association or yearly meeting in 1670. The early General Baptists never gained great strength. Most of their churches decayed, and some, including the Providence church, were reorganized as Particular Baptist churches. The half-dozen churches that survived never entered the main stream of American Baptist life, and they exerted no real influence upon its development.

The earliest strong Particular Baptist centre in the colonies was at Newport, R.I., where, between 1641 and 1648, the church that had been gathered by John Clarke adopted Baptist views. Except for a church that had a brief existence at Kittery, Me., there were only two other Particular Baptist churches in New England for the better part of a century. One of these was at Swansea, Mass., where a church was formed by a group of Welsh immigrants under the leadership of John Myles; the other was organized at Boston in 1665. Another Particular Baptist church was established at Charleston, S.C., in 1683 or 1684.

The great centre of Particular Baptist activity in early America was in the Middle Colonies. In 1707 five churches in New Jersey, Pennsylvania and Delaware united to form the Philadelphia Baptist association, and through the association they embarked upon vigorous missionary activity. By 1760 the Philadelphia association embraced churches located in the present states of Connecticut, New York, New Jersey, Pennsylvania, Delaware, Virginia and West Virginia; and by 1767 further multiplication of churches had necessitated the formation of two subsidiary associations, the Warren in New England and the Ketochton in Virginia. The Philadelphia association also provided leadership in organizing the Charleston association in the Carolinas in 1751, and this in turn fostered the formation of the Kehukee association in North Carolina in 1765.

While this intercolonial Particular Baptist body provided leadership for the growth that characterized American Baptist life during the decades immediately preceding the American Revolution, that growth was largely a product of the Great Awakening. Baptists participated directly in the awakening only during its last phase in the south, but they attracted large numbers of recruits from among those who had been "awakened" by the preaching of others. In addition to strengthening and multiplying the "regular" Baptist churches, the awakening in New England produced a group of revivalistic Baptists, known as Separate Baptists, who soon coalesced with the older New England Baptist churches. In the south, however, they maintained a separate existence for a longer period of time. Shubael Stearns, a New England Separate Baptist, migrated to Sandy Creek, N.C. in 1755 and initiated a widespread revival that quickly penetrated the entire Piedmont region. The churches he organized were brought together in 1758 to form the Sandy Creek association. Doctrinally these churches did not differ from the older "regular" Baptist churches, but their emotional excesses and ecclesiastical irregularities created considerable tension with the older churches. By 1787, however, a reconciliation was effected.

In several of the colonies, Baptists laboured under legal disabilities of varying severity. The public whipping of Obadiah Holmes in 1651 for refusing to pay a fine imposed for holding an unlawful meeting in Lynn, Mass., caused John Clarke to write his *Ill News From New England* (1652). Fourteen years later Baptists of Boston were fined, imprisoned and denied the use of a meetinghouse they had erected. Payment of taxes for support of the established church was a cause of continuing controversy in New England, while the necessity to secure licences to preach became an inflammatory issue in Virginia.

19th Century.—The problem of travel had made it difficult for the Philadelphia association to serve as a bond uniting Baptists, and the rapid multiplication of churches made it impossible. It has been estimated that immediately before the American Revolution there were 494 Baptists congregations; 20 years later, in 1795, Isaac Backus estimated the number at 1,152. The initial expedient of the Philadelphia association had been to organize subsidiary associations, but during the war the churches, left to their own devices, proceeded to organize independent associations. By 1800 there were at least 48 local associations, and the great problem was to fashion a national body to unite the churches. The final impetus in this direction came from an interest in foreign missions. Adoniram Judson and Luther Rice had been sent to India as the first missionaries of the newly organized Congregational mission board. On shipboard they became convinced by a study of the Scriptures that only believers should be baptized. Upon arrival at Calcutta, Judson went on to Burma while Rice returned home to enlist support for him among American Baptists. As a result of Rice's efforts, a General Convention of the Baptist denomination was formed in 1814. Its scope was almost immediately broadened to include, in addition to the foreign mission interest, a concern for home missions, education and the publication of religious periodicals. In 1826 the General convention once again was restricted to foreign mission activities, and in the course of time it became known as the American Baptist Foreign Mission society. Other denominational interests were served by the formation of additional societies with similar specialized concerns, such as the American Baptist Home Mission society and the American Baptist Publication society.

The unity that was achieved through these societies was partially disrupted as a result of the slavery controversy. During the decade prior to 1845 various compromises between the proslavery and antislavery parties in the denomination were attempted, but they proved to be unsatisfactory. As a result the Southern Baptist convention was organized at Augusta, Ga., in 1845. Although its constitution provided for boards of home and foreign missions, education and publication, its energies were devoted largely to foreign missions. Consequently the American Baptist Home Mission society and the American Baptist Publication society continued to operate in the south after the Civil War and enjoyed a large measure of support from the churches. Toward the close of the 19th century, however, the Southern Baptist convention began to develop its own home mission and publication work and to protest the intrusion of the older societies in the south. The final separation between Baptists of south and north was formalized in 1907 by the organization of the Northern Baptist convention (after 1950, called the American Baptist convention), which brought together the older societies and accepted a regional allocation of territory between the northern and southern conventions.

Negro Churches.—Negro churches constitute an important segment of American Baptist life. Following the Emancipation Proclamation and the close of the Civil War, Negro Baptists began to organize their own churches. A state convention of Negro Baptist churches was formed in 1866 in North Carolina, and in 1880 the National Baptist Convention of America was organized. A dispute over the control of property and publications led to a division in 1916. The smaller of the two factions retained the original name, while the larger body adopted the name the National Baptist Convention, U.S.A., Inc.

Education.—From the beginning, American Baptists displayed an interest in an educated ministry, and their interest in higher education increased steadily as they grew in numbers. The Philadelphia association in the 18th century collected funds to help finance the education of ministerial candidates. Hopewell academy was established in 1756, and in 1765 Brown university was founded midway between Nova Scotia and Georgia, in Rhode Island. Eight other institutions were established before 1825; 25 more were established between 1825 and 1850, 39 between 1851 and 1875, and 70 between 1876 and 1900. The educational advance culminated in 1891 in the founding of The University of Chicago, which was intended to be a great national Baptist super-

university that would tie together the smaller Baptist colleges.

In the north, regional education societies were the usual channels through which support was given to education, while in the south the institutions more often were sponsored directly by state conventions or the Southern Baptist convention. After the Civil War, the American Baptist Home Mission society established a number of Negro Baptist colleges in the south, which came to be administered by Negro boards of trustees with the co-operation of the American Baptist Home Mission society and the board of education and publication of the American Baptist convention.

20th Century.—After 1900 Baptists were troubled by theological controversy that led to the formation of several new Baptist groups. Some of the tensions arose over questions of polity; some arose over refusals to adopt an authoritative creedal statement; some were the product of dissatisfaction with the affiliation of the American Baptist convention with interdenominational and ecumenical bodies. Questions of polity were involved in the formation of the American Baptist association in 1905 by churches located primarily in Oklahoma, Texas and Arkansas. Two other groups were products of the "fundamentalist" controversy: the General Association of Regular Baptist Churches, organized in 1932; and the Conservative Baptist association (1947).

A phenomenon of the post-World War II period was the abandonment by the Southern Baptist convention of its regional limitations. Because of increasing mobility of population, the Southern Baptist convention felt it necessary to follow its members to the growing urban centres of the north and west; by the second half of the century Southern Baptist churches were to be found in almost every part of the United States.

Growth Outside the U.S.—While Baptists have been troubled by divisive tendencies during the 20th century, a parallel tendency has been toward greater unity and cohesiveness through the Baptist World alliance. The 19th century was the great period of Baptist missionary endeavour. Penetration of Asia was led by William Carey in India, Adoniram Judson in Burma and Timothy Richard in China, and by the late 1950s there was a Baptist community of about 750,000 adherents in 17 Asian countries. The first Baptist activity in Africa was initiated in 1819 by Negro Baptists of Richmond, Va., and the total communicant membership in the late 1950s was 300,000. Of later origin is the Baptist community of 275,000 in Latin America.

The pioneer Baptist on the continent of Europe was John Gerhardt Oncken, who organized a church at Hamburg in 1834. Oncken had become acquainted with Barnas Sears of Colgate Theological seminary, who was studying in Germany, and with six others he was baptized by Sears. From this centre evangelistic activity was extended throughout Germany and missions were established in Austria, Hungary, Rumania, Bulgaria, Switzerland, Belgium, Holland, Denmark, Poland and Russia. Baptist activity was initiated independently in France, Italy and Spain. Swedish Baptist beginnings date from the conversion of Gustaf W. Schroeder, a sailor baptized in New York in 1844, and Frederick O. Nilsson, also a sailor, who was baptized by Oncken in 1847. From Sweden Baptists penetrated Norway and Finland. Excluding the British Isles, there were over 800,000 European Baptists in 1958.

It was this expansion of the Baptist community in Asia, Africa, Latin America and Europe that led to the formation of the Baptist World alliance at London in 1905. The purpose of the alliance is to provide mutual encouragement, exchange of information, coordination of activities and consciousness of the larger Baptist fellowship. Periodic world congresses are held, and a headquarters secretariat is maintained in Washington and London.

The most notable growth occurred in Russia, where a Russian Baptist union was formed in 1884 as a result of influences stemming from Oncken. Another Baptist body, the Union of Evangelical Christians, was organized in 1908 by a Russian who had come under the influence of English Baptists. Persecution of Baptists, which had been severe, was relaxed in 1905, and within the remaining disabilities a moderate growth occurred. The Revolution of 1917, with its proclamation of liberty of conscience, ushered in a period of astonishing advance: by 1927 the Russian Baptist union numbered some 500,000 adherents, while the Union of Evangelical Christians embraced more than 4,000,000. The Soviet constitution of 1929 subjected them to pressure once again, however, and in 1958 the two groups, which had combined in 1944 to form the All-Union Council of Evangelical Christians-Baptists, reported 518,973 baptized believers.

POLITY, WORSHIP AND DOCTRINE

Polity.—Baptists insist that the fundamental authority, under Christ, in church life is vested in the local congregation of believers, which admits and excludes members, calls and ordains pastors and orders its common life in accord with what it understands to be the mind of Christ. These congregations, which are manifestations of the whole Church of Christ, are linked together in co-operative bodies to which they send their delegates or messengers—regional associations, state conventions and national conventions. These larger bodies, it is insisted, have no control or authority over a local church; they exist to implement the common concerns—missionary, educational, philanthropic—of the local churches.

The pattern of organization of the local church has been undergoing change during the 20th century. Traditionally the pastor was the leader and moderator of the congregation; more recently there has been a tendency to regard him as the employed agent of the congregation and to elect a lay moderator to act in his stead at corporate meetings of the church. Traditionally the deacon's functions were to assist the pastor and to serve as agents to execute the will of the congregation in matters both temporal and spiritual; more recently there has been a tendency to multiply the number of church officers by the creation of boards of trustees, boards of education, boards of missions and boards of evangelism. Traditionally decisions were made by the congregation in a church meeting; more recently church meetings have become less and less frequent and there has been a tendency to delegate decision-making to various boards. The relationship of local churches to the co-operative bodies has been undergoing similar change, and this has occasioned continuing discussion among all Baptist groups.

Worship.—Baptist worship is hardly distinguishable from the worship of the old Puritan denominations of England and the United States. It centres largely around the exposition of the Scriptures in the sermon, and the emphasis is upon extemporaneous rather than set prayers. Apart from the centrality of the sermon, hymn singing is one of the most characteristic features of worship. Communion, received in the pews, is customarily a monthly observance. Baptism is by immersion.

Doctrine.—Initially Baptists were characterized theologically by strong to moderate Calvinism. The dominant continuing tradition in both England and the United States was Particular Baptist, whose confessions of faith—the London (1688) and the Philadelphia (1742)—were slightly altered transcriptions of the *Westminster Confession of Faith* (1648), with a hyper-Calvinist triple covenant being substituted for the double covenant of the Westminster confession. By 1800 this older tradition was beginning to be replaced by the evangelical doctrines fashioned by the leaders of the evangelical revival in England and the Great Awakening in America and further elaborated by subsequent New England divines and frontier revivalists. By 1900 the older Calvinism had almost completely disappeared, and Evangelicalism was dominant. The irenic tendency of Evangelicalism and its almost complete preoccupation with heart-religion and the conversion experience largely denuded it of any solid theological structure, however, and this opened the door to a new theological current, which in its later phases became known as Modernism. Modernism, which was an attempt to adjust the Christian faith to the new intellectual climate, made large inroads among the Baptists of England and the United States during the first two decades of the 20th century, and Baptists provided many outstanding leaders of the movement. William Newton Clarke, Shailer Mathews, George Burman Foster and Harry Emerson Fosdick were among conspicuous exponents of the new views. To many these views seemed to pose a threat to the uniqueness of the Christian revelation, and they precipitated a counterreaction that became known as Fundamentalism (*q.v.*).

As a result of the controversy that followed, many Baptists

developed a distaste for theology and became content to find their unity as Baptists in promoting denominational enterprises. By 1950 both Modernists and Fundamentalists were becoming disenchanted with the positions into which they had been forced in the heat of controversy, and it was from among adherents of both camps that a more creative theological encounter began to take place. While the majority of Baptists remained nontheological in their interests and concerns, there were multiplying signs that Baptist leadership was increasingly recognizing the necessity for renewed theological inquiry.

Distinctive Aspects.—The unity and coherence of the Baptists is to be found in six distinguishing, although not necessarily distinctive, convictions they hold in common.

1. The supreme authority of the Bible in all matters of faith and practice. Baptists are a noncreedal people, and their ultimate appeal always has been to the Scriptures rather than to any confession of faith which they may have published from time to time to make known their commonly accepted views.

2. Believer's baptism. This is the most conspicuous conviction of Baptists. They hold that if baptism is the badge or mark of a Christian and if a Christian is one in whom faith has been awakened, then baptism rightly administered must be a baptism of believers only. Furthermore, if the Christian life is a sharing in the life, death and resurrection of Christ, if it involves a dying to the old life and a rising in newness of life, then the act of baptism must speak in these terms. The sign must be consonant with that which it signifies. It is for this latter reason that Baptists were led to insist upon immersion as the apostolic form of the rite, in addition to their initial insistence upon the baptism of believers only.

3. Churches composed of believers only. Baptists reject the idea of a territorial or parish church and insist that a church is composed only of those who have been gathered by Christ and who have placed their trust in him. Thus the membership of a church is restricted to those who—in terms of a charitable judgment—give clear evidence of their Christian faith and experience. The basis of their church life is a church covenant wherein they covenant with God and one another to walk together in Christian obedience.

4. Equality of all Christians in the life of the church. By the doctrine of the priesthood of all believers, Baptists not only understand that the individual Christian may serve as a minister to his fellows, but they believe that it also confers upon each member of a church equal rights and privileges in determination of the affairs of the church. The church officers—pastor and deacons—have special responsibilities, derived from the consent of the church, which only they can discharge, but they do not have unique sacerdotal status.

5. Independence of the local church. By this principle Baptists affirm that a properly constituted congregation is fully equipped to minister Christ and need not derive its authority from any source, other than Christ, outside its own life. Baptists, however, have not generally understood that a local church is autonomous in the sense that it is isolated and detached from other churches. The local church is but one manifestation of the Catholic Church, and as individual Christians are bound to pray for one another and to maintain communion with one another, so particular churches are under like obligation. Thus the individual churches testify to their unity in Christ by forming associations and conventions through which they can seek counsel and advice and cooperate in common concerns.

6. Separation of church and state. From the time of Smyth, Baptists have insisted that a church must be free to be Christ's church, determining its own life and charting its own course in obedience to Christ without outside interference. It was for this reason that Smyth asserted that the "magistrate is not by virtue of his office to meddle with religion or matters of conscience, to force and compel men to this or that form of religion or doctrine, but to leave Christian religion free to every man's conscience." Baptists were in the forefront of the struggle for religious freedom in both England and America; they cherish the liberty that was established in early Rhode Island; and they played an important role in securing the adoption of the "no religious test" clause in the federal constitution as well as the guarantees embodied in the first amendment.

Few Baptists have been willing to become sectarian by denying the Christian name to other denominations. With the exception of the Southern Baptists, the vast majority of Baptists co-operate fully in interdenominational and ecumenical bodies, including the World Council of Churches.

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BA'QUBAH, a market town and capital of the Diyala *liwa* (province), Iraq, lies near the left bank of the Diyala river 34 mi. N.N.E. of Baghdad. Pop. (1957) 18,547. Its chief importance arises from control of rail and road crossings of the Diyala by main direct routes between Baghdad and central Iran. It also has some importance as a market for the agricultural produce of an extensive irrigated area, grain, dates, oranges and vegetables being the chief items of trade. It has frequently been occupied in the past by the Persians, and received large numbers of Assyrian refugees during World War I. (W. B. Fr.)

BAR, COUNTS AND DUKES OF, the holders of extensive domains on the old frontier between Champagne and Lorraine, the nucleus of which was the town eventually known as Bar-le-Duc (*q.v.*) in the modern French *département* of Meuse. In A.D. 951 the emperor Otto I gave the countship of the Barrois (*i.e.*, the district of Bar), then a fief of the duchy of Lorraine (*q.v.*), to Frederick of Ardenne, who in 959 was made duke of Upper Lorraine. In 1033, on the death of Duke Frederick II, it passed to his younger daughter Sophia, who married Louis, count of Mousson, Ferrette and Montbéliard. On the death of their son Thierry (Dietrich) II, his estates were divided between his sons, and the third, Renaud (Raynald), received the Barrois and founded the house of Bar. The counts of Bar increased their demesne and soon became the most powerful vassals of the dukes of Lorraine, with whom they carried on endless struggles. They usually fought in the French ranks, while the dukes adhered to the German. Henry II was an ally of Philip Augustus and distinguished himself at the battle of Bouvines. The annexation of Champagne to France, however, made them neighbours of the French king, with whom Thibaut II got into difficulties. His son Henry III made an alliance against France with Edward I of England and the German king Adolf of Nassau, but, abandoned by his allies, was defeated at Louppy-le-Château (1296) and, under the treaty of Bruges (1301), did homage to Philip IV for that part of the Barrois west of the Meuse which was claimed as being in the *mouvance* or feudal dependency of France and which from then on was called the Barrois mouvant. In 1354 Robert of Bar, who had married the daughter of John II of France, was made marquis of Pont-à-Mousson by the emperor Charles IV and took the title of duke of Bar. In the 14th century the Barrois fell under French influence. Edward III of Bar was killed, with his brother and his nephew, at Agincourt in 1415 and so was succeeded as duke by his other brother, Louis, bishop of Châlons and a cardinal. Louis in 1419 chose as his heir René (*q.v.*) of Anjou, his sister Yolande's grandson, who in 1420 married Isabella, daughter and heiress of Charles II, duke of Lorraine, so that on Charles's death in 1431 the Barrois and Lorraine were united. Though he gave up the duchy of Lorraine to his son John of Calabria in 1453, René retained the Barrois till his death in 1480. By his will (1474) he had left it to his grandson René II, duke of Lorraine since 1473. Meanwhile, Louis XI of France had ordered the occupation of the Barrois mouvant, but after Louis XI's death it was recovered by René. From then on, the Barrois shared the fate of Lorraine, being annexed to the French crown on the death of Stanislaw Leszczynski (the former king of Poland, to whom it had been granted in 1738) in 1766.

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BAR, FRANÇOIS DE (1538–1606), French scholar, born at Jézencourt, near St. Quentin, became prior of the Benedictine abbey of Anchin, near Pecquencourt, on March 22, 1576. He spent much of his time in the valuable library of the abbey studying and compiling ecclesiastical law, and also wrote treatises on geography, cosmography and canon law. Bar made a catalogue of the manuscripts at Anchin and annotated many of them. He died at Anchin on March 25, 1606. During the French Revolution his manuscripts were removed to the library at Douai.

BAR, in physical geography, a ridge of sand or silt deposited on the bed of a stream, sea or lake. When a river enters a tidal sea its rate of flow is reduced, and the material it carries in suspension is deposited in a shifting bar lying athwart the channel. Where the channel is only partly closed and the bar is attached to the land on one side, the feature is called a spit. A bar may also be produced by tidal action alone in an estuary or narrow gulf (as at Port Adelaide) where the tides sweep the loose sand backward and forward, depositing it where the motion of the water is checked. In lakes and other bodies of water bars are produced where the rate of flow of shore currents carrying material in suspension is reduced. *See* also WAVES AND SHORE CURRENTS.

BAR, CONFEDERATION OF, a league of the Polish nobles and gentry formed at the little fortress of Bar in Podolia in 1768 to defend by insurrection the privileges of the Catholic Church and the independence of Poland against the encroachments which the Russian government was making through its ambassador in Warsaw, Prince Nikolai Vasilievich Repnin (*q.v.*). The originators of this confederation were Adam Krasinski, bishop of Kamieniec, Jozef Pulaski and Michal Krasinski. The king of Poland, Stanislaw II Poniatowski, was at first inclined to mediate between the confederates and Russia. Finding this impossible he sent a force against them under Gen. Ksawery Branicki, who captured Bar. The simultaneous outbreak of a *jacquerie* in the Ukraine checked the extension of the confederation throughout the southeastern provinces of Poland. The confederates thereupon appealed for foreign help and contributed to bringing about the Russo-Turkish War of 1768–74. So serious indeed was the situation that Frederick II of Prussia advised the Russian empress Catherine to come to terms with the confederates.

The confederates' troops under Ignacy Malczewski, Prince Karol Radziwill and, most important, Kazimierz Pulaski (*q.v.*), who later distinguished himself in the American War of Independence, ravaged the land in every direction, engaged in several battles and at last, utterly ignoring the king, sent envoys on their own account to the principal European powers.

In 1770 the council of the confederation was transferred from its seat at Teschen (Cieszyn), in Austrian Silesia, to Presov in Slovakia whence it conducted diplomatic negotiations with France, Austria and Turkey with the view of forming a league against Russia. The French court sent C. F. Dumouriez to act as military instructor of the confederates. It was he who induced them to proclaim, on Oct. 22, 1770, the deposition of King Stanislaw II as tyrant and traitor—at the very moment when he was about to accede to the confederation. The king thereupon reverted to the Russian faction and the confederation lost the confidence of Europe. Nevertheless, its army, thoroughly reorganized by Dumouriez, gallantly maintained the hopeless struggle for several years, and it was not until 1772 that the last traces of it disappeared.

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BAR, THE: *see* LEGAL PROFESSION.

BARABANKI, a town and district in the Fyzabad division of Uttar Pradesh, India. The town, 17 mi. E.N.E. of Lucknow, is contiguous with Nawabganj, with which it forms the municipality of Barabanki (Nawabganj). Pop. (1951) town 28,958. The district courts and "civil lines" (administrative quarter) are in Barabanki, the main market and educational institutions in Nawabganj. The town is on the hard-surfaced road from Lucknow to Fyzabad, and on the Fyzabad loop of the Northern railway. It is also an important junction for the Northeastern railway metre-gauge system serving the districts along the Nepal frontier. Barabanki is a major centre of the handloom industry and trades in sugar and cotton. About one-fifth of the town's population depends on agriculture for a living.

BARABANKI DISTRICT (1,714 sq.mi.: pop. [1961] 1,411,883) is a level plain lying mainly between the Gumti and Gogra rivers, dotted with *jhils* (marshy lakes). The higher ground to the west has sandy soil, while the lower areas are clayey and produce cereals, mainly rice, wheat and gram. Some areas become waterlogged in years of heavy rainfall. Only about 6% of the district's population is urban and 82% of the people depend on farming or farm labour for a livelihood.

At Deva, an ancient village 7 mi. N. of Barabanki lived one of the greatest Muslim Sufi or mystic saints, Haji Hafiz Sayyed Shah Warris Ali (1819–1905), whose mausoleum is a place of pilgrimage for people of different religions and faiths. A large annual fair is held there. Another important fair is held at Bansda in honour of Abd ur-Razzaq, the 14th-century Persian Sufi. (B. St.)

BARABRA (literally "Berbers"), a name applied in a restricted sense by the Egyptians to the inhabitants of lower Nubia (*q.v.*) from Aswan south to Argo Island. It includes the Kenuz, Sukkot and Mahas and sometimes the Danagla farther south. Apart from the Kenuz, whose Arab ancestors occupied the First Cataract in the 11th–12th centuries A.D., the basic stock is proto-Egyptian, reinforced by Libyan immigration from the west and diluted with Negro blood from the south. Since the fall of the Christian town of Dongola in the 14th century, the Barabra have been Muslims and increasingly Arabicized. They vary in colour from the fair-skinned Kenuz to black but generally preserve the bronze skin, oval face, regular features and slim build of their Hamitic ancestry, together with their Nubian dialects. The women know little Arabic. Like the Ga'alin (*q.v.*), the Barabra use razor cuts on cheek or temple to indicate tribal or religious affinity.

The Barabra supplied Egypt with its 25th dynasty and later colonized Kordofan and Jebel Meidob, following the Wadi al Melik south from the Nile bend. (According to Meidob tradition a large party went on to settle west of Chad.) Their learned families provided the Fung sultans with many famous religious leaders. In the 18th century the raids of the neighbouring Shaikia led to further emigration by Barabra and Danagla to settle as traders and teachers in the market centres of Kordofan, Darfur and Wadai. After the Egyptian conquest of 1821–22 the Danagla rivaled the Ga'alin as slave traders, penetrating far into the south, where their descendants remain as traders, the Gellaba of modern terminology. In the 20th century they have provided Egypt and the Levant with "Berberine" servants, whose remittances enable the villages of Nubia to cling precariously to the rocks above their drowned date gardens and wheat fields and the ever encroaching waters of the Aswan dams. Enterprise in individual emigration is accompanied by a deep attachment to the ancestral home and reluctance to move to other areas.

See also ARAB. (K. D. D. H.)

BARACALDO, a city in northeastern Spain, in the province of Biscay, on the navigable estuary of Bilbao, 8 km. (5 mi.) N.W. of that city and linked to it by the Bilbao-Portugalete railway. Pop. (1950) 41,163 (mun.); area 47 sq.km. (18 sq.mi.). Following the establishment in Baracaldo of Altos Hornos and a complex of heavy industries, it provided one of the clearest examples of the modification of a rural community into an industrial concentration. From a town which in 1900 had only 15,000 inhabitants, it became a large urban concentration. Its growth was matched by the provision of housing and public services, its houses, parks and plazas making Baracaldo a model town. Its main rivers are the Cadagua and the Galindo. It has an important iron-mining area, the ore being exported from Luchana. (M. B. F.)

BARAHONA, a province in southwestern Dominican Republic with an area of 976 sq.mi. Pop. (1960) 79,880. It consists of the high Sierra de Bahoruco, a broad peninsula jutting into

the Caribbean south of the range, and a broad coastal lowland north of the range. The main crops are sugar cane in the alluvial lowland irrigated by the Río Yaque del Sur and coffee in the mountains. A huge deposit of rock salt and gypsum is worked in the arid lowland. Coastal forests provide mahogany and other fine hardwoods. Barahona was established in 1888 as a maritime district and was separated from Bahoruco province in 1943. The capital, also named Barahona (pop. [1960] 20,398), is an important port. (D. R. D.)

BARAHONA DE SOTO, LUIS (*c.* 1548–1595), Spanish poet, whose best-known work is the *Primera parte de la Angélica* (1586; facsimile, 1904), a continuation of the Angelica and Medoro episode in Ariosto's *Orlando furioso,* was born at Lucena, Córdoba, and studied at Antequera under the humanist Juan de Vilches, later practising medicine in Madrid and the principal towns of Andalusia, where he moved in humanistic and literary circles. His friendship with the "divine" Fernando de Herrera survived his parodying of the irascible older man in a sonnet entirely made up of resounding Herreran neologisms. Barahona himself is a poet of understatement, and in his cool and unemphatic style appears as a precursor of the younger generation of eastern Andalusian poets represented in the *Flores* of Pedro Espinosa and Agustín Calderón and the *Cancionero antequerano* of Toledo y Godoy. Barahona has also been shown to be the author of an anonymous treatise on hunting, the *Diálogos de la montería* (ed. by F. R. de Uhagón, 1890), which contains numerous quotations from the *Angélica,* including fragments of a lost second part. (F. S. R.)

BARAMULLA, a town and district in Jammu and Kashmir state, India, lies 31 mi. W. of Srinagar. Population of the town (1951 est.) 15,184; of the district (1961) 602,273. The town is on the left bank of the Jhelum river, at the point where it leaves the broad Kashmir valley and enters the gorge through the Pir Panjal range. It is a holiday resort and houseboats may be hired for trips on the river and Wular lake. The economy and geography of the district are essentially parts of those of the vale of Kashmir (*q.v.*). At Patan, 16 mi. S.E., are two temples of the 9th century, and 21 mi. S.E. at Parihasapura are Buddhist remains of the 8th century. (S. Gl.)

BARANTE, AMABLE GUILLAUME PROSPER BRUGIÈRE, Baron de (1782–1866), French historian and statesman, a member of the Académie Française and a representative of liberal tendencies in the period under the Restoration. He was born at Riom, Auvergne, on June 10, 1782. At 16 he entered the École Polytechnique in Paris and at 20 formed an attachment in Geneva with Mme. de Staël, to whom he proposed marriage. This was, however, to be complicated by his later platonic attachment to Mme. Récamier. Between 1806 and 1815 Barante was auditor to the council of state, prefect of the Vendée and, under Napoleon, prefect of the Loire *Inférieure.* An ardent royalist, he nevertheless upheld liberal tendencies and when, in 1819, he was created a peer he used his rank to promote liberal reforms. Removed from the council of state by the duc de Richelieu, he was offered, after the Revolution of 1830, the post of ambassador at Turin and, in 1835, ambassador at St. Petersburg. Throughout the reign of Louis Philippe he remained a supporter of the government, and after the fall of the monarchy, in 1848, he withdrew from political affairs. He died at Le Dorat (Puy-de-Dôme), Nov. 21, 1866.

Barante's historical writings include the *Histoire des ducs de Bourgogne* (1824–28) and biographies of Joan of Arc, Mathieu Molé and Royer-Collard. His political tracts deal with contemporary views on aristocracy and social organization.

See C. de Barante (ed.), *Souvenirs du baron de Barante* (1890–1901).

BÁRÁNY, ROBERT (1876–1936), Austro-Swedish physician of Hungarian descent, who won the Nobel prize in 1914 for his work on the physiology and pathology of the balancing apparatus of the internal ear, was born in Vienna on April 22, 1876. He studied medicine in his native town. Early in the 1900s he became assistant at the ear clinic of Vienna university, which was conducted by Adam Politzer. In 1909 he was made lecturer on otological medicine. In the same year he found a new method of examining the interrelationship of the vestibular apparatus, the brain and the spinal marrow, a method known as the indication test. From 1917 until his death, April 8, 1936, he was professor at Uppsala university and head of the ear, nose and throat clinic. Bárány published numerous treatises. His works include *Physiologie und Pathologie des Bogengang-Apparats beim Menschen* (1907). (F. L. A.)

BARAT, SAINT MADELEINE SOPHIE (1779–1865), French nun, foundress of the Society of the Sacred Heart, was born at Joigny, Burgundy, Dec. 12, 1779, of peasant stock. She received from her brother Louis an exceptional education fitting her for her lifework. After the reign of terror she went to live in Paris with Louis, who had joined the Fathers of the Faith. His superior, Joseph Varin, was looking for a young woman to head an educational order dedicated to the Sacred Heart of Jesus, and in the shy, gifted Madeleine Sophie he found her.

With three companions she made her first consecration on Nov. 21, 1800; in 1801 the first Convent of the Sacred Heart was opened at Amiens, Mother Barat becoming superior in 1802. In 1804 she journeyed to Grenoble to found her second convent and receive into the order Rose Philippine Duchesne (*q.v.*), its first missionary. In 1806 Mother Barat was elected superior general for life, and in 1815 the constitutions and rules of the order, drafted with Varin's help, were adopted. The Society of the Sacred Heart received ecclesiastical approval in 1826.

With clear educational objectives and constantly improved methods, the order spread during the lifetime of the foundress from France to 11 countries of Europe, Algeria and North and South America. Under Mother Barat's guidance remarkable union and uniformity were established. She died in Paris on May 25, 1865, and her body is enshrined at Jette-Saint-Pierre, Belgium. In 1908 Madeleine Sophie Barat was declared blessed, and in 1925 she was canonized. Her feast day is May 25.

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BARATYNSKI, EVGENI ABRAMOVICH (1800–1844), foremost Russian philosophical poet contemporary with Aleksandr Pushkin (*q.v.*), was born at Vyazhli (Tambov), of noble parentage, March 3 (new style; Feb. 19, old style), 1800. Expelled from the imperial corps of pages, he entered the army (1819), was commissioned (1825) and retired (1825). He married and settled in Muranovo, near Moscow. His early romantic lyrics are strongly personal, sometimes epicurean, sometimes elegiac. His narrative poems *Eda* (1826), *Bal* (1828; "The Ball") and *Nalozhnitsa* (1831, "The Concubine," rewritten as *Tsyganka,* "The Gipsy Girl," 1842) treat the emotions analytically. He published three other books of verse (1827, 1835, 1842). Tragic pessimism predominates in his later poetry, mainly on philosophical and aesthetic themes. Modern critics value his thought more highly than his contemporaries. He died in Naples, July 11 (N.S.; June 29, O.S.), 1844.

See his complete works, ed. by M. L. Hoffman, 2 vol. (1914–15) and collected poems, 2 vol., in "Biblioteka poeta" (1936, 1957). (E. Hl.)

BARBADOS (formerly often Barbadoes), a British island colony, one of the West Indies group, is located about 100 mi. E. of St. Vincent. It is 21 mi. long, 14 mi. at its broadest and 166 sq.mi. in extent (somewhat larger than the Isle of Wight). Its coasts are almost encircled with coral reefs, which extend in some places more than 2½ mi. seaward. The capital and only port of entry is Bridgetown (*q.v.*). From fine sandy beaches and coastal strips or small plains the ground rises in a series of terraces to Mt. Hillaby, 1,105 ft., in the north-central part of the island. Nearby is the Scotland district which, with its steep slopes and jagged scenery, looks like the crater of an extinct volcano, though it is not one. Geologically, a basement of much folded sandstones and shales (the Scotland series) is covered unconformably by chalklike rocks of the Oceanic series. Except in the Scotland district, both series are covered unconformably with a layer of limestone, of thicknesses up to 240–250 ft. Streams are few and insignificant.

Climate.—The climate of Barbados is generally pleasant. The temperature rarely rises above 86° or falls below 65° F. In the

dry season (roughly, from December to May) the heat of the sun is tempered by the easterly trade winds and, because of the ocean breezes, it is only occasionally that the weather during the remaining months becomes disagreeably hot or humid. The average rainfall varies markedly from district to district within a range of approximately 75 in. to 50 in. The island is free from malaria. Barbados lies on the southern border of the West Indian hurricane zone. The hurricanes of 1780 and 1831 caused great devastation and others of lesser intensity have visited the island, one in 1955 after an interval of 57 years.

Vegetation and Animal Life.—Only about 40 ac. of the forest or scrub that once covered the island still remain. Palm trees of different kinds, mahogany, breadfruit, tamarind, casuarina and other trees, including the magnificent flamboyant or poinciana (*Delonix regia*) and the frangipani, are found in many places. Flowering shrubs adorn parks and private gardens; but the characteristic landscape of inland Barbados is one of wide undulations pervaded with the pale green of sugar cane.

There are very few wild animals. Some monkeys live in the wooded area and give pleasure to visitors but annoy local cultivators. The mongoose, introduced to destroy rats, has become something of a pest. There are some hares and—Barbadians insist—a few raccoons. The few species of resident birds include two kinds of hummingbird, two kinds of dove, and the ubiquitous "Barbados sparrow"—a relative of the English sparrow. A night-long piping or whistling comes not from a bird but from a diminutive tree frog. Fish caught in local waters include flying fish, grouper, kingfish, snapper and bonito.

Population.—The population at the census of 1960 was 232,085. This represents a density of almost 1,400 persons per square mile—one of the highest in the world for such a community. The 1946 census gave the racial divisions as: African descent, 77.3%; mixed descent, 17.5%; European descent, 5.1%. The people are Christian (mostly Anglican) and the language spoken is English.

No legal distinction is made between the races, either in theory or in practice; but there is truth in the charge often brought by the other West Indian colonies that colour discrimination exists in social life to a degree that has become outmoded elsewhere. Even in this most conservative of colonies, however, changes in basic attitudes have taken place. Moreover, an intense local patriotism is characteristic of all Barbadians; white and nonwhite are equally ready to declare that if anything could conceivably be wrong in their island they themselves would be capable of putting it right in their own time and in their own way.

Administration.—The legislature consists of two bodies: the house of assembly, which celebrated its tercentenary in 1939, contains 24 members who are elected under full adult suffrage for a period of five years; and a legislative council with 15 appointed members. The crown has only a veto on legislation. Barbados retains a governor. The position of the executive bodies and their relationship with the legislature is complicated, since historical survivals have been more or less fitted into a modern framework. The practical effect has been that Barbados has enjoyed self-government in internal affairs. Elementary education is free but not compulsory. Harrison college (boys) and Queen's college (girls) are state aided secondary schools known throughout the West Indies; Codrington college, on the windward coast, was founded in 1710. After undergoing various changes in its functions, it is today a priory and seminary of the Community of the Resurrection (the "Mirfield Fathers").

The only town besides Bridgetown is Speightstown (pronounced "Spikestown") which once carried on a flourishing trade with Bristol. Barbados has produced many fine cricketers.

History.—Much about the early history of Barbados is obscure—including the origin of its name, which may come from a Spanish word meaning "bearded fig trees." Remains show that the island once supported a considerable population of Arawak Indians; and it is probable that it was visited by raiding or hunting parties of the savage Caribs, who, like the Arawaks, came to the Antilles from South America. Columbus failed to sight the island, but there is evidence that Spaniards had landed there by 1518 and had taken Indians from it for slaves in their colony of Hispaniola. By 1536, apparently, no Indians remained.

There is uncertainty about the beginnings of the English connection and the story of the landing from the ship "Olive Blossom" in 1605 is almost certainly a myth. Whatever the precise details, Barbados, uniquely in the West Indies, has not changed hands since the original British settlement. Simon Gordon claimed to be the first Englishman to set foot on the island, which was then presumably without inhabitants. He may have been in a ship under the command of Sir Thomas Warner that called there some time between 1620 and 1624. In 1624 or early 1625 John Powell landed a party, who set up a cross and inscribed on a tree: "James K. of E. and of this Island." In 1627 Capt. Henry Powell, John's younger brother, landed a party of settlers near the same spot. This expedition had been fitted out by Sir William Courteen, a protégé of the duke of Marlborough, to whom James I had granted the island. In 1627 a new patent was granted by Charles I to Lord Carlisle. Proprietary rule ended in 1652 when Barbados, which was being governed by Lord Willoughby of Parham in the name of the king, surrendered to a force dispatched by the Commonwealth. The instrument of surrender provided that the government of the island should be vested in the governor, council and assembly, according to ancient and usual custom, and established the principle that there should be no taxation without consent. After the Restoration the claims of the Carlisle patent and others were revived, and an agreement was eventually reached under which the patent was surrendered to the crown for compensation in the form of a 4½% duty on exports, which until 1838 remained a constant grievance to the colony. The abolition of slavery in 1834, and the complete freeing of slaves in 1838, shook but did not destroy the island economy which has shown a remarkable power of survival.

Some rioting took place in 1876 as a result of an attempt to bring about a federation of Barbados and four other islands. Rioting next occurred in 1937 when, primarily as a result of the world depression and the rapid growth of population, economic conditions had become very bad. The disorders were widespread though the British West Indies, and the modern history of Barbados and of the other Caribbean colonies may be said to begin with the subsequent dispatch to the area of the Moyne commission to investigate conditions, and the adoption by the United Kingdom parliament of the first Colonial Development and Welfare act, 1940, under which large sums were provided for the benefit of these and other colonies. The Development and Welfare organization, which was a major factor in the growth of a regional spirit in the West Indies, had its headquarters in Barbados from 1942 until it came to an end in 1958. With the coming into being of the federation of The West Indies in 1958, the premier of Barbados, Sir Grantley Adams, became the first federal prime minister.

Trade and Finance.—Since the middle of the 17th century the basis of the entire economy of Barbados has been sugar, which is cultivated with great skill, and its by-products, rum and molasses, though the growing tourist industry is a helpful adjunct. An agreement made in 1951 between the United Kingdom government and commonwealth sugar producers enables Barbados to sell most of its sugar crop to the United Kingdom at a guaranteed price which is reviewed each year. The chief export trade is thus naturally directed to the United Kingdom. Most of the colony's imports come from the United Kingdom and other commonwealth countries, chiefly Canada. The West Indian dollar, with a value of 4*s.* 2*d.* sterling, is the monetary unit.

Transport and Communications.—The island is provided with a network of good roads. It has long been a port of call for ships of many nations. At Bridgetown a deep-water harbour costing B.W.I. $25,000,000 began operations in 1961. Several international airlines run regular services to Seawell airport near the south coast, and British West Indian airways connects Barbados with all parts of the West Indies. The schooner fleet of the eastern Caribbean has its headquarters there. The receiving and transmitting stations of Cable and Wireless, Ltd. are of major importance in international communications.

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BARBARA, SAINT (*c.* A.D. 200), a virgin martyr of the early church. According to the legend, which is not older than the 7th century, she was the daughter of a pagan, Dioscorus, who kept her guarded in a tower. When she admitted having become a Christian he took her to the prefect of the province to be tortured and beheaded. On his way back from the execution her father was struck by lightning. Some accounts name Heliopolis, others Nicomedia or a town in Tuscany as the scene of her sufferings. The original Greek accounts of her martyrdom are lost, but Syriac, Latin and other versions are extant. Her story, reproduced in great detail in the *Golden Legend*, was very popular in the middle ages. She is venerated as one of the 14 Auxiliary Saints (Holy Helpers), especially as the patroness of artillerymen and firemen; she is also invoked in thunderstorms. Her feast day is Dec. 4.

See *Butler's Lives of the Saints*, ed. by H. Thurston and D. Attwater, vol. iv, pp. 487–489 (1956). (H. C. G.)

BARBARIAN (Gr. Barbaros), the name among the early Greeks for all foreigners, including the Romans. The word probably represents the uncouth babbling of which languages other than their own appeared to the Greeks to consist. It soon assumed an evil meaning, becoming associated with the vices and savage natures which the Greeks attributed to their enemies. The Romans adopted the word for all peoples other than those under Greco-Roman influence and domination. The name Barbary, for northwestern Africa, is derived from that of its Berber inhabitants, not from *barbaros*.

BARBAROSSA ("Redbeard"), the European name for Khair ed-Din (d. 1546), a Barbary pirate and later admiral of the Ottoman fleet, whose activities in Algeria and Tunisia influenced the political development of the area for the next three centuries. He was originally named Khidr but adopted Khair ed-Din as an honorific title. The name Barbarossa often was applied to his brothers and son also.

The founder of the family was a Turk, probably of Albanian origin, from the island of Lesbos. His four sons Elias, Ishak, Aruj and Khidr soon took up a life of piracy. Elias was killed in an encounter with the Knights of St. John in 1503, and Aruj, now the head of the family, moved with his brothers from a base in Egypt to Djerba, an island in the western Mediterranean.

It was a time of crisis in north Africa. Between 1505 and 1511 increasingly numerous attacks by the Portuguese and Spaniards culminated their seizure of certain ports. Morocco maintained its independence after the establishment of the native Sa'adi dynasty, but the rulers of Tlemcen and Tunis had to contend with domestic disorders and the Spaniards were able to establish themselves at Mers al Kebir, Oran, Bougie, Tripoli and on the islet of Algiers. The weakness of the Muslim rulers, and hatred for the Christians exacerbated by Spanish successes, encouraged Aruj and Khidr in their aggressive policy. From the outset the two brothers were successful in piracy and hoped, with the aid of their Turkish compatriots and Muslim emigrants from Spain, to wrest an African domain for themselves. In 1516 the Muslims of Algiers appealed to Aruj, who had been based at Djidjelli since 1512. Unable to capture the Spanish fortress on the island, he nevertheless founded a principality on the littoral with the capture of Miliana, Médéa, Ténès and then Tlemcen. In 1518, however, the last was retaken by the Spaniards and Aruj was killed in the fighting there.

Khidr, who had been his brother's lieutenant, assumed the title of Khair ed-Din. He realized that all the brothers had built up was now threatened, for the Muslim peoples were trying to free themselves from their Turkish oppressors and the Spaniards were not less threatening. Khair ed-Din conceived the bold stroke of offering homage to the sultan of Istanbul for his possessions; in return the sultan granted him the title of *beylerbey* and dispatched military reinforcements (1518). With this help Khair ed-Din was able to re-establish his authority and, having driven the Spaniards from the islet of Algiers (subsequently called Peñón; 1529), to build up Algiers itself as the great stronghold of Mediterranean piracy.

In 1534 he took Tunis and conquered the whole of Tunisia for the Turks, Tunis itself becoming the base for piracy against the Italian coast. In 1535 a powerful expedition sent by the emperor Charles V on behalf of the Tunisian Hafsid sultan recaptured Goletta and Tunis. Khair ed-Din had just carried out a daring raid against Malta when he was summoned to Istanbul, where, in 1533, the sultan had made him admiral in chief of the Ottoman fleet. He took up his duties in 1536 and was one of the great figures of the court at Istanbul until his death there in May 1546. His work in Africa was continued by his successors, in particular by his son Hassan, who, like his father, became admiral in chief. Through Khair ed-Din's initiative Algeria and Tunis, for centuries separate from the eastern caliphates, became part of the Ottoman empire, the Christian threat was removed and the Spanish foothold in Africa reduced to Oran and Mers al Kebir. For three centuries the Mediterranean coastal towns and villages suffered the depredations of Barbarossa's successors.

See P. Achard, *La Vie extraordinaire des frères Barberousse Corsaires et rois d'Alger* (1939); A. Papell, *Reyes y Corsarios. Los Barbarroja* (1935). (H. L. E. T.)

BARBARY or Barbary States, part of northern Africa bounded east by Egypt, west by the Atlantic, south by the Sahara and north by the Mediterranean, comprising Morocco, Algeria, Tunisia and Libya. The name comes from the Berbers, chief inhabitants of the region.

BARBARY APE (Magot), *Macaca sylvana*, a tailless monkey inhabiting Algeria, Morocco and the Rock of Gibraltar and belonging to the group of macaques (*q.v.*). It is light yellowish-brown above and yellowish-white below, with the naked part of the face flesh-coloured. The barbary ape is terrestrial and travels about in droves.

BARBARY PIRATES, Moorish sea robbers operating from the coast of north Africa, who were at their most powerful during the 17th century, but continued their depredations down to the 19th century. North African piracy had very ancient origins but gained a new significance during the 16th century mainly through Khair ed-Din, or Barbarossa (*q.v.*; d. 1546), who united Algeria and Tunisia as military states under the Ottoman caliphate, and maintained his revenues by piracy. With the arrival of powerful Moorish bands in Rabat and Tetuan (1609), Morocco became a new centre for the pirates and the Alaouite sultans who quickly gained control of the two small republics and encouraged piracy as a valuable source of revenue.

The maritime side of this long-lived brigandage was conducted by the captains or *reises*, who, in Algiers and Tunis, formed a class or even a corporation. Cruisers were fitted out by rich men and commanded by the *reises*. The treasury of the ruler who bore the title of agha or dey or bey, received 10% of the value of the prizes. Bougie was the chief shipbuilding port. Until the 17th century the pirates used galleys, but Simon Danser, a Flemish renegade, taught them the advantage of using sailing ships. During the 17th century the Algerian and Tunisian corsairs joined forces and in the first half of the century more than 20,000 captives were said to be imprisoned in Algiers alone. The rich were allowed to redeem themselves, but the poor were condemned to slavery. Their masters would not in many cases allow them to secure freedom by professing Islam. In the early part of the 19th century Tripolitania (*q.v.*), as a result of its piratical practices, was several times involved in war with the United States. After the general pacification of 1815 the British made two vain attempts to suppress Algerian piracy, which was ended only by the French conquest of Algiers in 1830. (H. L. E. T.)

BARBAULD, ANNA LAETITIA (1743–1825), English poet, miscellaneous writer and editor, probably best known for the lyric, "Life! I know not what thou art," was born at Kibworth-Harcourt, Leicestershire, on June 20, 1743. In 1758 her father became theological tutor at the Dissenting academy at Warrington, Lancashire, and she was brought into contact with a distinguished circle which included Joseph Priestly. In 1773 she

published *Poems* and co-operated with her brother, John Aiken, in *Miscellaneous Pieces in Prose.* Her most important poems—*Corsica* (first published in 1768) and "The Invitation"—show her as an idealistic writer, concerned with political and social questions. Her prose, especially the essay "On Romances," was acknowledged by Dr. Johnson to be the best of the many imitations of his style.

In 1774 she married Rochemont Barbauld, Presbyterian minister of Palgrave, Suffolk, where they established a school. Her *Hymns in Prose for Children* (1781) were written "to impress devotional feelings as early as possible in the infant mind." In 1787 the Barbaulds moved to Hampstead and later to Stoke Newington, where they remained until his death in 1808. In 1794 she published an edition of Mark Akenside's *The Pleasures of Imagination* with a critical essay, followed in 1797 by an edition of William Collins' *Poetical Works.* In 1804 she edited a selection from the 18th-century essayists, with a critical introduction, and also a selection from Samuel Richardson's correspondence prefaced by a perceptive biographical essay which is still of critical value. In 1810 she edited *The British Novelists* in 50 volumes, and in 1812 appeared her longest poem, *Eighteen Hundred and Eleven,* a gloomy meditation upon the position and expectations of Great Britain which, despite its late date, belongs essentially to the tradition of 18th-century meditative verse. She died at Stoke Newington on March 9, 1825.

Her works were edited with a memoir by Lucy Aikin, 2 vol. (1825).

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BARBED WIRE: *see* WIRE.

BARBEL, a common name for a fish (*Barbus barbus*) of the carp family (Cyprinidae); found in the rivers of central and western Europe. The name is derived from the four feelerlike barbels, or barbs, near the crescent-shaped mouth. As in other barbed fishes, the barbel has sense organs for taste concentrated on these appendages and uses the barbels to search for food along the river bottom. *Barbus barbus* has a rather elongate body, and attains a weight of 50 lb. in the Danube.

In Africa and Asia many species of *Barbus* are called barbel, or barb. Some of these are small and are kept in home aquariums; others, such as the mahseer (*q.v.*) of India, are important food and game fishes. (C. HU.)

BARBELLION, W. N. P. (pen name of BRUCE FREDERICK CUMMINGS) (1889–1919), English diarist and biologist remembered for his autobiographical *Journal of a Disappointed Man,* was born at Barnstaple, Devon, on Sept. 7, 1889. He won a position at the Natural History museum, London, in 1911, but his health deteriorated. He suffered from multiple sclerosis and, although his wife was told before their marriage in 1915, Cummings did not discover the truth until later. He had to resign from the museum in 1917 and died at Gerrard's Cross, Buckinghamshire, on Oct. 22, 1919.

The Journal of a Disappointed Man (1919) was prepared from his diary covering 1903–17 and is, in the author's words, "a self-portrait in the nude." "I am the scientific investigator of myself," he remarked, and the book is an objective account of Cummings' struggle against increasing ill-health, written in a graphic and sensitive style. Of his two other books, posthumously published, *Enjoying Life, and Other Literary Remains* (1919), which he prepared for publication before he died, included literary and scientific essays too long for the *Journal. A Last Diary* (1920), written for publication, and more deliberately self-conscious than the *Journal,* shows the same keen observation of nature and humanity.

BARBÉ-MARBOIS, FRANÇOIS, MARQUIS DE (1745–1837), French statesman, who in 1803 negotiated the Louisiana Purchase (*q.v.*), was born at Metz. Having served as a diplomat in Germany and with the American revolutionaries, he was intendant of Santo Domingo (1786–89) and then returned to France. He was from 1795 a moderate deputy of the *conseil des anciens,* from which he was expelled on 18 Fructidor (Sept. 4, 1797) and deported to French Guiana; he was set free in Jan. 1800 and became a counselor of state. In 1801 he became director and then minister of the treasury. In the Louisiana negotiations he got a better price than had been expected, but his excessive advances to contractors in 1805 caused a grave financial crisis and Napoleon dismissed him (Jan. 1806). However, he was made first president of the *cour des comptes* in 1807 and a senator and a count in 1813. Hastily attaching himself to the Bourbons, he was made a peer of France (1814) and a marquis (1817) by Louis XVIII. He was minister of justice from Sept. 1815 to May 1816, when he again became president of the *cour des comptes* until he resigned in March 1834, having declared himself in favour of the July monarchy in 1830. He died in Paris on Jan. 12, 1837.

Barbé-Marbois' works include *Réflexions sur la colonie de Saint-Domingue* (1796), *Histoire de la Louisiane et la cession de cette colonie par la France aux États-Unis* (1829) and *Journal d'un déporté non jugé,* the story of his deportation (1834).

(C. E. DU.)

BARBER, SAMUEL (1910–), U.S. composer, one of the most expressive representatives of the lyric and romantic trends in American composition, was born March 9, 1910, in West Chester, Pa. He studied the piano from an early age (his mother was an amateur pianist, and his aunt was the contralto Louise Homer) and soon began to compose. In 1924 he entered the Curtis Institute of Music in Philadelphia, where, in addition to piano and composition, he studied singing and conducting.

After graduation in 1934, Barber devoted himself entirely to composition. He developed a distinctive style, absorbing some technical procedures of modern music but without indulging in experimentation for its own sake. His *Overture to "The School for Scandal,"* op. 5 (1932), based on Sheridan's comedy, and composed while he was still a student, and *Music for a Scene from Shelley,* op. 7 (1933), inspired by *Prometheus Unbound,* established his reputation.

Although literary allusions occur in many of Barber's works, his music is not programmatic in the literal sense. Significant in this respect are the two *Essays for Orchestra,* op. 12 (1937) and op. 17 (1942), which are intended as musical counterparts of the literary form. Structural considerations govern Barber's instrumental writing; there is great astringency in harmony, but the basic tonality remains secure; the rhythmic lines are very strong, without loss of coherence.

In 1936 Barber wrote his First String Quartet, op. 11, the slow movement of which, arranged for string orchestra, was performed under the title *Adagio for Strings* by the NBC Symphony orchestra under Arturo Toscanini in New York on Nov. 5, 1938, and acquired extraordinary popularity both in America and in Europe. Barber's First Symphony, op. 9 (1936; revised, 1942), is in the romantic tradition; in the Second Symphony, op. 19 (1944; revised, 1947), commissioned by the U.S. army air forces (which Barber had joined in 1943), he introduced a special electronic instrument imitating the radio signals for air navigation, replaced in the revised version by an E-flat clarinet.

Barber wrote also a *Violin Concerto,* op. 14 (1939), and a *Cello Concerto,* op. 22 (1945). His *Piano Sonata,* op. 26 (1948), is the most ambitious work in this form by an American composer. Other compositions are *Dover Beach,* op. 3, for voice and string quartet (1931); two vocal works with orchestra, *Knoxville, Summer of 1915,* op. 24 (1947), and *Prayers of Kierkegaard,* op. 30 (1954); the ballet *Medea,* op. 23 (1946), and the opera *Vanessa,* New York (Jan. 15, 1958); and many songs. The opera won a Pulitzer Prize for him in 1958.

See N. Broder, Samuel Barber (1954). (N. SY.)

BARBER (from Latin *barba,* beard), one who cuts and trims hair, shaves beards, etc. The barber shop was a familiar institution in ancient Greece and Rome, and then as now was a centre for the exchange of gossip and opinion. However, the more prosperous citizens, particularly in Rome, had household barbers. The great houses of ancient Egypt also had barbers among their retainers, and offered the services of these as part of their hospitality to guests.

For six centuries the barbers of Europe practised surgery.

This custom began with the papal decree of 1163 that forbade the clergy to shed blood. Monks were required to undergo bloodletting at regular intervals, and some of them had been performing this task, along with minor surgery. Now they turned these duties over to the barbers—familiar figures at the monasteries since 1092, when the clergy had been required to be clean shaven. This arrangement was satisfactory to the doctors of the era, who considered that bloodletting was necessary but beneath their dignity, and were glad to relegate to the barbers other physical tasks such as the lancing of abscesses and treatment of wounds. At the beginning of his career Ambroise Paré (*q.v.*), one of the great pioneers of surgery, was among those who gave shaves and haircuts for a living.

In France a royal decree of 1383 declared that "the king's first barber and valet" was to be head of the barbers and surgeons of the kingdom, who had been organized in a guild in 1361. The barbers of London were first organized as a religious guild, but were granted a charter as a trade guild in 1462 by Edward IV. This guild was amalgamated with that of the surgeons in 1540 under a charter granted by Henry VIII, and the members of the joint corporation were accorded the right to be addressed as "Master"—colloquially, "Mister." British surgeons still prefix their names with "Mr." instead of "Dr."

The barber-surgeons were sometimes called "doctors of the short robe" to distinguish them from university-trained physicians and surgeons, whose superiority was apt to be only in their knowledge of Latin and their title of "doctor of the long robe." In England the guild of surgeons was separated from that of barbers in 1745. However, the Royal College of Surgeons did not receive its charter until 1800.

Discussing colonial barber shops in the first half of the 18th century, William Chauncey Langdon says in *Everyday Things in American Life* (Charles Scribner's Sons, New York, N.Y., 1937): "'Barber and Chirurgeon' was the familiar sign, and the red stripe on the barber's pole represented the blood he spilt, the white the bandage. . . ."

The barber's trade was acquired only by a long apprenticeship until the 1890s, when schools for barbering were established. A traditional male sanctuary, the barber shop was invaded by thousands of women in the 1920s, when the shingle bob came into vogue. Widespread use of the safety razor and the electric shaver has transformed U.S. barber shops, once adorned with rows of individual shaving mugs, and tended to limit the function of barbers everywhere to haircutting, shampooing, etc.

BARBERI, DOMENICO (called Dominic of the Mother of God) (1792–1849), Italian Passionist and mystic who worked as a missionary in England, was born of peasant stock near Viterbo on June 22, 1792. Brought up without any formal education he entered the Passionist order as a lay brother and was admitted to the priesthood in 1818. In 1821, when he had finished his studies, he became lecturer in theology at a Passionist college near Vetralla, Viterbo. In 1824 he moved to Rome, where he continued to teach. An early inspiration had convinced him that he should work for the conversion of England, and he now met a number of English converts to Roman Catholicism from whom he learned much. But his appointments to Lucca in 1831 and as provincial for southern Italy in 1833 seemed to preclude his hopes, until in 1840 he was sent to Belgium, to found a Passionist house at Ere, near Tournai. English friends helped him there, and in 1841 offered him a house at Aston, Staffordshire. He was already following with keen sympathy the growth of the Tractarian movement, and it was he who in 1845 received Newman into the Roman Catholic Church. In Staffordshire Barberi incurred constant insults and even violence with undaunted patience. He always spoke English with difficulty, but he made converts everywhere, among all classes, by his ardent apostolic zeal. He founded four Passionist houses in England, and had planned the subsequent Irish foundation before his death in Reading on Aug. 27, 1849. He was declared venerable in 1911 and beatified in 1963.

See Denis Gwynn, *Father Dominic Barberi* (1948). (D. G.)

BARBERINI, an aristocratic Italian family, probably of Sienese origin, but established in Florence by the 14th century. During the pontificate of Paul III (Alessandro Farnese) part of the family settled in Rome; and by the lifetime of Maffeo Barberini (1568–1644), elected pope as Urban VIII in 1623, their energies were concentrated in that city about the papal court. Able pontiff though he was, Urban won distinction also for his nepotism: one brother, Antonio, and two nephews, Francesco and Antonio, he created cardinals; on another brother, Carlo, he bestowed lucrative offices; and for a third nephew, Taddeo, he secured the principality of Palestrina. Together their revenues were enormous and their power such as to provoke war in the papal states and the jealousy of neighbouring princes. When Innocent X, Urban's successor as pope, began an investigation into the Barberini nephews' use of public money, Antonio fled to France (1645), followed by Francesco and Taddeo (1646). Cardinal Mazarin gave them his protection and Innocent eventually decided to pardon them. Francesco returned to Rome in 1648, Antonio in 1653; Taddeo had died in 1647. Taddeo's son Maffeo married Olimpia Giustiniani, Innocent's protégée. Cornelia Barberini, daughter and heiress of this Maffeo's son Urbano (d. 1722), in 1728 married Giulio Cesare Colonna di Sciarra, who added her family name to his own and secured the title prince of Palestrina for his house. The name and title were later extended likewise to Luigi, marchese Sacchetti, who in 1891 married Maria Barberini-Colonna di Sciarra, heiress of the last Colonna prince of Palestrina. The Barberini palace and library in Rome witness to the Barberini's magnificence and to their patronage of the artist Bernini (*q.v.*). Bernini, it is said, advised the removal of the ancient bronze girders of the Pantheon to be melted down for guns in 1625, which inspired the epigram: "Quod non fecerunt barbari, fecerunt Barberini" (What the barbarians did not do the Barberini did).

(P. J. J.)

BARBERRY, any shrub of the genus *Berberis* (family Berberidaceae), which comprises more than 200 species, many of them handsome, spiny evergreens, used as ornamental plants. The common Eurasian *B. vulgaris* is naturalized in Great Britain and the eastern United States, and grown as an ornamental; but, because it serves as a host plant for the destructive wheat rust, its culture is often prohibited, and rust-resistant species such as *B. thunbergi*, the Japanese barberry, are often grown instead. (*See* also Wheat: *Diseases.*)

Far more important horticulturally are the splendid, mostly evergreen, species introduced from western China and Chile. Over 30 are in common cultivation in the United States and England. Nearly all of them have yellowish flowers, often in hanging clusters, and many have showy red or yellow fruits. Among these evergreen shrubs are *B. buxifolia*, a reasonably hardy species from Chile; *B. darwinii* from Chile, hardy in milder climates; and *B. julianae* of China, the hardiest of the evergreen species.

(N. Tr.; X.)

BARBER'S ITCH, known also as ringworm of the beard, is a contagious disease caused by the fungus *Tinea barbae trichophytia*. There is a superficial scaly affection of the bearded region which involves the hairs. There is also a deeper infection called *Sycosis parasitara* which may result in small abscesses. The treatment varies with the stage of the disease, and fungicidal remedies, except of a nonirritating character, are not to be used in the acute stage. (F. L. A.)

BARBERTON, an industrial city of Summit county, O., U.S., situated on the Tuscarawas river, and adjoining Akron on the southwest. (For comparative population figures *see* table in Ohio: *Population.*) Barberton's principal industries include the manufactures of automobile tires, chemicals, iron and metal products, high-tension insulators, steam boilers and marine power plants. A deposit of limestone more than 345 ft. thick and ½ mi. below the surface of the earth is one of the deepest mines of its kind in the world and is the source of raw material for the manufacture of soda ash (used in glassmaking), sodium bicarbonate and chlorine.

O. C. Barber, with his associates, founded Barberton in 1891 as the new site of his match works (later called the Diamond Match company), which had been established as the Barber Match company in Akron in 1867. Lake Anna, a natural pool in the heart

of the city, was named for Barber's daughter. (W. D. Ov.)

BARBET, the general name for small birds of the family Capitonidae, closely allied to the honey guides (*q.v.*) and placed with the woodpeckers in the order Piciformes. Barbets inhabit the tropical regions of the world, but are absent from Australia. They have brilliant plumage, predominantly green, and a large, stout bill, more or less beset with bristles. Being almost exclusively arboreal, they feed mainly on fruit and lay several white eggs in holes in trees. The blue-throated barbet (*Megalaima asiatica*) of eastern Asia is the best-known in captivity. The family also includes the coppersmith and the South African tinker (*Pogoniulus pusillus*), the latter a small black, yellow and brown bird with a red cap. (G. F. Ss.; X.)

BARBEY D'AUREVILLY, JULES AMÉDÉE (1808–1889), French novelist and one of the most independent and penetrating critics of the 19th century, was born on Nov. 2, 1808, at Saint-Sauveur-le-Vicomte, Manche. His father belonged to the minor nobility of the region, with which the family of Barbey had long connections (the writer adopted the additional surname d'Aurevilly about 1837, eight years after the death of an uncle who had borne it). In his youth Barbey made two important friendships, the first with Maurice de Guérin (*q.v.*), whom he met while at the Collège Stanislas in Paris (1827–29), the second with Guillaume Stanislas Trebutien, a bookseller whom he met while studying law at Caen (1829–33). From 1833 to 1836 he divided his time between Paris and Normandy, but he finally set himself up in Paris in Jan. 1837 and began to earn a precarious living by writing for periodicals. Despite poverty, he went to great lengths to establish himself as a dandy, and his sartorial splendours and magnificent attitudes became legendary. He took Beau Brummell, whose rise to pre-eminence in English society fascinated him, as his model and in 1844 published a treatise *Du dandysme et de Georges Brummell* (dated 1845). After years of hardship he was appointed, in 1868, to alternate with Sainte-Beuve as literary critic for *Le Constitutionnel,* and on Sainte-Beuve's death in 1869 he succeeded to his position on that paper. Thenceforward his reputation grew, particularly among younger writers, for instance Paul Bourget, Léon Bloy, and some of the Symbolists, and he came to be known as *le Connétable des Lettres* ("Lord High Constable of Literature"). He died in Paris on April 23, 1889.

A romantic in an age of materialism, a fervent royalist with a contempt for democracy and an ardent but by no means orthodox Catholic, Barbey d'Aurevilly sought to live in superiority and detachment, disdaining everything that seemed to him vulgar or commonplace. In some ways he belonged to a bygone age, in others he was ahead of his contemporaries. Often arbitrary and vehement in his criticism, he was especially caustic about the realists and the naturalists, Émile Zola in particular. Some of his verdicts, however, have stood the test of time, and he recognized the attainments of Balzac, Stendhal and Baudelaire when they were far from being fully appreciated. His critical articles were collected in *Les Prophètes du passé* (1851), *Les Oeuvres et les hommes,* 26 vol. (1860–1909), and *Le Théâtre contemporain,* 5 vol. (1888–96). His various *Memoranda* and his extensive correspondence constitute an invaluable source of information about his life and personality.

Barbey d'Aurevilly was much influenced by Sir Walter Scott and by Lord Byron, and his novels are sombre in tone and often strained or melodramatic. They are written, however, with verve and poetic imagination. *L'Ensorcelée* (serialized 1852; in book form 1854), *Le Chevalier des Touches* (1864), both dealing with local insurrections in the French Revolutionary period, and *Un Prêtre marié* (1865), all notable for their vivid evocations of his native Normandy, are perhaps his best novels. *Les Diaboliques* (1874), a collection of six short stories illustrating the power of evil, is often considered his masterpiece.

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BARBEYRAC, JEAN (1674–1744), French jurist, famous chiefly for the preface and notes to his translation of Samuel Pufendorf's treatise *De Jure Naturae et Gentium,* was born at Béziers in lower Languedoc. Migrating with his family into Switzerland after the revocation of the Edict of Nantes, he studied jurisprudence at Geneva and then at Frankfurt am Main, and became professor of belles-lettres in the French school of Berlin. Then, in 1711, he was called to be professor of history and civil law at Lausanne, and finally settled as professor of public law at Groningen.

In theory Barbeyrac follows closely Locke and Pufendorf, but he works out with great skill the theory of moral obligation, referring it to the command or will of God. He indicates the distinction, developed more fully by Christian Thomasius and Kant, between the legal and moral qualities of action. The principles of international law he reduces to those of the law of nature, and combats many of the positions taken up by Hugo Grotius. He rejects the notion that sovereignty resembles property and makes even marriage a matter of civil contract.

Barbeyrac also translated into French Grotius' *De Jure Belli et Pacis* (1724), dedicated to "Sa majesté Britannique, George I"; Cumberland's *De Legibus Naturae;* and Pufendorf's small treatise, *De Officio Hominis et Civis.* Among his own productions are a treatise, *De la morale des pères,* which criticized the fathers of the church; a history of ancient treaties contained in the *Supplément au grand corps diplomatique;* and the curious *Traité du jeu* (1709), in which he defends the morality of games of chance.

BARBIER, ANTOINE ALEXANDRE (1765–1825), French librarian and bibliographer, who produced a standard reference work of lasting value, the *Dictionnaire des ouvrages anonymes et pseudonymes,* was born Jan. 11, 1765, at Coulommiers, Seine-et-Marne. He took priest's orders, from which, however, he was released by the pope in 1801.

In 1794 he became a member of the temporary commission of the arts and was charged with the duty of distributing among the various libraries of Paris the books confiscated during the Revolution. In the execution of that task he discovered the letters of Pierre Daniel Huet, bishop of Avranches, and the manuscript of the works of Fénelon. He became librarian successively to the Directory, to the *conseil d'état* and, in 1807, to Napoleon, for whom he carried out a number of commissions. His *Dictionnaire des ouvrages anonymes et pseudonymes* was published during the years 1806–09 (3rd ed. 1872–79). Only the first part of his *Examen critique des dictionnaires historiques* was published (1820). He had a share in the foundation of the libraries of the Louvre, Fontainebleau, Compiègne and St. Cloud. Under Louis XVIII he became administrator of the king's private libraries, but in 1822 he was deprived of all his offices; as a result, his health broke down and on Dec. 5, 1825, he died in Paris.

See a notice by his son Louis and a list of his works prefixed to the 3rd ed. of the *Dictionnaire des ouvrages anonymes,* vol. i (1872).

BARBIERI, GIOVANNI FRANCESCO: *see* GUERCINO.

BARBITURATES, a group of compounds that, in proper doses, can produce sleep (hypnotic action) or sedation; these two properties have rendered them indispensable to the practice of medicine. Barbital, phenobarbital, amobarbital, butabarbital, pentobarbital, secobarbital, thiopental and thiamylal are most commonly used.

Uses.—The choice of a barbiturate for application to a therapeutic problem is determined by consideration of the particular drug's duration and mode of action (*see* below). Barbital and phenobarbital are employed extensively, for example, in conjunction with other drugs for treatment of certain convulsive disorders (epilepsy) where prolonged depressant action is desired. Secobarbital and pentobarbital comprise the active ingredients of preparations commonly referred to as "sleeping pills"; their relatively short period of effectiveness enables the induction of sleep without, as a rule, undesirable aftereffects. Thiopental is extremely useful as an anesthetic agent. In skilled hands this drug induces unconsciousness smoothly and rapidly, and can be supplemented by other agents when longer periods of anesthesia are necessary.

Metabolism and Duration of Action.—The most useful clas-

sification of barbiturates takes into account duration of action; that is, the length of time following administration of a therapeutic dose over which sedative or hypnotic action may be expected to persist. Barbiturates, then, are divisible into (1) long-acting (barbital, phenobarbital); (2) intermediate-acting (amobarbital, butabarbital); (3) short-acting (pentobarbital, secobarbital); and (4) ultrashort-acting (thiopental, thiamylal) groups. As a rule, administration of a hypnotic dose to a human subject will produce, in the case of the long-acting compounds, an effect persisting for six hours or more. The other groups act for correspondingly shorter periods (intermediate, three to six hours; short, less than three hours).

The ultrashort-acting compounds are never administered via the usual routes (oral, intramuscular) but are used principally as intravenous anesthetic agents.

The duration of action of a barbiturate is determined by several factors, including (1) the rate of destruction (conversion to physiologically inactive compounds); (2) the rate of excretion via the kidneys; and (3) distribution within tissues and organs of the body. As a general rule, all but the long-acting compounds are transformed more or less rapidly by enzyme reactions in the liver (and to a lesser extent, kidney) into substances possessing little or no hypnotic or sedative action of their own (metabolites), which are ultimately excreted by the kidney. Barbital and phenobarbital, on the other hand, are metabolized to a much lesser extent; sizable amounts of a given oral dose are recoverable from the urine in a form not different from that given above.

This knowledge is of practical importance to intelligent clinical use of barbituric acid derivatives. The administration of long-acting compounds is contraindicated in the presence of decreased kidney function (may cause retention and persistence of the effects of the drug), while other types must be used with caution in any condition manifesting reduction of the functional capacity of the liver. Thiopental and thiamylal, in addition to their rapid destruction by the liver, are stored to an appreciable extent in body fat. Their comparatively short duration of action and ineffectiveness by routes of administration other than intravenous are explained on the basis that the operation of both these factors does not permit the maintenance, for long periods of time, of concentrations in the blood or other organs compatible with sleep.

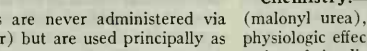
Barbiturate Poisoning and Addiction.—The incidence of barbiturate poisoning resulting from accidental or intentional overdosage has increased markedly. This situation, a reflection perhaps of the stress of modern times, is abetted by the tendency to overprescribe barbiturates and by laxity in enforcement of laws governing sales. Overdosage may be fatal due to brain damage caused by lack of oxygen and on the basis of other complications (pneumonia) incident to a prolonged, inactive, depressed state.

Methods employed in the treatment of acute barbiturate intoxication vary considerably and have been subjected to critical study. The use of stimulant drugs (picrotoxin, Metrazol) in conjunction with supportive measures (removal by lavage of barbiturate still present in the stomach, maintenance of open airway, adequate oxygenation and administration of intravenous fluids) is not universally accepted.

Therapeutic use of these compounds is not without hazard, and studies comparing mortality in groups of patients treated with stimulants and those given supportive treatment alone indicate no marked difference in survival rate. Each point of view, however, has its own merits, and it would seem that the treatment problem rests in individualized management for each case of acute barbiturate poisoning.

Prolonged use of the barbiturates (especially secobarbital and pentobarbital) for relief of anxiety or insomnia may in time progress to a point at which the user requires amounts of the drug much in excess of the initial therapeutic dose. This represents a state known as tolerance (ability to withstand amounts larger than the usually effective dose). Denial of a barbiturate to the habitual (tolerant) user may precipitate a series of systemic reactions described collectively as the withdrawal syndrome, indicative of physiologic dependence on the drug (addiction). Symptoms observed vary among patients but may include restlessness, anxiety, weakness, insomnia, nausea, delirium and convulsions. Severe reactions may be ultimately fatal. Treatment of the barbiturate addict involves gradual withdrawal of the drug under medical supervision, followed by a program of rehabilitation. The habitual user of barbiturates presents much the same therapeutic problem as the chronic alcoholic or morphine addict. The common denominator in all these is a basic character (psychological) defect; a combination of proper medical and psychiatric care offers the barbiturate addict some hope of restoration to a normal, useful life.

Chemistry.—The barbiturates are derived from barbituric acid (malonyl urea), a substance that in itself produces no marked physiologic effects on animals or man. It is prepared by condensation of the diethyl ester of malonic acid with urea, and may be depicted structurally as follows:



The barbiturates are prepared by addition to the parent compound of various chemical groups, usually (exceptions occur) at position 2, or 5, or both (a second group introduced at the 5-position is designated 5′). Examples are:

Name	2-Position	5-Position
Barbital	C=O	5-ethyl, 5′-ethyl
Phenobarbital	"	5-ethyl, 5′-phenyl
Amobarbital	"	5-ethyl, 5′-isoamyl
Butabarbital	"	5-ethyl, 5′-(1-methylpropyl)
Pentobarbital	"	5-ethyl, 5′-(1-methylbutyl)
Secobarbital	"	5-allyl, 5′-(1-methylbutyl)
Thiopental	C=S	5-ethyl, 5′-(1-methylbutyl)
Thiamylal	"	5-allyl, 5′-(1-methylbutyl)

The compounds listed are, with the exception of the thiobarbiturates, white, crystalline and odourless (thio compounds are yellow-green and crystalline; thiopental possesses a garliclike odour). The "free-acid" forms, characterized by a C=O or C=S group at position 2, are insoluble in water. For medicinal use, the free-acid form is converted to the soluble sodium salt by addition of a sodium atom at position 2.

See L. S. Goodman and A. Gilman, *The Pharmacological Basis of Therapeutics*, 2nd ed. (1955); H. Isbell, "Addiction to Barbiturates and the Barbiturate Abstinence Syndrome," *Ann. Int. Med.*, 33:108 (1950). (L. B. Ar.)

BARBIZON SCHOOL, an important school of 19th-century French painting. The name is derived from that of Barbizon, a village on the edge of the forest of Fontainebleau, about 30 mi. S.E. of Paris, where the school's leaders, Théodore Rousseau and J. F. Millet, driven from Paris by poverty and lack of success, settled in 1847 and 1849 respectively. There they led lives of struggle and sacrifice, which achieved in the end a belated recognition. A colony of landscape painters and animal painters gathered about them. Among these were N. V. Diaz, J. Dupré, H. Harpignies, F. L. Français, C. Jacque and C. Troyon, while J. B. Corot, P. Huet, A. L. Barye and Gustave Courbet occasionally made visits.

Historically, the painters of Barbizon belong to the generation that was born at the end of the first empire and was frustrated by its defeat. Socially, they were confronted with the hostility of the bourgeoisie which had assumed power and favoured academic conventions. Artistically, these painters were the children of the romantic movement, from which they inherited restlessness and nostalgia for greatness; but, wearied of imagination, they turned to nature and reality. The forest of Fontainebleau, with its fantastic scenery of rocks, oaks and pools, offered an ideal refuge. They based themselves on the French 17th-century tradition, on examples of the old Dutch masters and on the new English school of landscape painting.

Rousseau became absorbed in a mystic communion with nature and found fulfillment in it. "The soul of the artist," he said, "must take its fullness from the infinite in nature." He listened to the mysterious murmur of the forest, "the voice of the trees, the surprises of their movements, the variety of their forms . . ." Millet

was more responsive to the nobility of man. "In art it is the human aspect which touches me most deeply," he confided. He chose Barbizon in order to contemplate the open country beyond and its husbandry, and the age-old movements of the peasant, who embodied for him the dual faith of 1848, the people and nature.

Barbizon became an international centre, and its influence extended over all Europe as well as the United States. It was also in the forest of Fontainebleau that the future Impressionist painters began their work.

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BARBON, NICHOLAS (*c.* 1640–1698), English economist, probably the son of Praise-God Barbon, was born in London, studied medicine at Leyden, graduated M.D. at Utrecht in 1661 and was admitted an honorary fellow of the College of Physicians in 1664. He took considerable part in the rebuilding of London after the great fire of 1666, and has a claim to be considered the institutor of fire insurance in England, which he started about 1680. He died in 1698, having appointed John Asgill his executor, with instructions that none of his debts should be paid.

Barbon's writings on economics are interesting as expressing views much in advance of his time and very like those of modern times on such important topics as value, rent and foreign trade. He anticipated to some extent the conclusions of Adam Smith on the division of labour and the theory of currency as expounded by David Ricardo.

The more important of his works were *Apology for the Builder; or a Discourse Showing the Cause and Effects of the Increase of Building* (1685), in which he discussed the theory of rent; *A Discourse of Trade* (1690), which insisted that exports could be paid for only by imports; and *A Discourse Concerning Coining the New Money Lighter* (1696).

BARBON (BAREBONE OR BAREBONES), **PRAISE-GOD** (*c.* 1596–1680), was the English leather seller and sectarian preacher from whom Barebone's parliament derived its nickname. He was admitted freeman of the Leathersellers company in 1623 and liveryman in 1634; and about the same time he became minister to a congregation which assembled at his own house, the "Lock and Key," in Fleet street. His preaching attracted large audiences and was sometimes the occasion for riots, as on Dec. 19, 1641, when a mob attacked his house and one man was kicked "as if they meant to beate him into a jelly."

Barbon, who was a man of substantial property, was summoned by Cromwell on June 6, 1653, to sit as member for the city of London in the assembly of nominees which met on July 4, 1653, and which was later named after him. He appears to have taken no part in the debates, and after the members' resignation in Dec. 1653 he sat in no other parliament. But the prospect of the Restoration roused him to political activity and in Feb. 1660 he presented a petition to parliament deprecating any reconciliation with the Stuarts. He was also responsible for the circulation of Marchamont Needham's pamphlet *News From Brussels in a Letter From a Near Attendant on His Majesty's Person* . . . (1660), which retailed unfavourable anecdotes relating to Charles II's morals. Even after the Restoration (May 1660), he made no secret of his opinions, boldly visiting friends in prison, and he was himself held in the Tower of London from Nov. 26, 1661, to July 27, 1662. He died in London and was buried on Jan. 5, 1680.

Barbon's opponents styled him a Brownist (*see* BROWNE, ROBERT) and Anabaptist (*q.v.*), but his congregation originally chose him for his advocacy of pedo-baptism, a practice in defense of which his two books were written. Otherwise the exact nature of his religious opinions is not perfectly clear. In the preface of *A Discourse Tending to Prove . . . Baptism to be the Ordinance of Jesus Christ. As Also That the Baptism of Infants . . . is Warrantable* . . . (1642), he displayed a gift of toleration unusual in a period of much acrimonious controversy.

See Jane Lane, *Puritan, Rake and Squire* (1950). (S. R. BT.)

BARBOSA, RUY (1849–1923), Brazilian statesman and jurist, noted for his championship of the principle of equality of nations, was born at San Salvador, Braz., on Nov. 5, 1849. A lawyer by profession and an orator by temperament, he entered Brazilian public life in the movement to abolish slavery and subsequently took an active part in the republican revolution of 1889. Appointed vice-president and finance minister of the provisional government in 1889, he was one of the principal authors of the constitution submitted to the constituent assembly. He represented the state of Bahia in the Brazilian senate from 1891 until his death.

In 1907 at the second Hague Peace conference, Barbosa achieved international repute as the result of his advocacy of the principle of the legal equality of all sovereign states. He was subsequently appointed to the panel of judges of the Permanent Court of Arbitration at The Hague; upon the establishment of the Permanent Court of International Justice in 1921 he was elected a judge, but because of ill-health, he was unable to take up his duties. Barbosa's writings, among which should be noted his *Letters From England*, deal not only with jurisprudence but also with sociology and politics. He died at Rio de Janeiro on March 1, 1923.

(OR. S.)

BARBOUR (BARBERE; BARBIER), **JOHN** (1325?–1395), author of the first substantial Scottish poem. He may have been at first a scribe or clerk in a noble household, or at court, under the patronage of David II's queen, Joanna. He speaks highly of her in his poetry, and he received his only ecclesiastical preferment as archdeacon of Aberdeen while yet a young man and just before the queen left Scotland in 1357. In Aug. 1357 Edward III granted him a safe-conduct to travel to Oxford. In the September following he was nominated by his bishop as one of three procurators-general to discuss the terms of David II's release from captivity in England. In Nov. 1364 he was granted another safe-conduct into England, probably again on an academic visit. It has been suggested that he spent part of his youth in France; it is certain that he went on pilgrimage to St. Denis in 1364, and that his studies took him again to France in 1368 *cum duobus valettis et duobus equis* ("with two servants and two horses") . . . *causa studendi*. In 1372 he was one of the auditors of exchequer, and in 1373 a clerk of audit in the king's household. He received many grants from the royal bounty, and in Dec. 1388 he was given a life pension of £10 "for faithful services." He died at Aberdeen on March 13, 1395, assigning his pension to the cathedral church.

Barbour completed *The Actes and Life of the most victorious Conquerour, Robert Bruce King of Scotland*, an historical romance in 20 books (nearly 7,000 octosyllabic couplets) in 1376. The background of the *Bruce* is the political history of Scotland from the death of Alexander III (1286) to the death of Douglas and the burial of Bruce's heart (1332). Barbour is a serious historian, writing of "nocht but sothfast thing" in a metrical form which was then judged proper for chronicle. Allowance must be made for literary conventions, and also for the freer medieval notions of historiography; but in the main line of the narrative, and in much of his detail and anecdote, Barbour's concern for accuracy and truly critical assessment of events wins respect. Yet his intention is patriotic and practical as well as commemorative: his story exemplifies the chivalry and idealism of the Scottish heroes, and ends with a prayer that the successors of Bruce and his men may emulate "thair nobill elderis gret bounte." To this end, and appropriately, Barbour draws the devices of metrical romance into service: "he is writing history which has all the qualities of romance in real life." But the *Bruce* remains a harshly realistic story of recent events in the style of the *chansons de geste* rather than in that of the later high romance of idealized chivalry and courtly love. Barbour's knights are not out *en aventure;* they are defenders of their country's independence through what a 15th-century historian calls "disasters, flights and dangers, hardships and weariness, . . . guile, banishment, imprisonment, slaughter, and destruction of those near and dear." Their chivalry is functional, concerned with the defense of freedom and with upholding the rights of the weak against the tyranny of the strong. The style of the poem is vigorous, direct, admirably suited to the

matter. Barbour describes mortal combat with economy and enthusiasm, not as it looks to a literary observer, but as it feels to a participant. His narrative manner has much in common with that of the Scottish border balladry.

A convincing attempt was made by R. L. Graeme Ritchie to identify Barbour as the author of *The Buik of Alexander*, a translation of two French romances (*Li Fuerres de Gadres* and *Les Voeux du Paon*) which are "branches" of the *Roman d'Alixandre*. *The Buik of Alexander* survives in an apparently unique copy of Arbuthnet's edition (*c.* 1580); the colophon dates the version 1438. If Ritchie's thesis is correct, Barbour schooled himself in French romance in the most practical way, and brought to the composition of his national epic not only the ideals of chivalry but an arduous apprenticeship in the art of heroic narrative in the French manner.

Wyntoun speaks (*Cronykil*, VIII, 1445–50) of the "Stewartis Oryginalle," a genealogy of the Scottish kings, which Barbour "has tretyt haille / In mater fayr." This work has not survived. It is probable that the "tretis" of "Brutus lynnage" made, says Wyntoun (*ibid*, III, 621), by Barbour "intill a genology," is the same work; medieval genealogists habitually started from the beginning, and Brutus of Troy was by now a popular British original. Modern critical opinion is against the identification of Barbour's "Brut" as a "Troy book" based on Guido delle Colonne's *Historia Destructionis Troiae*.

Correspondences between *The Buik of Alexander* and the short *Ballet of the Nine Nobles* (incorporated in two manuscripts of Scottish chronicles, written in 1510 and 1521, and in Edinburgh University library), and further correspondences between the *Ballet* and the *Bruce*, led Ritchie to attribute the *Ballet* to Barbour. His arguments are inconclusive. Another uncertain attribution is the immense verse *Legends of the Saints*, which was probably begun at Aberdeen toward the end of Barbour's life.

BIBLIOGRAPHY.—(1) *Bruce*. The *Bruce* survives in two manuscripts: one in the library of St. John's college, Cambridge (1487), and the other in the National Library of Scotland (1489). Extracts were incorporated by Andrew of Wyntoun in his *Orygynale Cronykil of Scotland*, the manuscripts of which are earlier than those of the *Bruce*. The earliest surviving printed edition is Henry Charteris's (1571); the second is A. Hart's (1616). Bad 18th-century issues are common. Modern editions: J. Pinkerton (1790)—the first edition to be based on a manuscript; J. Jamieson (1820); C. Innes (Spalding Club, 1856); W. W. Skeat (Early English Text Society, 1870–79; revised for the Scottish Text Society, 1893–95); W. Mackay Mackenzie (1909). On the recension of the text, *see* J. T. T. Brown, *The Wallace and the Bruce Restudied* (1900). For critical discussions, *see* J. M. Ross, *Scottish History and Literature* (1884); T. F. Henderson, *Scottish Vernacular Literature*, 3rd ed. (1910); J. Kinsley, *Scottish Poetry: A Critical Survey* (1955). (2) *The Buik of Alexander*, ed. by D. Laing (Bannatyne Club, 1831); ed. by R. L. Graeme Ritchie, with full critical discussion and the French originals printed facing the Scottish text, 4 vol., Scottish Text Society (1921–29). (3) On Barbour and the *Troy Book*, *see* Henry Bradshaw, *Transactions of the Cambridge Antiquarian Society* (1866); *The Geste Historiale of the Destruction of Troye*, ed. by G. A. Panton and D. Donaldson (Early English Text Society, part ii, introduction); P. Buss, in *Anglia*, ix (1886); E. Koeppel, in *Englische Studien*, x (1887). Two fragments have been preserved in manuscripts of Lydgate's *Troy Book*, and are printed in C. Horstmann, *Barbours des schottischen Nationaldichters Legendensammlung nebst den Fragmenten seines Trojanerkrieges* (1881–82). (4) *The Ballet of the Nine Nobles*. Text and commentary in Ritchie's edition of *The Buik of Alexander*, I, cxxxiii–clviii. (5) *Legends of the Saints*. Text in Horstmann, ed. by W. M. Metcalfe, from the manuscript in Cambridge University library (Scottish Text Society, 1888–95). *See* also Ritchie, op. cit., I, ccxviii–ccxxi.

For Barbour's life, *see* W. W. Skeat's edition of the *Bruce* (Early English Text Society, iv); Ritchie's edition of *The Buik of Alexander* (Scottish Text Society, I, clxxiii–ccxxv). (J. Ky.)

BARBUDA: *see* ANTIGUA.

BARBUSSE, HENRI (1873–1935), French novelist, author of *Le Feu*, an authentic picture of the life of French conscripts in World War I, was born in Asnières, Seine, May 17, 1873. He had published a book of poems, *Pleureuses* (1895), and two novels, *Les Suppliants* (1903) and *L'Enfer* (1908), a fiery mixture of naturalism and symbolism, before becoming editor of *Je Sais Tout* (1910). In 1914 he volunteered for the infantry, was twice cited for gallantry and was invalided out in 1917. *Le Feu, journal d'une escouade* (1916; Eng. trans. *Under Fire*, 1917), a merciless report of his two years in the trenches, won him the Prix Goncourt. His pacifism led him to become a Communist and to write for *L'Humanité*: his later books, from *Clarté* (1919; Eng. trans. *Light*), to *Staline* (1935; Eng. trans.), were openly propagandist. He died in Moscow, Aug. 30, 1935.

See J. Duclos and J. Fréville, *Henri Barbusse* (1946), a Communist biography. (RE. L.)

BARCA (BARCE; Arabic BARQAH), a town and the official name of the eastern province of Libya, Africa, coincident to the conventional western name of Cyrenaica (*q.v.*). The Arab name reflects the fact that during the first centuries after the Islamic invasion the district was administered from Barca, the name of which survived long after the town itself had decayed.

Ancient Barca was founded in the mid-6th century B.C. by Greeks, who had fled from the tyranny of Arcesilaus II (*see* CYRENE) and formed an alliance with the Libyan tribes. After a Persian attack (*c.* 515 B.C.) the city was sacked. In the Hellenistic period it was overshadowed by the port Ptolemais (modern Tolmeita or Tulmaythah) and during Roman and Byzantine times was of minor importance. Its recovery began with the Islamic invasions of the 7th century A.D. when it became the seat of government. In the 9th century new defensive walls were built, but after the Hilallian invasions of the 11th century Barca declined and was soon entirely abandoned. Its modern revival dates from 1835 when the Turks constructed a fort on the ancient site of Barca, round which a township grew up, taking the name Al Marj ("the meadows"). The new town expanded notably during the Italian occupation (1913–41), when it was linked with Bengasi by road and rail.

Al Marj (also called Barca) is now the seat of a *mutassarifiya* (district administration) and had an urban population in 1954 of 9,982. It is principally an agricultural and marketing town, with extensive private and governmental farms in its vicinity. Of its ancient history there are few visible remains, though Greek tombs and early Islamic Kufic inscriptions are periodically found.

(R. G. G.)

BARCAROLLE or BARCAROLE, a name given to a piece of music, deriving from the songs sung by the *barcaruoli*, the old Italian word for boatmen, particularly, in this case, of the gondoliers in Venice. It is usually in 6/8 time and in a gentle rhythm that was associated with the motion of the boat and the lapping of the waves. Nineteenth-century barcarolles are stylized examples of this model. Ferdinand Hérold, Auber, Donizetti and Offenbach are among the composers who introduced the barcarolle into opera, the last in *The Tales of Hoffmann*. Schubert used the barcarolle rhythm in his song "Auf dem Wasser zu singen" and Mendelssohn in his "Songs without words." Well-known barcarolles for the piano are by Chopin (Opus 60) and a series of 13 pieces bearing this name by Gabriel Fauré.

BARCELONA, COUNTS OF. The county of Barcelona came into existence in 801 when a Frankish army under Louis of Aquitaine (afterward the emperor Louis I) freed the city and surrounding territory from the Moors and incorporated it into the kingdom of the West Franks. The first count of Barcelona, installed in 801, was a Goth, BERA, but after his deposition (820) the county usually was conferred upon prominent Franks. Of these the most important was BERNARD of Septimania (d. 844), who was also count of Narbonne and for a short time exercised great influence at the imperial court.

The first hereditary count was GUIFREDO (Vifredo, Joffre) the Hairy (d. 898), who was awarded the counties of Barcelona and Gerona by the Frankish king Louis II le Bègue in 878. Guifredo was also count of Urgel and so ruled territory constituting the nucleus of the future principality of Catalonia. He was an able and energetic man who brought about the resettlement of central Catalonia and founded the monasteries of Santa María de Ripoll and San Joan Guifredo was succeeded by his sons GUIFREDO BORRELL (d. 911) and SUNYER (abdicated 947), who gradually freed themselves from Frankish control. Independence finally was secured during the reign of Sunyer's son BORRELL (d. 992), partly because the Carolingian dynasty had been replaced by the Capetians and partly because the Franks failed to respond to an

appeal for help when Barcelona was attacked by the Moors in 985.

Borrell's son RAMÓN BORRELL (972–1018), who became count in 992, organized an expedition to Andalusia and sacked Córdoba in 1010. His son and successor BERENGUER RAMÓN I (*c.* 1006–35) inherited the county in 1018 under the regency of his mother, Ermesindis (d. 1058). Berenguer Ramón's son RAMÓN BERENGUER I the Old (1024–76) imposed taxes (*parias*) on neighbouring Moorish kingdoms, promulgated the celebrated legal code *Usatges de Barcelona* and secured the enfeoffment of the adjacent counties of Ampurias and Pallars. He was succeeded by his sons RAMÓN BERENGUER II (1054–82) and BERENGUER RAMÓN II (1054–97) who reigned jointly from 1076 until 1082, when Ramón Berenguer was murdered, apparently by his brother. Berenguer Ramón reconquered the Tarragona area and reigned until 1097, when he retired to Jerusalem where he died, probably in that year. He was succeeded by the son of Ramón Berenguer II, RAMÓN BERENGUER III the Great (1082–1131), who reigned from 1097 to 1131. He acquired the counties of Besalú (1111) and Cerdaña (1117), fought against the Almoravids and undertook, with the Pisans, a joint expedition against the Balearic Islands (1114–15). He married Douce, countess of Provence, in 1112 which county he bequeathed to his second son. His eldest son, RAMÓN BERENGUER IV (1115–62), who succeeded him in 1131, was the last count of Barcelona to take this as his principal title, for from 1137, when he was betrothed to Petronila, queen of Aragon, Ramón Berenguer IV was also ruler of Aragon (though he himself never assumed the title of king). From the reign of his son, who in 1162 succeeded him with the title ALFONSO I, the counts of Barcelona styled themselves, in the first place, kings of Aragon. By his conquests from the Moors—Tortosa (1148), Lérida and Fraga (1149), Mequinenza, Prades and Siurana (1153)—Ramón Berenguer IV definitively established the boundaries of the principality of Catalonia (*q.v.*).

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BARCELONA, the chief Catalan province of northeastern Spain, was formed in 1833 from a number of districts stretching between the Pyrenees and the Mediterranean coast. Pop. (1960 est.) 2,560,464; area 7,734 sq.km. (2,986 sq.mi.); density of population 331 per sq.km. (857 per sq.mi.). The province follows the axis of the river basin of the Llobregat, from which its regions are symmetrically arranged. No province has more diversity of landscapes; it is a cross section of many varied geological zones, namely, the Pyrenees, the scarps and basins of the interior of Catalonia, the Serralada interior, the central depression, the Serralada del Mar, and the coastal plains. Bergadá on the borders of the Pyrenees is a mountainous tableland, framed by the Sierra del Cadí to the north. A pastoral region, it centres on Berga (pop. [1950] 7,870) with its lignite mines and cement works. Southwest, in the Cardona valley, the salt hills have been exploited since Roman times, but the potash deposits of Suria, discovered in 1912, produce over 1,000,000 tons annually and are of much greater economic importance. Westward is the arid *Segarra,* an inlier of the Segre depression, presenting a monotonous series of tablelands and scarps. In the northeast is the geological trough of the *Plana de Vich* at about 2,000 ft., dominated to the north by steep scarps and high tablelands (2,200–2,500 ft.) and merging southward into the rolling country of the Cabreres. The region is drained by the upper Ter and Congost: Vich (16,710) is located as an important route centre in the latter valley. A comparable geological basin of scarps and "badlands" to the southwest is *Bages,* drained by the Llobregat. Manresa (40,021) with its textile industry is already within the industrial influence of Barcelona. Downstream, the Llobregat cuts through an impressive defile at Montserrat (4,054 ft.), the Catalans' sacred mountain towering over 1,000 ft. above the river, with conglomerate pinnacles sometimes with a sheer fall of 400 ft. It is difficult to imagine these mountains as the ancient deltas (Oligocene) deposited on the northwestern edge of an ancient continent, still represented by the smooth skyline of the *Guillérias* (3,940 ft.) and Montseny (5,617 ft.). These granitic massifs northeast of Montserrat are deeply cut by the rivers separating high plateaus by gorges, a silent forested world formerly notorious for its banditry. Eastward from these remnants of the Serralada interior, the valleys of the Llobregat and Besós etch out a discontinuous lowland in the central depression (300–200 ft.), termed *Vallés* in the northern sector and *Panedés* south of the Llobregat. The clay lands of *Vallés* are the granary of the province with its twin woolen towns of Sabadell (57,594) and Tarrasa (57,729) (*qq.v.*). Granollérs (15,476) is an old centre of the region. The stony lands of the *Panedés,* gently folded into rolling hills, are famous for their vineyards and the wine centre of Villafranca (10,773).

Overlooking the central corridor to the east are the coastal ranges, interrupted by the valleys of the Llobregat, Besós and Tordera as the limestone massif of Garraf, Tibidabo overlooking Barcelona, the Sierra de Levante and the Costa Brava respectively. The coastal plain is discontinuous except at Mataró (31,011) and the delta of the Llobregat. The latter is Barcelona's market garden with over 50,000 ac. under intensive horticulture.

Barcelona province is the heart of the greatest industrial concentration of Spain and the chief seaport, having three-quarters of the textile manufactures and a high proportion of the chemical and engineering industries. It utilized the hydroelectric power sources of the Pyrenees and its strategic location for its own advancement. *See* also BARCELONA, city.

See Solé Sabaris (ed.), *Geografía de Catalunya,* 15 parts (1958–). (J. M. Ho.)

BARCELONA, the capital of the province of Barcelona, Sp., since 1833 (until which date it was the capital of Catalonia; *q.v.*), a port, commercial centre and seat of a bishop, is built on a gentle slope facing southeast to the Mediterranean, on the eastern coast of Spain. The city lies in a fertile plain, between the rivers Besós, to the northeast, and Llobregat, to the southwest, and is backed by an amphitheatre of mountains which culminate in the Tibidabo (1,745 ft.). The fortified hill of Montjuich (630 ft.) rises from the sea and separates the city from the mouth of the Llobregat. Pop. (1960 est.) 1,503,062 (mun.); municipal area 91 sq.km. (35 sq.mi.).

The oldest part of the city is built on a small hill, called by the Romans Monte Taber. The Roman walls are still visible in the Vía Layetana, which runs north from the Plaza de Antonio López near the harbour. They can also be seen in other streets including the Avenida de la Catedral, which joins the Vía Layetana at right angles in the Plaza de Antonio Maura. In the centre of the old city stands the cathedral. The present structure was built between 1289 and 1450 and the west front was added in the 19th century. Excavations, however, brought to light the remains of a 6th-century basilica. Close by, in the Plaza del Rey, are the chapel and great hall of the Palacio Real Mayor, the royal palace of the counts of Barcelona (mainly 14th century, but with earlier parts) and the 16th-century palace, housing the archives of the crown of Aragon, the most important series consisting of medieval documents and records. South of the cathedral are the archdeacon's house (16th century), containing the city's archives, and the episcopal palace. In the Plaza de San Jaime are the Diputación (congress hall), which was built in the 15th and 16th centuries and contains the chapel of San Jorge and the Orange Tree court. The Gothic town hall is a 14th- and 15th-century building with a modern façade.

Cutting through the old city to the west is the street called the Ramblas leading from the Puerta de la Paz to the Plaza de Cataluña, the centre of the modern Barcelona where there are numerous banking houses. In the Puerta de la Paz is the Columbus monument (199 ft. high and put up for the 1888 International exhibition) which overlooks the port, and also the Atarazanas, a 14th-century arsenal housing the maritime museum. The Ramblas, known for its charm, has seats beneath the double row of trees down either wide pavement, and many stalls where birds and flowers are sold. The opera house (1847, 1862) and other theatres are there. The Rondas, occupying the ground where the fortifications once stood, enclose in a semicircle the old city and the more modern part west of the Ramblas which, though

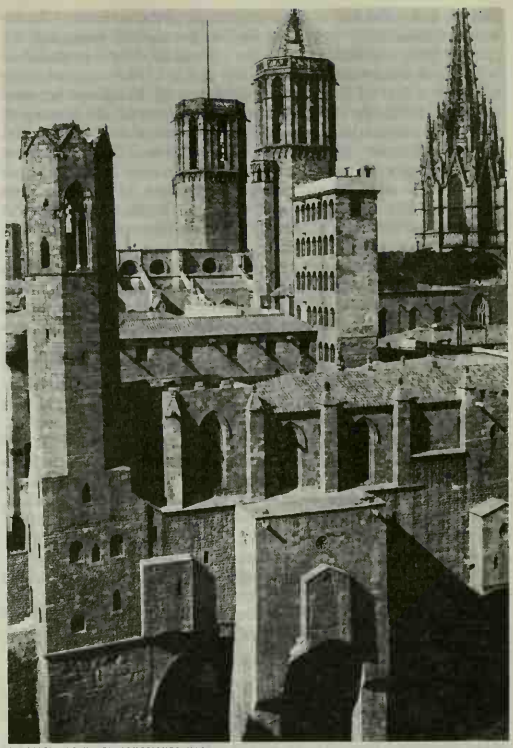
it has lain within the city bounds since 1350, was not built over until the 18th century. At the northernmost point of the Rondas is the Plaza de la Universidad through which runs the broad Avenida José Antonio (formerly known as the Avenida de las Cortes) with, at either end, an arena for bullfighting. The other great thoroughfare, the Avenida Generalísimo Franco (formerly Gran Vía Diagonal) is a residential street running southwest-northeast across the upper part of the town to the slopes of Pedralbes where a 14th-century monastery stands on the hillside. In the new part of Barcelona, laid out with broad straight roads crossing each other at right angles, is the huge and elaborate church of the Holy Family designed by Antonio Gaudí and begun in 1882 but far from finished by the early 1960s. The city park, to the east of the old city, occupies the site of the citadel erected in 1715 and destroyed during a revolt in 1868; it contains a zoological garden and aquarium, a natural history museum and a museum of modern art. East of the park, on a tongue of land that forms part of the port, the suburb of Barceloneta was built between 1752 and 1775 in rectangular blocks by order of the Marqués de la Mina, the commandant of the port. From 1864 onward the rapidly-increasing population of Barcelona poured out to the northwest and five villages were incorporated in the city between 1897 and 1904; Horta, to the northeast, was added before 1908 and that of Sarriá in 1922. Much of the hillside of Montjuich has been made into a fine park with terraced gardens, statues and an open-air theatre. Two of the palaces there, built for the International exhibition of 1929, house the Museum of Fine Arts of Catalonia and the Museum of Archaeology.

The university (Universidad Literaria) was founded in 1430 by the magistracy of the city and received a bull of confirmation from Pope Nicholas V in 1450, though Barcelona was a seat of learning long before. The college of medicine and surgery was confirmed by a bull of Benedict XIII in 1400. The university was transferred to Cervera in 1714, restored in 1841, and enlarged in the 1950s when a big group of buildings was put up close to the royal palace of Pedralbes on the lower slopes of the hills near Sarriá. There are also academies of letters, natural sciences and fine arts. The principal charitable foundations are the Casa de Caridad ("House of Charity") and the hospital of Santa Cruz, which dates from 1401 but was moved to a new building outside the city. The old hospital contains the Central library and other learned bodies, while in its grounds is the Royal Academy of Medicine, founded at the end of the 18th century.

Communications within the municipal area were improved in Dec. 1924 by the opening of a tube railway. The Prat airport, 7 mi. W. in the plain of Llobregat, serves international airlines. Railways connect Barcelona with the rest of Spain and with France.

The Port and Industries.—The port of Barcelona, at first little more than an open roadstead, was improved in 1474 by the construction of a mole, the Moll de Santa Creu, but the harbour proper dates from the 17th century. It was greatly enlarged after 1873, and again after 1903, and includes an outer and inner harbour. The outer harbour is protected by two breakwaters, the easternmost of which was extended, and is entered by a channel 33 ft. deep; the inner harbour can usually provide accommodation alongside the quays for vessels drawing 24 to 27 ft. The floating dock is able to admit vessels of 10,000 tons. Transatlantic ships call at Barcelona and also those from Mediterranean and northern European ports.

As a commercial city, Barcelona is the centre for the entire industrial area of Catalonia, which has its warehouses there. As an industrial city, it is characterized both by the great variety of its manufactures and by the amount of almost domestic manufacture, carried out in small workshops. The textile industry, especially the cotton industry, revived around 1750, is the most important, but the engineering works, including works for the construction of rolling stock for the railways, employ large numbers of persons. Foodstuffs, raw materials and combustibles form the greater part of the imports, but a considerable quantity of foreign manufactured goods is also imported. The principal exports are wine, olive oil, silk, cork, sandals, fertilizers, woolen and cotton goods and paper.



AMPLIACIONES Y REPRODUCCIONES MAS

ROOFTOPS OF THE OLDEST PART OF BARCELONA WHICH DATES FROM THE 6TH CENTURY

History.—During the Roman period Barcino, a town of the Lacetani, raised to the rank of a colony under the name of Pía Faventia and Julia Augusta (afterward Pía and Augusta), gradually replaced Tarraco (Tarragona) as a seaport. The Bardjaluna of the Moors, who captured it in 713, it became, after its reconquest by the Franks in 801, the chief town of the Marca Hispánica and, by the end of the 9th century, of the independent countship of Barcelona with recognized supremacy over its neighbours. The union in 1137 of Catalonia and Aragon was followed by the rise to political importance of the wealthy merchant class, from which were elected, at first exclusively, the members of the municipal council (*Consell de Cent*) of Barcelona. Barcelona now became one of the foremost trading cities of the Mediterranean, the rival of Genoa and Venice, and its maritime code, *Consulado de Mar*, dating from the late 13th century, was for long widely recognized as authoritative (*see* "Consulate of the Sea").

By 1479, the date of the union of Aragon with Castile, the city had extended its direct jurisdiction by the technical inclusion within the municipality of protected areas scattered over Catalonia. In municipal politics a democratic tradition had been established. The merchants, and sometimes representatives of the lower classes, ruled the council with a marked independence of royal authority which was shown by the successful resistance of the city to John II of Aragon during the ten years ending in 1473.

The power of the Turks in the Mediterranean and the difficulties of commerce due to their politics strongly prejudiced Barcelona and its commerce, as did also the monopoly of the American trade retained by Castile until 1778. Barcelona like most of Catalonia took the part of the Austrian pretender during the War of the Spanish Succession. The city was taken in 1705 by the

English under the earl of Peterborough, and the archduke Charles was enthusiastically welcomed by the population, who paid the price of their enthusiasm when the *Consell de Cent* was abolished by Philip V after the recapture of the city in 1714. No permanent traces were left of the French occupation of Barcelona between 1809 and 1813. In the modern period after 1815, the history of Barcelona was marked by episodes indicative of social, industrial or political unrest, the combination of different forms of unrest in one complex movement being characteristic of the city. Specially serious were the uprising of 1835, when 11 convents were destroyed, and of the "tragic week" in 1909, when over 60 churches and religious buildings disappeared from the city's architectural inheritance.

The military committees of defense had their headquarters there in 1916, and it was there that the movement began which led to the establishment of the military directory in 1923. The evolution of the labour movement from the earlier, pacific phase of the General Workers' union (*Unión General de Trabajadores*), founded at the second Barcelona congress in 1888, to the phase characterized by the terrorist action of the anarchist *Sindicato único* led to the revolutionary strikes of 1919 and 1920. Barcelona was also the headquarters of the Catalonian separatist movement, and on Aug. 2, 1936, following the outbreak of civil war in Spain, it became the seat of an autonomous Catalonian government. During the civil war it became the main centre of Republican strength and suffered some damage from bombing. The fall of Barcelona almost without resistance, on Jan. 26, 1939, doomed the cause of the Republican government and led to its final surrender in March. The city later prospered and expanded.

See also Index references under "Barcelona" in the Index volume.

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(X. D. S.)

BARCELONA, a city and river port in Venezuela. It is the capital of the state of Anzoátegui and lies on the west bank of the Neveri river 3 mi. inland from the Caribbean and 150 mi. E. of Caracas. Pop. (1961) 40,733. It is connected by rail with its port of Guanta, 11 mi. distant, and with the Naricual coal fields. The site has not been a healthful one but the surrounding area is fertile and productive. Thus Barcelona naturally became the commercial focus for a region productive of cattle, coal, coffee, cotton, salt, sugar cane and tobacco. Cotton is ginned in the city and leather goods and jerked beef are produced. The development of petroleum in central Anzoátegui brought some prosperity to Barcelona, even though it and Guanta became overshadowed by the phenomenal expansion of Puerto La Cruz (*q.v.*) 6 mi. to the east.

Barcelona dates from 1634, when it was situated several miles farther inland; it was moved to its present site in 1671.
(L. WE.)

BARCLAY, ALEXANDER (*c.* 1476–1552), English poet whose adaptation from the German of the popular Renaissance satire, the *Ship of Fools,* became famous. His nationality is a matter of dispute. William Bulleyn, who probably knew him when he was at Ely, asserts that he was born "beyonde the cold river of Twede" but the records of his ordinations describe him as "of the diocese of Lincoln." Whatever his birthplace, his language is English, not Scots, and his writings belong to the history of English literature. By 1508 he had become chaplain of the college of St. Mary Ottery, Devonshire. Here he adapted the German satire *Narrenschiff* ("Ship of Fools," 1494) by Sebastian Brant (*q.v.*) and even introduced his neighbours into the satire:

> For if one can flatter, and beare a Hauke on his fist,
> He shall be parson of Honington or Clist.

Later on he became a monk in the Benedictine monastery of Ely. There he probably wrote his eclogues, but in 1520 "Maistre Barkleye, the blacke monke and poete" was desired to devise "histoires and convenient raisons to florisshe the buildings and banquet house withal" at the meeting between Henry VIII and Francis I at the Field of Cloth of Gold. He at length became a Franciscan friar of Canterbury. It is presumed that he conformed with the change of religion, for he retained under Edward VI the livings of Great Baddow, Essex, and of Wokey, Somerset, which he had received in 1546, and was presented in 1552 by the dean and chapter of Canterbury to the rectory of All Hallows, Lombard street, London. He died shortly after this last preferment, at Croydon, Surrey, where he was buried on June 10, 1552.

The *Ship of Fools* (*The Shyp of Folys of the Worlde,* first printed 1509) is not a close translation of Brant but an adaptation "some tyme addynge, somtyme detractinge and takinge away." It describes an imaginary ship's company of fools and worse—the bibliophile who collects books but learns nothing from them, the evil judge who takes bribes to favour the guilty, those too eager to follow the fashion, the priests who spend their time in church telling "gestes" of Robin Hood, and so forth. Some of the scenes have a certain vigour and occasional lines are effective; but for the most part the writing is prolix and pedestrian and the metre (ostensibly "rhyme royal") is very incompetently handled.

Certayne Egloges of Alexander Barclay Priest (reprinted as *Eclogues,* ed. by B. White, Early English Text society, no. 175, 1928) written in his youth, appeared in several partial editions from about 1530. The first complete edition is that in John Cawood's reprint (1570) of the *Shyp of folys.* These were the first formal eclogues in English. In them Barclay gives some entertaining pictures of rustic life: the Sunday games in the village, football, and the struggle for food at great feasts; but they are, like his Italian models, also satires on social evils. Though Barclay drew extensively upon humanist writers, he remained largely medieval in his treatment of their themes. His prose is more accomplished than his verse.

BIBLIOGRAPHY.—His other works are: *The Castell of Labour,* not certainly his (first printed in Paris *c.* 1503; by Wynkyn de Worde, 1506), tr. from the French of Pierre Gringoire; the *Introductory to write and to pronounce Frenche* (Robert Copland, 1521); *The Myrrour of Good Maners* (Richard Pynson, undated), a translation of the *De quattuor virtutibus* of Dominicus Mancinus; a *Cronycle compyled in Latyn by the renowned Sallust* (Pynson, undated), a translation of the *Bellum Jugurthinum; The Lyfe of the glorious Martyr Saynt George* (Pynson *c.* 1515; ed. by W. Nelson, Early English Text society, no. 230, 1955). *The Lyfe of Sainte Thomas* and *Haython's Cronycle,* both printed by Pynson, are also attributed to Barclay, but on very doubtful grounds.

See T. H. Jamieson's edition of the *Ship of Fools* (1874), which contains an account of the author and a bibliography of his works; A. Pompen, *The English Versions of the Ship of Fools* (1928). (N. D.)

BARCLAY, JOHN (1582–1621), Scottish satirist and Latin poet whose *Argenis* had great influence on the development of the romance in the 17th century, was born at Pont-à-Mousson, near Nancy, where his father held the chair of civil law. In 1603 he went to London, but in 1605 he was again in Paris. His *Sylvae,* however, was printed in London in 1606, and he remained in London until 1616. He then went to live in Rome, where he died on Aug. 15, 1621.

His *Satyricon* (1603–07), a severe satire on the Jesuits, is modeled on Petronius. His most celebrated work was the *Argenis* (1621, trans. 1623?, 1625, 1629), a long poem of romantic adventure. Its political implications were so marked that many editions were supplied with a key to the characters and names. Its fame on the continent persisted, and inspired learned studies, notably by K. F. Schmid (1904) and L. Bardino (1939).

See also G. Langford, in University of Virginia *Abstracts of Dissertations* (1940).

BARCLAY, JOHN (1734–1798), Scottish founder of a religious sect called Bereans because of their diligent study of the Scriptures (Acts xvii, 10, 11), was born at Muthill in Perthshire and educated at St. Andrews university. He was expelled from the Church of Scotland on May 24, 1773, mainly because of his unorthodox assertion that faith was an intellectual act, not merely a passive state. He formed congregations at Sauchyburn in Kincardineshire and in Edinburgh and visited London and Bristol, but after his death in Edinburgh on July 29, 1798, his teaching was quickly forgotten. His writings, which included paraphrases of the Psalms, were edited by J. Thomson and D. Macmillan (1852).

BARCLAY, ROBERT (1648–1690), Scottish apologist of the Society of Friends, was born at Gordonstown, near Elgin, on Dec. 23, 1648. He was educated at the Scots college in Paris, and after his return to Scotland joined the Society of Friends. A public discussion of his *Theses Theologiae,* printed in English, Latin, French and Dutch, was held at Aberdeen (March 14, 1675). Barclay's great work, *An Apology for the True Christian Divinity held by the Quakers* (1678), was written in defense of his *Theses.* The number of editions through which the *Apology* has gone since its appearance gives some indication of its importance. In it the Quaker movement defined itself against both Roman Catholicism and classical Protestantism, including Anglicanism, as a religion of the "inner light." Neither the church nor the Scriptures could claim completeness or ultimate authority, but the Holy Spirit working within the believer granted the assurance of salvation. The *Apology* was one of the first, and is still one of the most popular, of systematic statements of Quaker doctrine.

Barclay himself experienced to some extent the persecutions inflicted on the new society, and was several times thrown into prison. In later years he had much influence with James II, who as duke of York had given to 12 members of the society, under the leadership of Penn, a patent of the province of East New Jersey, Barclay being made nominal governor (1682–88). He is said to have visited James with a view to making terms of accommodation with William of Orange, whose arrival was then imminent. He died on his estate at Ury, near Aberdeen, on Oct. 3, 1690. His wife, née Catherine Gordon, who was also a Friend, lived until Dec. 14, 1722.

See Barclay's collected works under the title of *Truth Triumphant* (1692; 2nd ed. 1717–18); and M. C. Cadbury, *Robert Barclay, His Life and Work* (1912). (J. J. Pn.)

BARCLAY DE TOLLY, MIKHAIL BOGDANOVICH, Prince (1761–1818), Russian field marshal important for his services in the Napoleonic wars, was born at Luhda-Grosshof in Livonia, on Dec. 27 (new style; Dec. 16, old style), 1761, of a Scottish family that had settled in Russia in the 17th century. Entering the Russian army in 1786, he served against Turkey (1788–89), against Sweden (1790) and against Poland (1792–94). In the 1806 campaign against Napoleon he took a distinguished part in the battle of Pultusk and was wounded in the battle of Eylau, where his conduct won him promotion to the rank of lieutenant general. In 1808–09 he commanded against the Swedes in Finland. In 1810 he became minister of war, a post which he retained until 1812.

In 1812 Barclay was made commander of one of two Russian western armies operating against Napoleon. His tactics of avoiding decisive action and retreating into Russia, however, aroused strong criticism, and after defeat at Smolensk he resigned his command to serve under the veteran general M. I. Kutuzov, who followed the same tactics with success. Barclay was present at the battle of Borodino, but soon afterward left the army. In 1813, however, he was recalled to service and took part in the campaign in Germany. After the battle of Bautzen he was made commander in chief of the Russian forces. In this capacity he was present at the battles of Dresden, Kulm and Leipzig. After the last battle the emperor Alexander I bestowed on him the title of count. Barclay took part in the invasion of France in 1814 and in Paris he received the baton of field marshal. In 1815 he was again commander in chief of the Russian army that invaded France, and at the end of this war he was made a prince. He died at Insterburg (now Chernyakhovsk, R.S.F.S.R.) in East Prussia, on May 26 (N.S.; 14, O.S.), 1818. (I. Gy.)

BAR-COCHBA (Bar-Cocheba; originally Shimon bar Kosebah or bar Koziba) (d. A.D. 135), leader of the Jewish revolt against the Romans in Palestine during the reign of the emperor Hadrian. The revolt of Bar-Cochba, which began in A.D. 132, was provoked by Hadrian's repressive edicts against Judaism (*see* Palestine) and received considerable impetus when the great rabbi Akiba (*q.v.*) hailed him as the Messiah, giving him also the name Bar Kokhba ("son of a star") instead of his original one. Though the detail of its course is obscure, the rising was at first very successful against great odds. Bar-Cochba took the title of prince of Israel and struck coins in his name and that of the high priest Eleazar. The Romans, however, sent a large army to Palestine under Julius Severus, who reduced the rebel strongholds one by one. Bethar (Bittir, near Jerusalem) fell to the Romans in A.D. 135, Bar-Cochba being killed in the fighting. The remnant of his followers took refuge in the desert by the Dead sea.

In 1960 the Israeli archaeologist Y. Yadin discovered 15 dispatches by Bar-Cochba in a bundle of papyri in a cave in the desert by the Dead sea. From these he appears as a dynamic, stern commander, prompt to enforce obedience.

BARD, a word of Celtic origin applied by classical authors (Gr. *bardos,* Lat. *bardus*) to Celtic composers of eulogy and satire who formed a learned order lower than those of the druids and the *vates* ("seers"). The word is not used by Cæsar, in his account of the manners and customs of Gaul and Britain, but he appears to ascribe the functions of the bards to a section of the druids. Later Latin authors, such as Lucan, used *bardi* as the recognized title of the national poets or minstrels of Gaul and Britain. In Gaul the institution disappeared, but in Ireland and Wales it survived. The Irish *bárd* assisted the *fili* and chanted the eulogies composed by the latter (*see* Irish Literature). The Welsh word *bardd* has always been used as a general term for "poet," but the Laws, codified by Hywel Dda in the 10th century, mention three grades: the *pencerdd* ("chief poet"), the *bardd teulu* ("poet of the war-band") and the *cerddor* ("minstrel"). In Wales the bardic order declined toward the end of the middle ages, despite a series of *eisteddfodau,* representing formal congregations of bards, held during 1450–1600. However, the bardic technique and conception of poetry continued in the system of *cynghanedd* ("harmony" dependent on alliteration and internal rhyme), the distinctive feature of the canonical metres. In the modern *eisteddfod* the chaired poet (*bardd y gadair*) composes in strict *cynghanedd* metres, whereas the crowned poet (*bardd y goron*) composes in free metres. For the spurious grading of the bardic order, *see* Eisteddfod.

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BARDEEN, JOHN (1908–), U.S. theoretical physicist, a winner of the Nobel prize for physics in 1956, was born May 23, 1908, in Madison, Wis. After receiving the B.S. and M.S. degrees at the University of Wisconsin, he obtained the Ph.D. degree in mathematics and physics at Princeton university. During 1935–38 he was a junior fellow in the Society of Fellows, Harvard university.

Before World War II he was on the staff at the University of Minnesota. During the war he served as principal physicist at the U.S. naval ordnance laboratory, Washington, D.C. In 1945 he joined the Bell Telephone laboratories. While there the work on the transistor (*q.v.*), a device which replaced electronic tubes in many applications, was done. It was for this work that the Nobel prize was awarded—the award being shared with William B. Shockley and Walter H. Brattain (*qq.v.*), also members of the Bell Telephone laboratories.

Bardeen is especially recognized for a theory of superconductivity—the vanishing of the electrical resistance of some metals at low temperatures—and for contribution to theoretical understanding of semiconductors.

In 1951 he joined the staff of the University of Illinois. He was awarded the Ballentine medal of the Franklin institute (1952), the Buckley prize (1954) and the Scott medal (1955), and was elected member of the National Academy of Science. (J. W. B.)

BARDESANES (Bardaisan; Bar-Daisan) (154–222), an early Christian writer, was born and died at Edessa in Syria. He lived at court and wrote scholarly treatises and hymns in Syriac, becoming in a sense the creator of Syriac literature. His works were sufficiently popular after his death to cause Ephraem Syrus to write some of his poems to counteract their theological errors. Bardesanes also had a great influence on Mani and Manichaeism.

The only complete work of Bardesanes that has survived,

Dialogue of Destiny, or the Book of the Laws of the Nations, usually is identified with the treatise on fate mentioned in Eusebius' church history, in Jerome's sketches of famous men and in Epiphanius' treatise on heresies. Considerable passages of it in Greek translation are quoted by Eusebius in his *Praeparatio evangelica,* and other fragments of Bardesanes in Greek translation also survive.

Bardesanes often has been treated as a Gnostic, and was even called a Valentinian in Hippolytus' work against heresies. In his own day the orthodox Christians were probably a small minority at Edessa, ranking below Marcionites, Jewish Christians and Encratites. It would be fairer, perhaps, to regard Bardesanes' conceptions as the optimistic reaction of a gifted Christian against Gnosticism. Though he owed not a little to astrology, Greek philosophy and indeed to Gnosticism itself, it would appear that in his own period he was not heterodox. Bardesanes is neither an emanationist nor a dualist. His cosmogony accounts for the universe as the work of the Logos. This work, however, is still incomplete: some darkness remains to be overcome by the forces of light. Christians to him are the "new race," partaking in the conquest of darkness by their free obedience to God. Their outer circumstances depend on fate, but their ethical decisions are free. His emphasis on faith ("you have only to believe the faith and you will be able to know everything"), his monotheism and the fact that his contemporaries accepted him as orthodox seem to indicate that any heretical views he may have held concerned only peripheral matters, on which speculation was inevitable in his day.

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BARDI, an Italian family conspicuous among the rich nobility of Florence. Having risen from obscure origins to become during the 13th century the most powerful of Florentine business houses engaged in international trade and banking, the Bardi were naturally one of the overmighty families penalized in the Florentine antimagnate ordinances of justice of 1293 and 1295, of which they remained among the most active opponents. In 1341 they were forced to surrender the lordship of Mangona and Vernio, one-time fiefs of the Alberti counts in the hills behind Florence, which they had lately acquired by purchase; but they soon recovered Vernio. Their political importance ceased abruptly in 1345 when injudicious loans to Edward III of England, aggravated by the cost of local war with Lucca, involved them in the most publicized and resounding bankruptcy of medieval times. However, they continued trading and retained a place among the richer nobles of Florence. Notable among them was Giovanni, conte de Vernio (1534–1612), student and patron of music and letters. The family died out in the 19th century, but the name survives in the Via de' Bardi in Florence, where their urban properties were situated.

See F. de' Bardi, *Vernio, vita e morte di un feudo* (1883); A. Sapori, *La crisi delle compagnie mercantili dei Bardi e dei Peruzzi* (1926).

BARDI, GIOVANNI, COUNT OF VERNIO (1534–1612), Italian musician, writer and scientist, who was born in Florence, Feb. 5, 1534, was the leader of the group known as the Florentine *Camerata,* which he founded about 1580. Their attempts to revive Greek music created the monodic style which prepared the way for opera (*q.v.*). The group included the poet O. Rinuccini, the theorists V. Galilei and G. Mei, and the composers G. Caccini, J. Peri, P. Strozzi, E. de Cavalieri and C. Malvezzi, with most of whom Bardi collaborated in court entertainments from 1579 to 1608. His *Discorso mandato a Caccini sopra la Musica Antica* (1580) develops ideas similar to those of Galilei and Caccini: counterpoint obscures the words in musical settings, and should be abandoned; music should consist of a single vocal line, lightly accompanied, exactly reflecting the rhythm and intonation of speech. Ironically, Bardi's only surviving compositions are two highly contrapuntal madrigals. He died in Florence in 1612.

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BARDSEY, an island off the tip of the Llyn (or Lleyn) peninsula of Caernarvonshire, north Wales. Pop. (1951) 14. Area 0.7 sq.mi. The name is derived from Old Norse "Baror" (a personal name) and "ey" (island) and dates from the Viking age. The Welsh *Ynys Enlli* means "island of the current," referring to the swift and dangerous tide race of Bardsey sound. The island is a continuation of the Caernarvonshire hills separated from the mainland by a submergence of Pleistocene date. The sound thus formed is about 2 mi. wide and connects Caernarvon and Cardigan bays. A religious house, the earliest in Wales, was founded on the island by St. Cadfan in the early 6th century. It was later superseded by an Augustinian abbey, dedicated to St. Mary. The legendary burial place of 20,000 saints, Bardsey was famous as a goal of medieval pilgrimages. After the Dissolution, the abbey was granted to a Caernarvonshire squire, whose descendant retains ownership of the island. A favourite haunt of 16th-century pirates, the island was later ruled by a "king" chosen from among its fisher-farmers. It has a lighthouse, erected in 1821, and is a nature reserve. A bird and field observatory was established on the island in 1954. (W. O. W.)

BAREILLY, a city in Uttar Pradesh, north central India, headquarters of the Rohilkhand division and Bareilly district, is on the Ramganga river, 133 mi. E.S.E. of Delhi. Pop., city, (1961) 273,204. Municipal area 23 sq.mi. It has a suburb for railway employees and an extensive military cantonment. Its architectural monuments include a fort built in 1657 and a number of fine mosques of which the chief are the Mirzai Masjid (1579), Jamma Musjid ("great mosque") built in 1667, Gudri-ka-Masjid and Husain Bagh Baradari. Other places of note are the palace of the nawab of Rampur, the Mirzai Bagh and Company Bagh gardens, the garden and temple of Champat Rai, the tomb of Hafiz Rahman Khan (1775) and the American Methodist Episcopal mission. Bareilly college, affiliated to Agra university, was founded in 1837. The Indian Veterinary Research institute is in the suburb of Izatnagar.

Bareilly is a commercial centre on the road and railway (North-eastern metre-gauge system) linking Mathura and the plains with the Himalayan districts. It is at the junction of these routes with the main road and Northern railway system (broad-gauge) main line from Delhi to Lucknow. Another Northern railway system link runs westward to Chandausi on the Moradabad-Aligarh line.

Bareilly is known for its indigenous sugar industry. Manufactures also include rosin, catechu, matches, textile bobbins, cotton rope, tents, *durris* (coarse cotton rugs) and furniture.

The city, a 16th-century settlement, was built mainly by Makrand Rai, a governor appointed by the Mogul emperor Shah Jahan in 1657. It was the capital of the Rohillas (*see* below) in the 18th century, and in the 1857 Indian mutiny was the centre of a considerable popular rising against the British.

BAREILLY DISTRICT is open country on the southern fringe of the Himalayas, sloping gradually from north to south. Pop. (1961) 1,481,311. Area 1,591 sq.mi. Its soil is fertile and is watered by the Ganges tributary Ramganga and its subtributaries, and by canals. To the north of the district is a continuation of the *Tarai* (*q.v.*), whose forest (jungle) intrudes into it at several places for a few miles. Two-thirds of the people depend on agriculture; the main crops are wheat, rice and sugar cane.

Twenty-one miles northwest of Bareilly is the ancient fortress city of Ahichhattra, near the modern village of Ramnagar. In the *Mahabharata* it is mentioned as the capital of the kingdom of northern Panchala and a centre of Vedic culture. The Chinese Buddhist traveler Hsüan Tsang records in the 7th century A.D. that there were ten Buddhist monasteries with 1,000 monks and nine Brahmanical temples of Siva. Buddha is said to have

preached there for seven days to convert the Naga king, and the emperor Asoka (*q.v.*) later built a stupa or relic mound on the hallowed spot. These structures are now marked only by mounds and heaps of ruins.

ROHILKHAND DIVISION consists of the districts of Bijnor, Budaun, Moradabad, Pilibhit, Rampur, Shahjahanpur (*qq.v.*) and Bareilly. Total pop. (1961) 8,505,041. Area 11,705 sq.mi.

The Rohillas, a migrant Afghan or Pathan clan, gained control of a rich tract corresponding roughly with the modern division during the breakup of the Mogul empire in the early 18th century. It was the Rohilla raider-chief, Ghulam Kadir, who, enraged at not finding treasure in the Delhi palaces, blinded Shah Alam in 1788. (B. St.)

BARENTS, WILLEM (d. 1597), the most important Dutch navigator to search for a northeast passage to Asia, was born about the middle of the 16th century. In 1594 he left Amsterdam with two ships and reached the west coast of Novaya Zemlya, which he followed northward until forced to turn back near its northern extremity. In the following year he commanded another expedition of seven ships which made for the strait between the Asiatic coast and Vaigach Island, but was too late to find open water. On his third journey he had two ships and sighted both Bear Island and Spitsbergen. The ships then separated and Barents' vessel, after rounding the north of Novaya Zemlya, was beset by ice and he was compelled to winter in the north. As his ship was not freed in 1597, his party abandoned her, leaving in two open boats on June 13, and most of its members escaped. Barents himself died on June 20, 1597. In 1871 the house in which he wintered was discovered, and many relics from it are preserved at The Hague. In 1875 part of his journal was found. The arctic sea between Spitsbergen, Novaya Zemlya and Scandinavia was named after him.

See Gerrit de Veer, *Three Voyages . . .*, trans. by the Hakluyt Soc. (1876) from de Veer's text (1598).

BARENTS SEA, a part of the arctic water system, is framed by north Norway and the U.S.S.R. on the south, by Novaya Zemlya on the east, by Franz Josef Land on the north, and by Spitsbergen and Bear Island on the west. It is shallow, being entirely on the continental shelf, and occupies an area of 529,096 sq.mi. The first voyages into the sea were probably those of the Vikings in the 9th century. Russians appeared on the Murman coast in the 12th century, and in 1496 the Russian ambassador to Denmark sailed to his post through the Barents sea. In the 16th century English and Dutch seamen penetrated into it when searching for a northeast passage. In particular the Dutch sailor Willem Barents in 1594–97 crossed it several times, and died on the east coast of Novaya Zemlya while wintering there. The sea was first named after him on a map published by A. Petermann in 1853. In the 19th century a number of scientific expeditions, Russian and Norwegian, worked there, and Franz Josef Land was discovered in 1873. Since 1898 there has been a permanent Russian scientific station working on Barents sea problems. The zoologist N. M. Knipovich (1862–1939) was closely associated with this work at its start and for many years thereafter.

The air temperature over the Barents sea rarely goes far above 50° F. in summer, but in winter temperatures range from 14° to below zero. The Gulf stream (the North Atlantic current) brings to the southern part of the sea salt and relatively warm water of Atlantic origin from the west coast of Norway. In the northern part, however, the surface water is mostly polar, relatively fresh and cold. This cold water reaches to the neighbourhood of Bear Island and, when south winds bring relatively warm air to this region, extensive fogs are formed over the cold water. Ice never covers the whole sea, but in winter all but the southwest quadrant is covered. Access by ships to the White sea is thus impeded, but not to Murmansk (*q.v.*) which is almost the only Soviet port remaining ice-free all the year round. In the summer the ice retreats to the extreme north of the sea, and navigation to northern Novaya Zemlya and even Franz Josef Land is not difficult. The ice is almost all sea ice of local origin, but icebergs from the glaciers of Spitsbergen and Franz Josef Land are also found.

The importance of the fisheries in the Barents sea is increasing, the greater number of fish now found there being due in part to the general warming of the climate (*see* ARCTIC, THE: *Climate*). In the southern parts with their warmer water a number of marketable fishes are found on the sea floor. There are Russian fisheries in the White sea, reserved exclusively for them, and in the territorial waters on the coast; in the open sea the catches are made mostly by Russian, Norwegian and British trawlers which work even in winter in spite of great difficulties due to storms and the long darkness. The development of the steam trawler industry in the Barents sea and in Icelandic waters is partly due to the diminished returns from the fishing of the North sea. The most important fish in the Barents sea are cod, haddock and plaice, also Norway haddock. The most important mammals are the Greenland seal, which gather for breeding in January and February at the entrance to the White sea. Bearded seal, ringed seal, some toothed whales, polar bears and walrus are also found.

See also ARCTIC, THE: *The Arctic Ocean.* (T. E. A.)

BARÈRE DE VIEUZAC, BERTRAND (1755–1841), French revolutionary and member of the committee of public safety, was born at Tarbes on Sept. 10, 1755. He served as an advocate in the *parlement* of Toulouse (1775) and as a councilor in the *sénéchaussée* of Bigorre and became a member of the academies of Montauban and of Toulouse and of a masonic lodge. He married Elisabeth de Monde, a pious young woman of the impoverished nobility, in 1785, but saw no more of her after 1792. Elected to represent Bigorre in the estates-general of 1789, he frequented the house of Mme. de Genlis in Paris and founded an interesting and objective periodical, *Le Point du jour.*

Under the Constituent assembly, he was a member of the committees on *lettres de cachet* and on domain property. He joined the Society of Friends of the Truth and the Jacobin club, but rarely appeared at the latter. Appointed tutor to Paméla, the future Lady Fitzgerald, a natural daughter of the duc d'Orléans (Philippe Égalité), he seems to have remained attached to the latter and his family. Elected a judge in the tribunal of cassation in 1791, then deputy for Hautes-Pyrénées in the Convention in Sept. 1792, he served in the committees on legislation, on the constitution and on education and presided over the assembly on several occasions. In 1793 he voted for the death of Louis XVI and played an important part in the refusal of the stay of proceedings against him. He also did much to bring about the arrest of the Girondin deputies after June 2.

Barère's clearheadedness and extensive knowledge made him an important member of the committee of public safety, and he produced more than 200 reports on a great number of subjects. Believing that only vigorous measures could save the country, he collaborated with Robespierre, who regarded him as "a weak man but never the enemy of the public welfare." Yet Barère showed his opportunism and social conservatism on 9 Thermidor (July 27, 1794), when he deserted Robespierre's party. Even so he was proscribed by the Thermidorians in April 1795, and imprisoned first on the Isle of Oléron, then at Saintes. In the following winter he escaped and spent five years in hiding in Bordeaux. There he wrote *La Pensée du gouvernement, La Liberté des mers,* and began his *Mémoires,* but had to sell most of his possessions to keep himself alive. Barère was a secret agent under Napoleon I, but in 1816, after the Restoration, had to go into exile as a regicide at Brussels. He returned to France in 1830, settled at Tarbes in 1832 and was elected to the general council of Hautes-Pyrénées in 1834. Louis Philippe granted him some allowances. He died on Jan. 13, 1841.

See R. Launay, *Barère de Vieuzac, l'Anacréon de la guillotine* (1929); L. Gershoy, "Barère in the Constituent Assembly," *American Historical Review,* vol. xxxvi (1930). (MA. BO.)

BARETTI, GIUSEPPE MARC' ANTONIO (1719–1789), Italian critic who attacked some literary fashions of his time, and was a friend of Samuel Johnson, was born in Turin on April 25, 1719, and educated in Milan and Venice. In 1751 he went to London and became associated with Johnson's circle; he returned to Italy in 1760 and described his journey in his *Lettere familiari* (1762–63), later elaborated in *A Journey From London to Genoa* (1770–71). Under the pseudonym Aristarco Scannabue

he published the periodical *Frusta letteraria* (1763–65), in which he attacked contemporary writers. In 1766 he went to live in England, where in 1769 he was involved in a street fight in which he killed, in self-defense, one of his attackers. At his trial, at which he was acquitted, evidence was given for him by Johnson, Sir Joshua Reynolds, David Garrick, Oliver Goldsmith and others. Baretti published the *Discours sur Shakespeare et sur monsieur de Voltaire* in 1777 and a *Scelta di lettere familiari* which, apart from providing a text for students of Italian, is the most serious expression of his moral and literary opinions, in 1779. His numerous other publications include *An Account of the Manners and Customs of Italy* (1768), in answer to Samuel Sharp's libelous *Letters from Italy* (1766), *A Dissertation Upon the Italian Poetry* (1753) and *The Italian Library* (1757), which was intended to make Italian literature better understood in England. In his letters he shows himself an enemy of pedants and amateurs alike. He died in London on May 5, 1789.

Baretti's works were collected in seven volumes (1813–20) and in four volumes (1838–39); the *Prefazioni, Scelta delle lettere, Frusta,* and *Epistolario* were edited by L. Piccioni in the "Scrittori d'Italia Series" (1911–36).

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BARGEBOARD, also VERGEBOARD, as sometimes written, in architecture, the exposed board running down the slopes of a projecting gable roof: a false rafter. Bargeboards are frequently decorated. In the Tudor period in England, and in the late Gothic period throughout Europe, they became extremely rich decorative features.

BY COURTESY OF THE NATIONAL BUILDINGS RECORD. PHOTO BY M. CROSSLEY

BARGEBOARD OVER THE EAST ENTRANCE OF SPEKE HALL, LIVERPOOL, ENG.: 1598

BARGES AND CANAL CRAFT. The term "barge" was originally applied to a small sailing vessel, but later came into general use to designate a flat-bottomed boat used for carrying goods on inland waterways. A state barge was a heavy, often highly ornamented vessel used for carrying passengers on ceremonial occasions. This article describes the barges and other craft used for commercial transport on canals and rivers in the United States and in Europe, their methods of propulsion and their cargo. For related information *see* WATER TRANSPORT, INLAND; RIVER AND RIVER ENGINEERING.

UNITED STATES CRAFT

Early Types.—In the United States and Canada the use of lighters, barges to load and unload vessels in harbours, was introduced from England in colonial times. The earliest craft used in river transportation were the canoes and dugouts of the pioneers. Then the boxlike bateaux came as the requirements of commerce grew. Bateaux, lacking maneuverability and cargo capacity, were succeeded by Durham boats, which had semi-pointed bows and were typically 60-ft. long with a 15-ton capacity. They were usually provided with a sail for use when the wind was astern, but if it blew from any other direction they were unmanageable.

To meet requirements for maneuverability and speed, the keelboat appeared at the end of the 18th century. As the name implies, this type was fitted with a keel, and it also had a pointed bow and stern. Propulsion was provided by sail, oars or poles, the latter being most common in shallow rivers. One end of each pole was fitted with a "button" or shoulder piece, while the opposite end was ironshod for digging into the river bed or bank. Polers pushed in relays while walking along planks mounted on the gunwales. On the Willamette river in Oregon a keelboat was successfully propelled by paddles operated by six horses on a treadmill. By 1810 there were over 400 keelboats in service on the Mississippi and Ohio rivers; some of these were packet boats on scheduled runs.

River Barges.—Around 1817, by which time the western river steamboat had proved its superiority on the Mississippi system (*see* MISSISSIPPI RIVER STEAMBOAT), keelboats gave way to scowlike barges. Until shortly after the middle of the 19th century, barges were towed alongside side-wheelers. Then, with the rising popularity of the stern-wheeler, modern Mississippi system towboat methods evolved. Barges are now pushed, linked closely together by pawls, cables and ratchets. They can be readily broken off and moored to the river bank or levee for exchange of cargo without loss of time to the towboat. Pushing, as opposed to towing, reduces crew requirements and eliminates the adverse current produced under the barges by the propellers. Frequently more than 20 barges are pushed by one diesel towboat. Over 67,000 tons have been carried in a single tow—more than five times the capacity of many modern seagoing freighters.

The technique of pulling barges astern has been in general use in tidal rivers such as the Hudson. Among the earliest barges to be towed on this stream were the safety barges, passenger craft which had sleeping accommodations; they were towed by steamboats. Their use stemmed from a justified fear of boiler explosions.

Specialization in cargo on western rivers produced many kinds of barges. There are carriers for coal, chemicals, petroleum, automobiles, metal products, grain and general cargo. A typical river barge is 175 ft. long with a 26-ft. beam. General cargo carriers are larger, typically 300 ft. by 48 ft. with a capacity of about 3,000 tons.

To satisfy demands for speedy transportation, the integrated, articulated tow is widely used on the Mississippi and Ohio rivers and to some extent on the Columbia. This is a streamlined linkage of boxlike steel barges of equal dimensions, the width of the linkage generally matching that of the towboat. A headpiece, or special barge with a spoon bow, is secured at the forward end of the tow to act as a bow for the entire linkage.

Canal Craft.—The horse-drawn canal boat appeared during the construction of the Erie canal (1817–25). For a full century this craft was a familiar sight on an intricate system of canals which spread from New York to western Indiana. Typical of luxury packet boats of the 1830s was the 49-ton "Congress," capable of making 100 mi. a day. She was 77 ft. long with a beam of 14 ft., 3 in. to fit 15-ft. locks.

The opening of the New York State Barge canal in 1918 increased manyfold the volume of traffic between the port of New York and Lake Erie. Scowlike barges, chiefly of wood construction and with a 900-ton capacity, have traditionally been towed on this route. However, several types of self-propelled barges driven by diesel machinery have found favour. Low power, a maximum speed of 10 knots, and a large cargo-carrying capability are characteristic of these vessels, some petroleum barges being capable of transporting over 700,000 gal. of fuel in bulk. Because of the low bridges spanning this canal, self-propelled barges are devoid of superstructure, and many are equipped with telescoping pilot houses.

Seagoing Barges.—On the Atlantic coast, barges were originally hulks of schooners. Most modern construction is of steel, but barges have retained many schooner features, such as masts for aiding the tug with sail when the wind is favourable. On the Pacific coast, barges are built in the form of huge steel scows. The largest of these is 300 ft. long with a 75-ft. beam and with a capacity of 3,000,000 gal. of petroleum and 170,000 cu.ft. of dry cargo. (C. W. TH.)

EUROPEAN CRAFT

Early Sailing and Drawn Barges in England.—The boxlike "swim-ended" lighter of the Thames was improved into the round-bowed hull, spritsail barge, which was rigged so efficiently that two or three men could sail it as far as the ports of France, Belgium and Holland. "Stumpies" for river use carried a mainsail, foresail and mizzen; seagoing barges had also a topsail and jib, while the coasting type sometimes carried a square sail for

running before the wind. On the Tyne, Trent and Humber rivers bluff-ended keels had one or two square sails, as did the western barges of Samuel Pepys' day. On the Norfolk Broads, keels were replaced by wherries, which had a high-peaked mainsail only. The Severn "trows" originally had a square sail, but later were ketch- or schooner-rigged. The Mersey had its round-chined "flats" with foresail and mainsail.

On canals narrow boats, horse-drawn or towed by men, carried goods far inland. In every type shallow draft was essential, hence hulls were flat-bottomed, and on Thames and Humber craft leeboards facilitated sailing to windward and masts could be lowered for going under bridges. All made full use of the tides, assisted by sail and oar, but beyond tidal limits haulage against the current was laborious. Sails are no longer used, except in a few auxiliaries. Many hulls, often over 50 years old, have been fitted with diesel engines, while self-propelled narrow boats have supplanted animal traction. (E. J. Ma.)

Modern Barges.—Craft used for inland navigation must be adapted to suit special conditions. The aim is to utilize as fully as possible the depth of water available, which in western Europe generally varies between 5 and 16 ft. However, because a craft in motion lies deeper in the water than when at rest, the whole depth cannot be made use of, and barges generally have a draft of 5–10 ft.

Sizes and Speeds.—Where a waterway is curved the barge must lie obliquely to the banks. The length of each craft therefore depends upon the radius of the curves and the width of the channel, as well as upon the length of the locks encountered. The greatest length of craft possible on the rivers of western Europe is about 400 ft., but most barges are shorter and some are only about 125 ft. long. They need to be as broad as is compatible with the design of the locks and yet, on a river, as slim as their speed requires. Compromises between these two requirements result in widths of 16–36 ft. Modern waterways are generally suited for the passage of craft of from 280 to 2,000 tons, although the large Russian rivers can accommodate barges of 4,500 and even 10,000 tons.

On rivers, the speed of the craft must be markedly greater than that of the current, and barge speeds range from 8 m.p.h. on a slow river like the Seine to 14 m.p.h. on the Rhône. Because of the laws governing the resistance of the water to the progress of a boat (*see* NAVAL ARCHITECTURE: *Resistance and Propulsion*), a fast craft must be longer than a slow one, and on a swift-current river like the Rhône the minimum economical length is about 240 ft. On a canal a boat can only move forward if the water flows around and behind it, and when a certain speed has been reached the resistance to the barge's forward movement increases considerably and can cause serious damage to the bank. For this reason the speed limit on canals is low—about 3 m.p.h. on the small French canals. On very large canals, however, barges can travel at 12 m.p.h.

Living Arrangements.—The usual custom in western Europe is to have on board a crew which navigates only during the day, the craft stopping at night. The crew and their families live on board, and modern barges have spacious, comfortable quarters. In a few cases, however, navigation is continued at night, the boat having two crews whose families do not live on board.

Propulsion.—On waterways where the traffic is slight, diesel tractors are often used for haulage, and animals were still sometimes used at the beginning of the 1960s. Electrical trolley tractors are employed where the traffic is large enough to justify the cost of installation. However, most craft are self-propelled or hauled by tugs.

Propulsion by steam, first used for a tug on the Forth and Clyde canal in 1802, has virtually disappeared from the rivers of western Europe, being used only on some Rhine tugs. Because the power required is too slight to justify the use of turbines, almost all the motors are diesels. The power of self-propelled barges varies from as little as 80 h.p. on small canals to 1,000 h.p. on the Rhône, while that of tugs ranges from 500 to 3,000 h.p.

In the early 1960s a few large tugs on the Rhine still had side paddle wheels, and tugs with stern wheels were in use on African, Asian and South American rivers, but propulsion was usually by screw propellers. The use of propellers with vertical blades was becoming popular, especially on the Rhine, because of the greater ease such propellers give in handling the craft.

When the water is sufficiently shallow, it is inevitable that the screw is partly above the surface or, if submerged, that it operates inefficiently. In the first case, the water can be made to rise artificially around the screw by placing a cover over the screw, a technique that is widely used in western Europe; in the second case, the action of the screw can be improved by placing it in a tunnel.

Where the water is very shallow, perhaps only two feet, as on some rivers of the U.S.S.R. and in Africa, propulsion is sometimes accomplished by a pump which forces the water back toward the stern.

The powerful craft on the Rhine and the Rhône have steering devices composed of three rudders working together. This arrangement allows the pilot to maneuver the rudders without using a servomotor. A boat fitted with a Voith-Schneider propeller has no need of a rudder, because the propeller itself steers the boat. When a movable Kort nozzle is fitted, it too acts as a rudder. Craft which are towed have a rudder composed of two parts. The rear part folds up vertically beside the other part so that when the rudder is put hard over at right angles in a lock, the over-all rudder length does not exceed the width of the craft. These barges are often provided with a small bow rudder in order to resist the tendency to drift with the wind when they are empty.

On the Seine, craft towed by a tug are attached to one another by a single cable. On the Rhine, where the current is strong, each barge is attached to the tug by an individual cable in order to ease the cable strain and to make the barges easier to maneuver. It has, however, become a common practice to use a self-propelled barge to haul another, called a dumb barge, which has no motor. By 1960 this method was gradually eliminating the use of tugs in France, although they were still in steady use on the Rhine and Danube.

In the U.S.S.R., as in the United States, propulsion from behind is much used. Coupling the pushing tug close to dumb barges converts these temporarily into a self-steering, self-propelled unit. This method, which requires less power and obviates the need for crews of the craft so propelled, has spread less quickly in western Europe, where the rivers lack the necessary width. However, a French device allows the craft to be so attached that the whole train can respond to the curve of the banks or to the swell of the current while still under the control of the propelling tug.

Types of Cargo.—Dry goods carried in bulk are chiefly coal, grain, sand and iron ore. For coal, and especially coke, both of which have a low density, the capacity of the barge must be as great as possible and the hatches must be large to facilitate the handling of the goods by grab bucket and crane. The same is true of grain, with the added requirements that the plank lining at the bottom must not let the grain through, and the covering must be rain proof. Sand can be carried in the same type of craft, but when loaded by the force of a jet of water, the barge must have watertight longitudinal compartments to facilitate unloading by grab bucket. Iron ore has a high density and it is therefore best loaded into a small compartment having a plank lining to allow unloading with grab buckets. For iron ore use is also made of floating containers small enough to be placed on railway wheels for unloading at the steelworks; these containers are assembled in a large train between a propelling and a guiding tug.

Dry goods carried in packages require maximum capacity with rainproof coverings. When the cargo is of low density, *e.g.*, bales of cotton, the steering wheel is placed forward so that the steersman's view is clear. Barges for frozen cargo are uncommon in western Europe, though less so in the U.S.S.R.

Liquids carried are principally hydrocarbides, for which the hull itself acts as a tank. For heavy hydrocarbides and asphalts, a heating system is provided. In view of the danger involved in carrying hydrocarbides, particularly those which are highly volatile, the construction of these craft is subject to strict regulations.

Barges of this kind are sometimes used for carrying edible oils and molasses. In France, tanker craft transport much wine in bulk. To avoid adulteration, the tanks have special linings cleaned after each voyage. Chemical firms have special craft for the bulk transport of liquid chlorine, sulfuric acid and other chemicals.
(J. E. P. V.)

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BARGHEST (BARGUEST, BARGEST), the name given in northern England, especially Yorkshire, to a monstrous goblin dog with huge teeth and claws which appeared only at night, the sight of which was supposed to be an omen of death. The Demon of Tidworth, the Black Dog of Winchester, the Padfoot of Wakefield and the Barghest of Burnley were all similar apparitions. Their Welsh counterparts were red-eyed *Gwyllgi*, "the dog of darkness," and *Cwn Annwn*, "the dogs of hell": in Lancashire the monster was called Trash, Skriker or Striker because its broad, sometimes backward-pointing feet made a splashing noise and because it howled or "skriked" horribly; in east Anglia, where it was thought to be amphibious, it howled, but had only one eye and moved silently and was known as Black Shuck or Shock; in the Isle of Man it was called *Mauthe Doog* and is mentioned in Scott's *Lay of the Last Minstrel* as "the spectre hound in Man." The Manchester barghest was said to be headless. Those who saw one clearly, it was believed, would die very soon, whereas those who glimpsed it only faintly would not die until some months later. "Barghest" has been explained as deriving either from Old English *burg-gast* ("town-ghost"), or from German *Bahrgeist* ("bier-demon") or *Bärgeist* ("bear-demon").

BARHAM, RICHARD HARRIS (pseudonym: THOMAS INGOLDSBY) (1788–1845), English humorist and author of *The Ingoldsby Legends*, was born at Canterbury on Dec. 6, 1788. At the age of seven he inherited a small Kentish estate including the manor of Tappington Everard, scene of many of the *Legends*. Educated at St. Paul's school and at Brasenose college, Oxford, where he developed his habit of working through the night, he first studied law but was ordained in 1813. The next year he married; he had many children, five of whom predeceased him. He lived in Kent until 1821, when he moved to London on being appointed a minor canon of St. Paul's cathedral. A staunch Tory and High Churchman, he was made priest in ordinary to the Chapel Royal and held various city livings.

He had begun to write at 14 while recovering from an accident, and had published two novels. He joined the Garrick club, of which his friend Charles Bentley, the publisher, was a member, and there he met Dickens. In 1837 he began to contribute to the new *Bentley's Miscellany* the series of exuberant tales, ranging from the macabre to the hilarious, which were published as *The Ingoldsby Legends* (1840, 1842 and 1847; selected and edited by J. Tanfield and G. Boas, 1951). Most of them are in flowing verse of great sweep and variety, often satirical and with comic rhymes; but the medieval ritual and traditions they portray are based upon solid antiquarian research.

Although the best of entertainers, Barham remained primarily a priest. His kindness and sound judgment made him a trusted counselor, valued friend and frequent peacemaker, and he was intolerant of all that was mean or false. He died in London on June 17, 1845. The poem "As I Laye A-Thynkynge," composed on his deathbed, has quiet beauty.

See R. H. D. Barham, *The Life and Letters of the Rev. Richard Harris Barham*, 3rd ed. (1880).

BAR-HEBRAEUS ("Son of the Hebrew") (1226–1286), known also by the Arabic name Abu 'l-Faraj, one of the greatest Syriac writers and a man of wide learning, made noteworthy contributions to most branches of science and literature. He wrote treatises on grammar, astronomy, mathematics, medicine, philosophy, theology and history, reinvigorating the Syriac language and making Islamic learning accessible to his fellow Jacobites. The son of a Jewish physician, he was born at Melitene (mod. Malatya). He studied there and at Antioch and Tripolis (Lebanon), becoming a monk when he was about 17 years of age and being ordained Jacobite (Monophysite) bishop of Gubas near Melitene when he was 20. Bishop of the neighbouring diocese of Lakabhin in 1247 and of Aleppo in 1253, he was made *maphrian*, the rank next to patriarch, of the east in 1264 by the patriarch Ignatius III.

Diligent in the care of his diocese and in study and writing, he died at Maragah, Persia, on the night of July 30, 1286, mourned even by his rival, the Nestorian patriarch, and was buried at Mosul, Iraq, under the inscription: "This is the grave of Mar Gregory John," John being his baptismal name and Gregory probably the name he adopted when he became bishop.

His brother enumerates 31 books written by Bar-Hebraeus, some in Arabic, some translated from Arabic and the rest original Syriac works. Most widely known is his Syriac *Chronography*, comprising a secular history from the Creation and an ecclesiastical history dealing chiefly with the patriarchate of Antioch and with the Eastern Syrian Church. Using earlier works, which it supplements and corrects, it contains, besides history, much miscellaneous information. Of the secular history Bar-Hebraeus prepared an abridged Arabic version, adding references to Moslem sources. Important also is his *Ausar Raze* ("Storehouse of Secrets"), a biblical commentary more philological than theological, but citing various Fathers as well as the Syriac and Greek biblical versions.

The *Chronography* was translated from the Syriac by E. A. W. Budge, 2 vol. (1932); Bar-Hebraeus' *Scholia on the Old Testament*, pt. i: Genesis–II Samuel, was edited by M. Sprengling and W. C. Graham (1931).

See A. Baumstark, *Geschichte der syrischen Literatur*, pp. 312–320 (1922); J. Göttsberger, *Barhebräus und seine Scholien zur heiligen Schrift* (1900). (W. D. McH.)

BARI, a Nilo-Hamitic-speaking people living near Juba in the southern Sudan. They number 35,000 and live in small villages scattered across the hot, dry, flat countryside of the Nile valley. Their staple crops are millet and eleusine and they also keep cattle. They are tall, slender Negroes, and until recently the men went naked while the women wore an apron of iron chains decorated with beads.

They are divided into freemen and serfs. Blacksmiths, professional hunters and similar groups are regarded as inferior and are associated with the serfs. There are some 150 patrilineal, exogamous and totemic clans, most of which are composed of freemen. Both men and women undergo initiation by the extraction of the lower incisors and by cicatrization. Men then enter age sets (*q.v.*) which have distinctive names and ornaments. Age mates regard themselves as intimately linked and assist one another in many situations. The people have no single chief, but many "big men." These include ritual functionaries, the rainmakers, who are few but extremely powerful, and the "fathers of the earth" who are found in every village and are responsible for magic to ensure successful cultivation, hunting and warfare. Both these offices are hereditary and are held by certain descent lines. There are also secular functionaries: clan heads, village headmen and wealthy individuals. The Bari believe in a god, *Ŋun*, who has two aspects: a benevolent god who dwells in the sky and is concerned with rain, and a malevolent god who lives in the earth and is associated with cultivation. Sacrifices are made to the spirits of the dead.

They have been in contact with Europeans since the 1840s. Under Turko-Egyptian rule there was much slave raiding and the Bari and their neighbours are still suspicious of Arabs. In general the Bari area is poor, being remote from world markets and political centres. The culture and language are shared by many of the small tribes in the region. The most important are the Kakwa (45,000), Mandari (36,000), Kuku (26,000), Pöjulu (25,000), Nyangbara (18,000) and Nyefu (3,000). *See* also AFRICA: *Ethnography (Anthropology): Northeast Africa.*

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BARI, a city of southeastern Italy, Puglia region, capital of

the province of Bari and the seat of an archiepiscopal see, is an important Adriatic port situated in the coastal plain, 113 km. (70 mi.) N.W. of Brindisi by road and 294 km. (183 mi.) E.N.E. of Naples by road. Pop. (1957 est.) 304,642 (commune). The city is divided into three parts: the old city, on the peninsula dividing the old from the new harbours; the modern city, built on a chessboard plan; and the industrial area, inland, to the south of the railway. The chief features of interest are in the old city which has a network of narrow streets, many of them passing under arches. The 11th-century basilica of S. Nicola is in the Romanesque style and has a majestic façade. The relics of St. Nicholas, patron saint of Bari, are preserved in the crypt. Nearby is the 11th-century Romanesque church of S. Gregorio, small with a simple and austere interior. The 12th-century cathedral of S. Sabino, with a fine rose window, is situated nearer the base of the peninsula. Also in the Romanesque style it was sadly spoiled by baroque additions, now removed from the interior. The city is bounded by a promenade 9 km. (5½ mi.) long and on the eastern end is the provincial picture gallery. The archaeological museum is in the buildings of the university (founded 1924) in the new part of the town.

Bari is on the main east coast railway from Milan and Bologna to Brindisi and the "heel" of Italy. There are international air services from Palese airport (10 km. [6 mi.] N.W.) and steamer services to Adriatic ports and the Mediterranean and Black sea. The district is rich in olive and fruit trees and vines, and in lime-bearing soils. Industries include the production of wine, olive oil, fruit preserves, tobacco, sulfide, building materials, textiles, Armenian-type carpets, machinery and ironwork, and boat building and fishing. Bari is also a military centre.

The site of Bari may have been inhabited since 1500 B.C. Greek influence was strong as coins showed, and under the Romans, who called it Barium, it developed into a considerable port, the harbour being mentioned as early as 180 B.C. Fishing was important in Roman days. In the 9th century A.D. it became a Saracen stronghold and in 885 the residence of the Byzantine governor of Apulia. In 1071 it was captured for the Normans by Robert Guiscard. Peter the Hermit preached the first crusade in Bari in 1096 and a large party of crusaders started from there. In 1156 it was razed to the ground by William the Bad, but acquired new greatness under the emperor Frederick II (1194–1250). The Sforzas were the last of various masters, and in 1557 the emperor assigned it to Naples by arbitration. After Garibaldi had overthrown Naples in 1860, Bari became part of the Italian kingdom. In World War II it was occupied by Allied forces on Sept. 12, 1943.

BARI PROVINCE (area 1,980 sq.mi.; pop. [1961] 1,259,757) extends for 60 mi. along the Adriatic coast and has a maximum width of 30 mi. The country rises from the coastal plain to the Murgia mountains, which reach their summit in Monte Caccia (680 m. [2,231 ft.]). Along the coast are the resorts of Barletta, Trani, Bisceglie, Molfetta (*qq.v.*), Polignano a Mare and Monopoli, while inland towns are Canosa di Puglia, Andria, Corato, Ruvo di Puglia, Bitonto (*qq.v.*), Conversano, Gioia del Colle, Castellana and Alberobello. The chief river is the Ofanto (anc. Aufidus) dividing Bari from Foggia province. On its banks is the battlefield of Cannae (*q.v.*) (mod. Canne della Battaglia) where Hannibal defeated the Romans in 216 B.C. (M. T. A. N.)

BARILOCHE (SAN CARLOS DE BARILOCHE), resort town of Argentina's Andean lake district, is located about 2,500 ft. above sea level on the shores of Lake Nahuel Huapí, set in the heart of the beautiful national park of the same name. Chalet-type building construction, introduced in 1905 by the Swiss settlers of the region, provides an appropriate setting for skiing in the winter months, while the many lakes and streams afford excellent opportunities for fishing. The beauty of the surroundings and sport facilities make it one of South America's most popular resort areas. The town, which has approximately 3,000 inhabitants, is situated in the national territory of the Río Negro and may be reached by rail, road or plane. It is approximately 800 mi. S.W. of Buenos Aires. Bariloche was the scene of a meeting in 1960 between Pres. Dwight D. Eisenhower of the United States and Pres. Arturo Frondizi of Argentina. (T. F. McG.)

BARINAS, a state of western Venezuela, lies in an alluvial plain, the llanos, north of the Apure and Uribante rivers and east of the Andes as far as the Portuguesa river. Area 13,591 sq.mi. Pop. (1961) 134,811. It is plagued by alternate drought and flood: wide stretches of savanna are inundated during the rainy season, which lasts from May to December. Barinas ranks second among Venezuelan states as a producer of cattle. Coffee is grown in the uplands and the usual tropical crops are produced along the rivers. Petroleum was discovered south of the city of Barinas and a huge area of oil concessions covers most of the state. A pipeline transports oil northward from Silvestre to a terminal at Puerto Cabello.

The state capital, Barinas (pop. [1961] 25,707), lies in the north central part of the state 260 mi. S.W. of Caracas. It is the centre of the cattle-trading business and is connected by highway, most of it hard surfaced, with Valencia, Puerto Cabello and Caracas. (L. WE.)

BARING, the name of a family important in the financial and mercantile ventures of the British empire beginning in the late 18th century. The financial house, Baring Brothers and Company, was founded by Sir Francis Baring (*q.v.*). By 1810, the extent of its activities on the continent led the French prime minister to remark that the sixth great European power was Baring Brothers. The control of the firm passed to Francis Baring's second son Alexander, later Lord Ashburton (1774–1848), who married Ann Bingham, a member of one of the wealthiest families in Pennsylvania. Her dowry added to the family connections enabled the Barings to gain control of an important share of the U.S. banking business. Thomas Baring (1799–1873), a grandson of Francis, assumed control of the firm in 1848, and after Thomas the firm was managed by Edward Charles Baring, later 1st Baron Revelstoke (1828–97). In 1890 a crisis in the fortunes of the Barings occurred when Argentina defaulted on bond payments and the Barings were left with £21,000,000 (approximately $100,000,000) in liabilities. The firm was saved by the intervention of the Bank of England and an important group of the City of London bankers, including the Rothschilds. The continuing importance of the firm was indicated by the decision to place in the hands of its director the liquidation of Britain's fixed assets in the United States during World War II.

Other important members of the family include Thomas George Baring, 1st earl of Northbrook (*q.v.*); Charles Baring (1807–79), bishop of Durham; and Evelyn Baring, 1st earl of Cromer (*q.v.*).

See B. Mallet, *The Earl of Northbrook: a Memoir* (1908); R. W. Hidy, *The House of Baring in American Trade and Finance . . . 1763–1861* (1949). (L. N.)

BARING, SIR FRANCIS, 1ST BARONET (1740–1810), British financier who established one of the most influential business firms in the history of the United Kingdom, was born near Exeter on April 18, 1740, the third son of a German immigrant. He went to London, where he gained experience in two mercantile firms, and in 1763 set up the partnership of John & Francis Baring & Company. At first he acted merely as an import and export commission agent for other merchants, but the house of Baring, known as Baring Brothers and Company after 1806, also bought merchandise on its own account, lent its credit in the form of acceptances and received deposits of friends and clients. It became a key aid to the British government in financing the wars against France after 1792. Sir Francis also underwrote marine insurance and took an active part in the management of the East India company, of which he was head in the year 1792–93 and for which he received his baronetcy. He was a friend of Jeremy Bentham, a follower in large measure of Adam Smith and adviser to numerous politicians, the most notable being William Pitt the Younger. Sir Francis died at Lee, Kent, on Sept. 11, 1810. One admirer stated in the *Gentlemen's Magazine* that he was, at the time of his death, "unquestionably the first merchant in Europe; first in knowledge and talents, and first in character and opulence." The house he created became the leading firm in financing U.S. trade and in marketing U.S. bonds between 1815 and 1860; for its subsequent history see the article BARING.

See Ralph W. Hidy, *The House of Baring in American Trade and*

Finance, English Merchant Bankers at Work, 1763–1861 (1949). (R. W. Hy.)

BARING, MAURICE (1874–1945), English man of letters, a singularly perfect representative of the social culture which flourished in England before World War I, was born in London on April 27, 1874. The fourth son of the 1st Lord Revelstoke, he was educated at Eton and Trinity college, Cambridge, and in 1898 joined the diplomatic service. In 1904 he became a journalist and reported the Russo-Japanese War in Manchuria; later he was a correspondent in Russia and Constantinople. In World War I he served with distinction on the headquarters staff of the royal flying corps. He published novels, including *C* (1924), *Cat's Cradle* (1925) and *Daphne Adeane* (1926); poems, parodies and essays, *e.g.*, *Dead Letters* (1910), *Diminutive Dramas* (1911); and a study of *Sarah Bernhardt* (1933). He was also a distinguished Russian scholar and translator. He recorded his personality and experiences, until the outbreak of World War I, in *The Puppet Show of Memory* (1922) and his anthology *Have You Anything to Declare?* (1936) displays the width of his reading and his fine literary taste.

Baring's charm and original humour won him friends in many walks of life. He was a devout Roman Catholic convert. The fortitude with which he endured a fatal paralytic disease is described in Lady Lovat's book. He died at Beauly, Inverness-shire, on Dec. 14, 1945.

See Lady Laura Lovat, *Maurice Baring, a Postscript* (1947); Dame Ethyl Smyth, *Maurice Baring* (1938) gives a fuller account of his life. (J. Sp.)

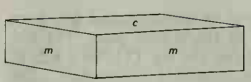
BARINGO, a lake in east Africa, is situated 3,200 ft. above sea level in the northern section of the Kenya rift valley with the Laikipia escarpment on the east and the Kamasia range to the west. It is 50 sq.mi. in area, 11 mi. long by 4½ mi. wide and it has an average depth of 17 ft. It has no visible outlet, but the freshness of its waters is maintained by a seepage into the lavas at its northern end where a rocky shore contrasts with the alluvial flat which borders the lake on the south. The Nilo-Hamitic peoples, Tugen and Njemps, who occupy the Baringo basin, catch *tilapia* (a perchlike fish) in the lake, herd cattle and with help from the Perkerra irrigation scheme practise agriculture. The earliest European travelers to reach the lake were Joseph Thomson (1883), Count Samuel Teleki and L. R. von Höhnel (1887) and J. W. Gregory (1893). Lake Baringo is approached from Nakuru by a rough road through Marigat. (S. J. K. B.)

BARISAL, a river port in East Pakistan, is in the Ganges delta 73 mi. S. of Dacca and more than 100 mi. from the Bay of Bengal. It is the chief town of Barisal district (part of former Backerganj). It lies on the west bank of a lesser deltaic distributary known locally as Kirtan Khola, an offshoot of the Arial Khan river. Pop. (1961) 70,025. It is linked by steamer with Dacca and westward with Khulna, the nearest railhead. Most of the jute and rice from east of the Brahmaputra are transshipped at Barisal to be carried in seagoing vessels to Chittagong. The town is a market for rice and betel nuts and exports fish in quantity. Its amenities include three colleges affiliated to Dacca university, a public library founded in 1855, and a public park. It has a good system of natural drainage, the *khals* (creeks) being flushed by the tides.

Barisal gives its name to a curious natural phenomenon, "Barisal guns," noises like cannon reports heard near Barisal and elsewhere and apparently coming from the sea. The phenomenon has not been satisfactorily explained, but many have a seismic origin. (K. S. Ad.)

BARITE (Barytes), a widely distributed mineral composed of barium sulfate ($BaSO_4$), is the commonest barium mineral. Its most striking feature and the one from which it derives its name (from the Greek for "heavy") is its weight, also the source of its common name, heavy spar. Its specific gravity of 4.5 is about twice as great as that of salt and of many other colourless, transparent and glassy minerals not unlike barite in general appearance. The mineral is usually found in a state of considerable chemical purity, though small amounts of strontium and calcium sulfates may replace the barium sulfate.

Crystals of barite are orthorhombic; they are usually perfectly developed and present great variety of form. The simplest crystals are rhomb-shaped tables bounded by the two faces of the flat basal pinacoid (*c*) and the four faces of the prism (*m*); the angle between the prism faces (*m*,*m*) is 78° 23′, while that between *c* and *m* is 90°. The mineral has perfect cleavage parallel to the faces *c* and *m*, and the cleavage surfaces are smooth and bright. The crystals may be transparent and colourless, or white and opaque, or of a yellow, brown, bluish or greenish colour. The mineral occurs also in a granular, earthy or stalactitic condition. It is known as "cawk" in the Derbyshire lead mines. Barite is of common occurrence in metalliferous veins, especially those which yield ores of lead and silver.



BARITE CRYSTAL IN SIMPLEST FORM

Commercially, ground barite is used in oil- and gas-well drilling muds. Barite also is used in the preparation of barium compounds, as a body or filler for certain kinds of paper and cloth and in phonograph records, as a white pigment ("permanent white") (*see* Lithopone) and as an inert body in coloured paints. (L. J. S.)

BARITONE, a brass instrument with valves, pitched in B flat, the term usually denoting in the U.S. the wide-bore instrument (in England, called the euphonium, *q.v.*), but in England the narrow-bore instrument (in the U.S. tenor horn; *see* Saxhorn). For the use of the term to describe a type of voice between tenor and bass, *see* Singing; Voice: *Attributes of the Voice.* (A. C. Ba.)

BARIUM, a metallic chemical element having a silvery white lustre when freshly prepared. It oxidizes very rapidly in air, and reacts readily with water and alcohol. Barium occurs chiefly in the form of barite (*q.v.*) or heavy spar, and witherite (*q.v.*), and to a less extent in baryto-calcite, baryto-celestine and various complex silicates. It is estimated that barium constitutes about .05% of the crust of the earth. The chemical symbol of barium is Ba. Its atomic number is 56 and its atomic weight is 137.36.

History and Preparation.—Barium takes its name from the Greek *Barys* (heavy) because of its presence in barite or heavy spar which was first investigated in 1602 by V. Casciorolus, a shoemaker of Bologna, who found that after ignition with combustible substances it became phosphorescent, and on this account it was frequently called Bolognian phosphorus. In 1774 K. W. Scheele, in examining a specimen of pyrolusite, found a new substance to be present in the mineral, for on treatment with sulfuric acid it gave an insoluble salt which was afterward shown to be identical with that contained in heavy spar.

The metal is difficult to isolate; Sir H. Davy tried to electrolyze baryta (barium oxide) but was unsuccessful; later attempts were made by him using barium chloride in the presence of mercury. In this way he obtained an amalgam, from which on distilling off the mercury the barium was obtained as a silver white residue. Barium was first isolated by Davy in 1808. R. Bunsen in 1854 electrolyzed a thick paste of barium chloride and dilute hydrochloric acid in the presence of mercury, at 100° C., obtaining a barium amalgam, from which the mercury was separated by a process of distillation. A. N. Guntz reduced barium oxide by aluminum powder at 1,200° C.; and C. Matignon reduced it in a vacuum at the same temperature by means of ferrosilicon (95% Si), barium of 98.5% purity distilling over.

The commercial production of barium depends upon the electrolysis of fused barium chloride or the reduction by aluminum of a mixture of barium monoxide and barium peroxide in a vacuum furnace which is heated electrically.

Uses.—The metal is used in the manufacture of radio vacuum tubes. It removes the final traces of gaseous elements remaining after the tubes have been evacuated almost completely by other methods. It is also used to remove oxygen in the refining of copper. It is a constituent of several alloys, one of the most important of which is Frary metal, a bearing or antifriction metal that contains lead and calcium as well as barium. An alloy of nickel and barium, which readily emits electrons when heated, is used for this reason in radio tubes and in the points of spark plugs. For the uses of the various barium compounds, see *Compounds.*

Properties.—Barium is one of the alkaline earths (*q.v.*) of Group II of the periodic system. It is slightly harder than lead and can be rolled and hammered. Other properties of the metal are listed below:

Atomic radius	1.98 Å (10^{-8} cm.)
Ionic radius	1.35 Å
Ionization potential (gaseous element)	
1st electron	5.19 v.
2nd electron	9.95 v.
Single electrode potential (metal-molal solution of Ba^{2+} ion)	2.90 v.
Density (20° C.)	3.59 g. per cubic centimetre
Melting point	850° C.
Boiling point	1,537° C.

The seven stable isotopes of the element have relative atomic masses of 138, 137, 136, 135, 134, 130 and 132 (listed in the descending order of abundance). Radioactive isotopes of mass numbers 126 to 129, 131, 133, 135, 137, and 139 to 144 have been prepared. The distribution of electrons in the outer levels of the barium atom is as follows: $4d^{10}$, $5s^2$, $5p^6$, $6s^2$; the superscript indicates the number of electrons in the corresponding sublevel.

As compared with the other metals of the alkaline earth family, barium has more pronounced base-forming tendencies than any other member of its group except radium. Its atoms are more readily converted into ions by the loss of their two outermost electrons and the element, consequently, is a more active reducing agent than magnesium, calcium or strontium. This behaviour is in keeping with the greater atomic and ionic radii, the smaller ionization potential and the lower position of barium in the periodic table as compared with other alkaline earth metals. The barium ion has a relatively high heat of hydration as compared with the ions of the alkali metals. This condition is one factor that causes the metal to be so readily oxidized.

The metal burns brilliantly in air or oxygen to form the monoxide, BaO. At high temperatures it reacts with nitrogen, carbon and phosphorus to form the nitride, carbide and phosphide, respectively. It reacts at ordinary temperatures with all the halogens to form halides, and with sulfur, when heated, to form the sulfide.

The valence number of barium in its compounds is +2. The barium ion, Ba++ is not easily reduced. It may be precipitated from solution by the addition of carbonate, sulfate, chromate, phosphate or certain other anions with which it forms slightly soluble salts. Volatile barium compounds, when heated in the Bunsen flame, impart a yellowish-green colour to the flame. The two characteristic lines of the barium spectrum have wave lengths of 455 and 493$\mu\mu$ (10^{-6}mm.), respectively.

Compounds.—Three oxides of barium are definitely known—the monoxide, BaO, the peroxide, BaO_2, and a suboxide, obtained by heating BaO with magnesium in a vacuum to 1,100° C. An oxide, BaO_4, has also been described. The monoxide is formed when the metal burns in air, but is usually prepared by the ignition of the nitrate, oxygen and oxides of nitrogen being liberated. It can also be obtained by the ignition of an intimate mixture of the carbonate and carbon or barium carbide. It is a grayish-coloured solid, which combines very energetically with water to form the hydroxide, much heat being evolved during the combination; on being heated at 500°–600° C. in a current of oxygen it forms the peroxide, which at higher temperatures (700°–800° C.) breaks up again into the monoxide and oxygen. The hydride, BaH_2, is obtained by direct combination at high temperatures; it is volatile and less stable than calcium or strontium hydrides.

Barium hydroxide, $Ba(OH)_2$, is a white powder that can be obtained by slaking the monoxide with the requisite quantity of water, but it is usually made on a large scale by heating heavy spar with small coal whereby a crude barium sulfide is obtained. This sulfide is then heated in a current of moist carbon dioxide, barium carbonate being formed, $BaS+H_2O+CO_2=BaCO_3+H_2S$, and finally the carbonate is decomposed by a current of superheated steam, $BaCO_3+H_2O=Ba(OH)_2+CO_2$, leaving a residue of the hydroxide. It is also made by electrolyzing a barium chloride solution, using a mercury cathode. Barium hydroxide is moderately soluble in cold water, readily soluble in hot water, the solution possessing an alkaline reaction and absorbing carbon dioxide readily. The solution, known as baryta water, has extensive applications, being used in gas analysis for the determination of the amount of carbon dioxide in the atmosphere; it is also used in organic chemistry as a mild hydrolyzing agent. E. Fischer has used it as a condensing agent in the preparation of α- and β-acrose from acrolein dibromide. A saturated solution of the hydroxide deposits on cooling a hydrated form, $Ba(OH)_2.8H_2O$, as colourless quadratic prisms, which on exposure to dry air lose seven molecules of water of crystallization. It is used as a depilatory in tanning.

Barium peroxide, BaO_2, can be prepared as shown above, or in the hydrated condition by the addition of excess of baryta water to hydrogen peroxide solution, when it is precipitated in the crystalline condition as $BaO_2.8H_2O$. These crystals on being heated to 130° C. lose water of crystallization and leave a residue of the anhydrous peroxide. In the Brin process for the manufacture of oxygen, barium peroxide was formed by heating barium monoxide with air at 700° C. under pressure, and decomposed by lowering the pressure. (This process has been superseded by the fractionation of liquid air.) It is a white powder which is readily decomposed by dilute acids with the production of hydrogen peroxide.

Barium chloride, $BaCl_2.2H_2O$, can be obtained by dissolving witherite in dilute hydrochloric acid, and also from heavy spar by ignition in a reverberatory furnace with a mixture of coal, limestone and calcium chloride, the barium chloride being extracted from the fused mass by water, in which it is readily soluble. It can be obtained in the anhydrous condition by heating it gently to about 120° C. It has a bitter taste and is a strong poison. Barium bromide is prepared by saturating baryta water, or by decomposing barium carbonate, with hydrobromic acid. It crystallizes as $BaBr_2.2H_2O$, isomorphous with barium chloride. Barium chlorate, $Ba(ClO_3)_2$, is obtained by adding barium chloride to sodium chlorate solution; on concentration of the solution sodium chloride separates first; after further evaporation barium chlorate crystallizes out and can be purified by recrystallization. It can also be obtained by suspending barium carbonate in boiling water and passing in chlorine. It crystallizes in monoclinic prisms of composition $Ba(ClO_3)_2.H_2O$, and begins to decompose on being heated to 250° C.

Barium sulfate, $BaSO_4$ (barite), is the most abundant of the naturally occurring barium compounds and can be obtained artificially by the addition of sulfuric acid or any soluble sulfate to a solution of a soluble barium salt, when it is precipitated as a white, finely divided crystalline powder of specific gravity 4.5. It is almost insoluble in water (about two parts per million at 15° C.), and is only very slightly soluble in dilute acids; it is soluble to some extent, when freshly prepared, in hot concentrated sulfuric acid, and on being cooled the solution deposits crystals of composition $BaSO_4H_2SO_4$. It is used as a pigment under the name of "permanent white" or *blanc fixe*, and with zinc sulfide in "lithopone." It is also used for weighting paper. A major use of barite is in the petroleum industry, where it is a constituent in the mud used to facilitate well drilling (*see* DRILLING MACHINERY: *Hole Maintenance*). In radiology (*q.v.*) the compound is used as an artificial contrast medium.

Barium nitrate, $Ba(NO_3)_2$, is prepared by dissolving either the carbonate or sulfide in dilute nitric acid, or by mixing hot saturated solutions of barium chloride and sodium nitrate. It crystallizes in octahedra, having a specific gravity of 3.2, and melts at 592° C. It is decomposed by heat and is largely used in pyrotechny for the preparation of green fire. Barium carbonate, $BaCO_3$, occurs rather widely distributed as witherite, and may be prepared by the addition of barium chloride to a hot solution of ammonium carbonate, when it is precipitated as a dense white powder with a specific gravity of 4.3, almost insoluble in water. It is much more stable toward heat than calcium or strontium carbonates. It is used in rat poisons and in glass manufacture.

Analysis.—Barium and its salts can be readily detected by the yellowish-green colour they give when moistened with hydrochloric acid and heated in the Bunsen flame, or by observation of their spectra, when two characteristic green lines are seen. In solution, barium salts may be detected by the immediate precipi-

tate they give on the addition of calcium sulfate (this serves to distinguish barium salts from calcium salts), and by the yellow precipitate of barium chromate formed in the presence of dilute acetic acid on the addition of potassium chromate. Barium is estimated quantitatively by conversion into the sulfate. For a comparison of the chemical properties of barium with those of radium, *see* RADIUM: *Chemical Properties.*

See also Index references under "Barium" in the Index volume.

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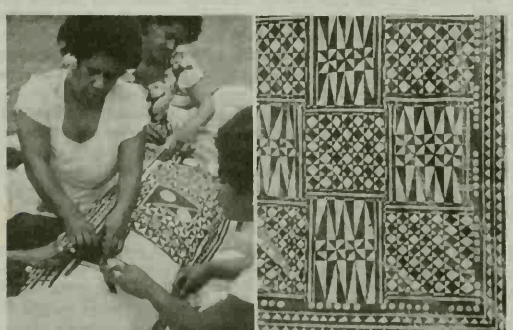
BARK CLOTH, a tropical textile produced until the 19th century from the inner bark (or bast) of several species of trees in Ceylon, the Nicobar Islands, parts of southeast Asia, the Malay peninsula, Indonesia, the Philippines, parts of Melanesia including most of New Guinea, some of the Caroline Islands and all of Polynesia; in America from Honduras southward to Amazonas and Mato Grosso in Brazil and eastern Bolivia; and in Africa in Uganda, Tanganyika, Nyasaland, Mozambique, and Madagascar, also on the upper Congo and Ubangi, and with scattered occurrences in west Africa.

In ancient times it was made in Hainan, Kwangtung, and Yünnan, and probably in all of southern China and parts of India. Archaeologically, bark cloth beaters appear in the earliest periods of Central America, and the cloth is found in the lowest levels (3rd millennium B.C.) of Huaca Prieta, Peru.

Bark cloth was replaced in most of the areas mentioned by woven cloth, imported or native, or, in Africa, by skins. In the 1960s it was made in Samoa and Tonga and parts of Melanesia and Indonesia, particularly Celebes, and by some South American tribes.

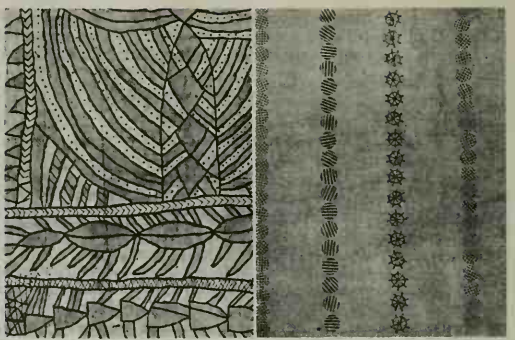
In Polynesia, paper mulberry (*Broussonetia papyrifera*) bast, which yields the best bark cloth, was used nearly everywhere. On a few islands breadfruit (*Artocarpus altilis*), figs (*Ficus tinctoria* and related species) and *Pipturus albidus* were common substitutes. The mulberry and breadfruit were cultivated. Various species of these genera furnished bast in Indonesia, as did *Trema, Antiaris, Sloetia,* and others; at Minahasa no fewer than 20 trees provided the material. In South America apparently only *Ficus* was used, as also in Africa, where it was often cultivated.

In Indonesia *fuya,* as it was there known, was used for jackets, ponchos, sarongs, loincloths, and as a thin material for headcloths. Where cotton cloth supplanted it, *fuya* was worn for religious ceremonies and for mourning; rougher kinds provided packing material, and a fine type was made for writing paper. Until the late 19th century, Celebes exported quantities of it to Singapore as underlay for coppering vessels. Polynesian uses included loincloths, skirts, mantles, bed covers, mosquito nets and burial shrouds. There the name was tapa. Tahitians prepared it in bales, sometimes 200 yd. long. A delicate white material was used in Fiji for turbans and coarser stuff for loincloths, which chiefs wore in long trains. South American bark cloth was used for tunics, aprons, breechcloths, mosquito nets, pouches and dance masks. In Africa only clothing was made of the material.



BY COURTESY OF PUBLIC RELATIONS OFFICE, SUVA, FIJI

(LEFT) WOMEN OF SUVA, FIJI, APPLYING DYE TO BARK CLOTH; (RIGHT) BARK CLOTH WITH GEOMETRICAL PATTERN CHARACTERISTIC OF FIJI ISLANDS



BY COURTESY OF (LEFT) THE TRUSTEES OF THE BRITISH MUSEUM, (RIGHT) AMERICAN MUSEUM OF NATURAL HISTORY

(LEFT) FREEHAND DESIGN OF BARK CLOTH FROM SANTA ISABEL ISLAND, SOLOMON ISLANDS; (RIGHT) STAMPED PATTERN OF HAWAIIAN TAPA

Basically, the manufacturing process, similar to making felt, consists of stripping off the bast and soaking, then beating it to cause the fibres to interlace and to achieve proper thickness. Polynesian bark cloth was generally superior to all others, and within Polynesia Hawaiian tapa was perhaps the best because of its great variety and beauty of design and texture. In Hawaii, the bast strips, peeled from mulberry shoots, were steeped in sea water, then beaten on stone anvils with round wooden beaters, causing the strips to expand in width. After being bleached they were again soaked and beaten together on wooden anvils, using squared wooden beaters with sides incised in various patterns, finishing with a beater having rectangular incising, which produced watermarked cloth. The finished piece was rectangular in shape. Special ribbed cloth was made by means of grooved anvils, and very fine, lacy material was also manufactured. Fourteen different plants yielded dyes of many colours. The general Polynesian methods of immersion dyeing and freehand painting were employed, plus the Hawaiian methods of overlaying, cord snapping, and printing with bamboo stamps.

In Polynesia outside Hawaii, beaters usually had only parallel grooves, dyes were fewer, block printing was absent, and there was less variety of decoration. Tahitian tapa, though of fine quality, had more limited design; sometimes it was waterproofed with varnish. In Samoa, Tonga, and Fiji, the cloth was laid on a design-tablet, made of leaves sewn together or of carved boards, and rubbed with swabs dipped in dye. To make large pieces, smaller ones were joined by pasting instead of by the usual felting method.

A coarser bark cloth was made in Melanesia. The designs, applied freehand, were often crude, though some New Guinea cloths had regular, well-drawn figures. Some Santa Cruz designs resembled Hawaiian types. In Indonesia, if paper mulberry was unavailable, coarser bast was boiled before beating, which took place in special houses in order not to offend certain spirits. Dyes were applied by immersing in plant infusions or mud, producing black cloth. Freehand drawing and design stamping were also known there, and oiled transparent cloth was produced for jackets and headcloths.

In South America and Africa, in contrast to the Pacific, bark cloth was often manufactured by men rather than by women. The process was essentially the same as in the Pacific but less elaborate, and the special beaters were sometimes replaced by hammers or stones. Decoration in South America was usually crude, but

Yuracare tunics were often elaborately designed. Some tribes practised design stamping. In Africa black stripes and simple patterns were sometimes applied, and Uganda royal cloth often had striking figures stencilled in black.

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BARKING, a municipal borough (1931) of Essex, Eng., which under the London Government Act 1963 was divided on April 1, 1965. The greater part (east of the River Roding) formed, with the south part of Dagenham, the new London borough of Barking; the rest was joined with East Ham, West Ham, and the two parts of Woolwich that are north of the Thames to form the new London borough of Newham (*see* LONDON). Barking municipal borough is on the north bank of the Thames, 8 mi. ENE of London Bridge. Pop. (1961) 72,293. Area 6 sq.mi. Barking was famous for its double monastery, one of the oldest (*c.* 670) and richest in England. Destroyed by the Danes, it was restored in 970 by King Edgar. Barking is a bishopric suffragan and a parliamentary constituency. The Becontree housing estate, Eastbury House (*c.* 1550; National Trust), and Barking power station are east of the Roding; west of it is Beckton gas works.

BARKLA, CHARLES GLOVER (1877–1944), British scientist, specialized in electric waves and X-rays. In 1917 he was awarded the Nobel prize in physics for his work with the characteristic Röntgen radiation of the elements. He was born June 7, 1877, at Widnes, Lancashire. He was educated at Liverpool institute; University college, Liverpool; and Trinity and King's colleges, Cambridge. In 1902 he joined the faculty of Liverpool university; in 1907 he moved to the University of London (King's college). He was appointed professor of natural philosophy at the University of Edinburgh in 1913. Barkla died on Oct. 23, 1944.

BARKLEY, ALBEN WILLIAM (1877–1956), 35th vice-president of the United States, was born in Graves county, Ky., Nov. 24, 1877. Reared on a farm under modest circumstances and educated in country schools, he graduated in 1897 from Marvin college (Clinton, Ky.) and pursued further study at Emory college and at the University of Virginia law school. He moved in 1898 to Paducah, Ky., entered law practice in 1901 and participated in Democratic politics. His career followed the familiar pattern of the times in rural America. He served as prosecuting attorney of McCracken county, 1905–09, and as judge of the county court, 1909–13. Elected in 1912 to the U.S. house of representatives from the first congressional district, he served seven successive terms, winning recognition as a conscientious legislator and supporter of the policies of Woodrow Wilson. In 1926 he was elected to the U.S. senate and subsequently re-elected three times, serving until 1949. For several years he was ranking minority member of the house committee on interstate and foreign commerce. Increasing senatorial seniority enhanced his influence on the committees on foreign affairs and finance. He was an able parliamentary tactician, and served from 1937 until 1947 as senate majority leader. He was a leading spokesman for the domestic and foreign policies of the Roosevelt administration, though he disagreed with the president on a tax bill in 1945, resigned as majority leader and was re-elected by his colleagues. In 1948 he was elected vice-president.

Barkley was a loyal and uncritical partisan and an indefatigable campaigner in many elections. His sincerity, integrity, wit and geniality made him a popular figure in Washington and throughout the country. He was a professional politician, completely loyal to party tradition and leadership but free from partisan bitterness and rancour. In the belief that he had substantial support, he sought the presidential nomination in 1952 but withdrew his name when informed that certain spokesmen for organized labour, though they respected his record, considered him too old for the presidency. Re-elected to the senate in 1954, he died at Lexington, Va., on April 30, 1956.

See his autobiography, *That Reminds Me* (1954). (T. S. BY.)

BARKLY TABLELAND, an Australian plateau with an area of about 50,000 sq.mi. that crosses the boundary of Northern Territory into Queensland, near 19° S. latitude. Its boundaries are indefinite, only its northern edge being marked by any appreciable change of slope. The general height is about 1,000 ft. Originally opened up for sheep about 1877–84, the tableland is now one of the main beef cattle areas of tropical Australia. The underlying Cambrian limestones have weathered into a soil supporting good Mitchell grass pastures so there are a number of large cattle stations, including the 11,000-sq.mi. Alexandria station. Surveys by the Commonwealth Scientific and Industrial Research organization ("Land Research Series, No. 3," *The Barkly Region*, Melbourne, 1954) indicate that with improved watering facilities, transport and techniques, stock capacity could be more than doubled, from 325,000 head to about 678,000, with 87,000 marketed each year. The motor highway and a major stock route leading to Townsville and Rockhampton on the Queensland coast follow the length of the tableland. The Mount Isa mining district lies near its eastern end. (O. H. K. S.)

BARKLY WEST (Afrikaans BARKLY-WES), a town of Cape province, Republic of South Africa, lies 21 mi. N.W. of Kimberley on the north bank of the Vaal, where a bridge spans the river. Pop. (1960) 3,648, including 1,037 Europeans. The oldest town of Griqualand West, it was founded after the discovery in 1869 of diamonds in the Vaal valley at Canteen Kopje (Klipdrift); Stone Age implements also found there are in the local museum. A branch railway and hard-surface road link the town with the railway, road and airport at Kimberley. It is still the centre of a 70-mi. stretch of scattered river diggings along the Vaal, the diamonds being noted for their purity and lustre. But it is also the commercial, civic and educational centre of an agricultural district which includes ranching, dairying, wheat, vegetables and fruit.

BARLAAM AND JOSAPHAT. The story of Barlaam and Josaphat is an edifying work that was translated into most languages of medieval Christendom. Incorporated into the Golden Legend, a famous medieval manual of lives of the saints and short treatises on the Christian feasts (*c.* 1250), it provided Shakespeare with the subject of the parable of the caskets in *The Merchant of Venice*.

The tale is set in India, in the realm of the idolatrous king Abenner, persecutor of the Christians. To this monarch is born a son, Josaphat (Gr. Joasaph). At the child's birthday feast 55 astrologers prophesy his greatness as king; however, one of them declares that his renown will not be of this world, but of the heavenly kingdom. To frustrate this prediction, Abenner confines Josaphat in a beautiful palace, and shields him from knowledge of human misery. The prince grows restive at last, and insists on seeing the world outside. He encounters a maimed man, a blind man and one at the brink of death, and is stricken by this revelation of man's wretched and fleeting existence.

At this point Josaphat is visited by the holy hermit Barlaam, who preaches to him in parables and finally baptizes him. Abenner fails to reconvert his son by holding a mock debate on the faith, in which the Christians are victorious. The pagan sorcerer Theudas vainly tries to seduce the prince by means of evil spirits and alluring women. Abenner divides his kingdom with Josaphat, is himself later converted, and dies. Josaphat abdicates and goes off into the wilderness to be reunited with Barlaam. After their death, the relics of the two holy men are laid in a shrine, which becomes a centre of pilgrimage and miraculous healing.

In spite of similarities noted by early travelers to India, it was not until the studies of E. R. L. Laboulaye (1859) and F. Liebrecht (1860) that the story was definitely proved to be a Christianized and much modified account of the Buddha's great renunciation. Modern research on ancient central Asian Buddhist Sogdian texts and on Old Turkish and Persian fragments discovered at Turfan in Chinese Turkistan has shown that there was current in those parts a set of legends about the Bodhisattva prince, whose name occurs in the form "Bodisaf." His life story, with extraneous elements, took on connected shape among the central Asian Manichaeans. The latter transmitted it to the Arabs, who adapted it

into a book called *Kitab Bilawhar wa Yudasaf*. The first Christian version was made from the Arabic by the Georgians, probably in the 9th century; in this, the prince is called Iodasaph, his teacher Balahvar. The Greek recension, formerly attributed to St. John of Damascus, which is a highly embroidered rendering of the Georgian, was made on Mt. Athos by St. Euthymius (d. 1028) the Iberian (*i.e.*, Georgian), possibly in collaboration with Greek monks there. This Greek redaction incorporates the early Christian defense of the faith known as the apology of Aristides (*see* APOLOGISTS, EARLY CHRISTIAN). From the Greek come the Latin, Slavonic, Christian Arabic and other Christian versions.

Though never officially canonized, Barlaam and Josaphat (*i.e.*, the young Buddha) are venerated by the Roman Catholic Church on Nov. 27; the Greeks commemorate Josaphat by himself on Aug. 26, the Georgians on May 19.

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BARLACH, ERNST (1870–1938), outstanding German sculptor of the expressionist movement who has often been called the modern Gothic. He was also a distinguished writer and graphic artist but his wood and bronze sculptures are his finest work. They combine strength, monumentality and expressive power.

Barlach was born Jan. 2, 1870, in Wedel, Holstein. He studied art in Hamburg and later in Dresden and Paris. After several years in Hamburg and Berlin and a visit to Russia he settled in 1908 in Güstrow, Mecklenburg, where he spent the remainder of his life and died on Oct. 24, 1938.

Barlach achieved great fame in the 1920s when he executed among other works the celebrated war memorials in Magdeburg and Hamburg and the religious figures for St. Catherine's in Lübeck, but he fell into disfavour under Hitler and his work was removed from the museums. After World War II Barlach's genius was once more recognized and several exhibitions of his work were held in Germany and abroad. A Barlach society was established in Hamburg and a small Barlach museum near Lüneburg. The best collections of the artist's works in the United States are in the Museum of Modern Art in New York city and the Busch-Reisinger museum in Cambridge, Mass.

See C. D. Carls, *Ernst Barlach*, 6th ed. (1954); E. Barlach, *Selbsterzähltes Leben* (autobiography) (1928). (H. MG.)

BAR-LE-DUC, a town of northeastern France, capital of the *département* of Meuse, lies in the narrow valley of the Ornain 228.5 km. (142 mi.) E. of Paris by road. Pop. (1962) 17,988. The town extends along the valley, shut in by wooded and vine-clad hills; on the northeast is the Marne-Rhine canal, on the southwest the Canal des Usines. The Ville Haute (upper town), on the left bank of the Canal des Usines, has houses of the 15th, 16th and 17th centuries, the surviving part of the château (1523, the rest pulled down 1670) of the dukes of Bar and the church of Saint-Étienne (15th–16th century), in which is the "Skeleton," a statue by Ligier Richier (early 16th century). The lower town contains the official buildings and the church of Notre Dame (13th–14th century) which has an 18th-century façade. Industries include iron founding and the manufacture of machinery, corsets, hosiery, flannel and jam. There is considerable trade in timber and iron. An industrial zone to the east of the town was established in 1960; products include metalwork, rubber and chemicals. Although probably ancient, Bar-le-Duc only became important when it became the residence of the 10th-century counts of Bar, who later became dukes (*see* BAR, COUNTS AND DUKES OF). It was an important base for the southern quadrant of the western front during World War I.

BARLETTA, a port, seaside resort and episcopal see on the east coast of Italy in the region of Puglia and province of Bari, lies 55 km. (34 mi.) by road W.N.W. of Bari. Pop. (1961) 66,995 (commune).

It was first known as Barduli and grew slowly. Only one of the medieval gates remains. The town is divided into two by the Milan-Brindisi railway, the northern part being the older and containing the Gothic cathedral (1150–1400) and the Norman castle (11th century) nearby. There are several palaces and museums. The people are mostly employed in viticulture and agriculture, and also grow olives and almonds. The main industries are electrical, automobile manufacture, sawmills, chemicals (especially acids and phosphates) and leather work. Wines, fruits, especially dessert grapes, and shoes are exported.

Barletta became part of the kingdom of Naples in medieval days. During the siege of Barletta (1503) a combat took place between 13 picked knights of Italy and France. The Italian victory was celebrated by Massimo d'Azeglio in *Disfida di Barletta*. During World War II the town was captured by the Allies on Sept. 24, 1943.

BARLEY. Barley is one of the five most important cereals, widely used for human food and malting, but more especially as a livestock feed grain. World-wide, approximately 3,200,000,000 bu. are harvested annually from about 136,000,000 ac.

Some investigators believe that barley is the most ancient of the cultivated grains, as ancient as the earliest traces of agriculture itself and extending back to perhaps 5000 B.C. in Egypt, 3500 B.C. in Mesopotamia, 3000 B.C. in northwestern Europe and 2000 B.C. in China. It was important to the Stone Age Swiss lake dwellers and was the chief bread plant of the Hebrews, Greeks and Romans. Barley is mentioned in the Bible and by the writers of antiquity and was included in mythology and the great festivals. It was probably the chief bread plant of continental Europe as late as the 16th century and was early transplanted to the pioneer fringe of the new world.

Barley was formerly believed to have originated somewhere in the dry lands of southwestern Asia. Later research pointed to two primary original centres of varietal diversity of cultivated barleys; *i.e.*, the highlands of Ethiopia and southeastern Asia. In any case, the kernels of the grain have remained apparently much the same during the whole of its history. Barley, of the genus *Hordeum* L. of the grass family Gramineae, includes both wild and cultivated types that differ widely.

The genus *Hordeum* includes four sections, of which one, Cerealia, includes the cultivated forms. Three species are recognized within the section Cerealia: (1) The six-rowed barley, *Hordeum vulgare*, in which the barley spike or rachis is notched on opposite sides with three spikelets at each notch and with each spikelet containing a floret. All florets are normally fertile and develop kernels. (2) The two-rowed barley, *Hordeum distichum*, with central florets fertile and lateral florets awnless and normally sterile. (3) The irregular barley, least known and sometimes referred to as Abyssinian intermediate barley, *Hordeum irregulare*.

Production.—This many-formed cereal race, in some one of its many varieties, is better adapted to a variety of climate than any other cereal, ranging through most types of temperate climate into the subarctic and the subtropical as well. It must, of course, compete with other cereals in the agricultural economy, whether primitive or technologically advanced, and its inclusion is related not only to natural factors but also to the nature and location of the specific economy and local consumer preferences.

Although it does better when the growing season is 90 days or more in length, its ability to grow and ripen within the shortest time known to cereals and with no more warmth than is required by other small grains permits it to be grown under subarctic conditions of very short seasons, 60–70 days, and at least as far as 71° N. in Norway and about 15,000 ft. altitude on the slopes of the Himalayas.

Total production under such marginal conditions is, of course, small, but possibly of vital importance locally. It is superior to other small grains in resistance to dry heat; it thrives on the desert margin of low rainfall, as in north Africa, where it is the important cereal and mostly a fall-sown crop. In the cooler, moist areas of western Europe and North America, spring-sown types reach their maximum in production.

Barley is a shallow rooted and rapidly growing grain which needs well-drained loams, almost as fertile as the soil needed for wheat. The land, however, should not have too high a nitrogen content if the plant is to stand well or if the grain is to be used for malting. Whether for fall or early spring sowing, the seed bed should be well prepared; the seed may be broadcast or drilled (preferred) at a rate of two to three bushels per acre. Harvest in the late spring or early summer by binder or combine gives widely varying yields depending on the area and year, but usually between 20 and 40 bu. per acre under modern agricultural practices.

Various insect pests, such as wireworm, Hessian fly, frit fly, chinch bug and aphides, damage the barley crop. Among parasitic fungi attacking barley are *Helminthosporium* and three kinds of smut (*Ustilago*), which destroy the spikelets. Other diseases serious at times are mildew (*Erysiphe graminis hordei*), leaf rust (*Puccinia graminis*), leaf scald (*Rhynchosporium secalis*) and the foot rots. Fusarium blight, or scab (*Gibberella saubinetti*), which shrivels the grain and makes it unfit for hog feed, may be serious in the upper Mississippi valley. Mercury dust compounds proved useful in controlling scab, leaf stripe and some of the smuts by seed treatment.

Plant breeders have attempted to increase barley yields of desirable-quality grain by improving such characters as stiffness of straw, earliness, shattering, disease resistance, winter hardiness and industrial quality. In Great Britain various hybrids, examples of which are Sprat-Archer and Plumage-Archer, have been produced for stiff straw and good yield. In the United States considerable effort has been made through hybridization to produce adapted strains with disease resistance. Smooth-awned varieties of hybrid origin increased the popularity of barley culture.

The types of barley usually grown in Europe and North America are, however, less tolerant of moist heat than are corn and rice. The naked types of Japan and India are apparently more tolerant of warm, moist conditions. The fall-sown winter varieties are less resistant to winter kill than wheat or rye. The more important producing areas are the United States, U.S.S.R., China, Eastern Europe, Canada, France, the United Kingdom, Turkey, West Germany, India and Denmark, in that order.

Production in the United States has shown much shift in location and in varieties planted. Prior to the Civil War the northeast, particularly New York, was the dominant area, and the old six-rowed barley of northwestern Europe prevailed. For the next 30 years this dominance was shared by California, which in addition to the six-rowed type produced types from the North African coast area. The next 30 years was a period marked by the rise of Manchuria varieties and by midwest production. From the end of World War I until the beginning of World War II the notable changes were the appearance of Trebi barley in the more arid western parts of the United States and of smooth-awned hybrids in the more humid northeast. The major changes during World War II were a marked decline in barley acreage in the eastern states of the north central region, and increased production in the less humid northern plains; there was a high variability in yield from year to year and a decrease in general malting quality. The postwar years showed some reinstatement in the eastern section, but the Red river area apparently fully established its dominance. North Dakota, the leading state in the 1960s harvested almost 4,000,000 ac. producing more than 75,000,000 bu.; California was second with about 70,000,000 bu. and Montana third with about 50,000,000 bu.

Approximately 140 varieties of barley were being grown in the United States and Canada by the 1960s, varying greatly in their adaptation to different soil areas, climatic regimes, types of farming and use characteristics. Thousands of varieties had been tested. An average of two or three new varieties were being released annually to U.S. farmers, each having some advantages as compared with those already used in particular areas for particular purposes.

Three groups of varieties, all of old world origin, became established early in the United States and Canada. The Manchuria-O.A.C. 21-Oderbrucker group, probably of Manchurian origin, is widely grown in the more humid sections of the upper Mississippi valley and the northeast; its varieties are six-rowed, awned, spring type with medium-sized kernels, tall, of midseason maturity and reasonably tolerant of humid heat and rain. Those in the Coast group are of north African origin, fall or winter sown in areas of mild climate and also adapted for spring sowing in areas of limited rainfall; they are six-rowed, awned, with large kernels, mature early and do not shatter easily. The Tennessee Winter group, of disputed origin, is fall sown in the humid south, mostly south of the Mason and Dixon line; its varieties are six-rowed, awned, with medium to small kernels.

Uses.—It is estimated that more than one-half the barley crop is used to feed livestock. The grain contains approximately the same percentage of carbohydrates as does corn, about 3% more protein and slightly less fat. Because of the hull it contains 5% less digestible material. Nevertheless, it is considered a fattening food and therefore not so useful for horses as for cattle, hogs and perhaps poultry. Europeans consider that it produces a high-quality pork with comparatively firm meat and fat.

Barley apparently was used for beermaking in prehistoric times. Nearly all beer is made from barley and more than 10% of the world's crop is so used. In the United States and some countries of western Europe the percentage used for beer may be one-fourth or even higher.

In the process of malting, malt barley is steeped in water and allowed to germinate or sprout, at which stage it is called green malt. It is then killed, usually by drying or roasting in a kiln. The dried material includes, as a result of the sprouting process, the enzyme diastase, which is capable under proper conditions of saccharifying the starch of the malt and also that of raw grain which is mixed with it in brewing or distilling beer or whisky.

Two-rowed barleys are the typical malting barleys except in the United States; they require soils as good as those for the best wheats. Malting barley has been described as fully mature grain, plump, mellow, small kernelled, firm hulled, carefully threshed, all of the same type, sound and free of damage by weather or disease. Black kernels are difficult to distinguish from kernels damaged by heat; skinned kernels or frayed ends are objectionable because they do not convert properly in malting. High protein is objectionable unless starch is to be added. (*See* MALT.)

Though a porous loaf cannot be made from barley flour because of its low gluten content, substantial quantities of barley are consumed for human food, as flatbread or porridge, particularly in north Africa and parts of Asia where it is the staple food grain, and as pearl barley. Most of the barley used as human food in the United States and in some other parts of the world is in the form of pearl barley—whole kernels from which the outer husk and part of the bran layer have been removed by a polishing process. Pearl barley is commonly added to some types of soups.

Barley straw is of a soft type, used mostly as bedding for livestock or as a coarse bulk roughage feed.

See also Index references under "Barley" in the Index volume.

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BARLOW, JOEL (1754–1812), U.S. poet and public official, one of the "Connecticut Wits" and author of the mock-heroic poem *The Hasty Pudding*, was born in Redding, Conn., on March 24, 1754. He graduated from Yale in 1778, did postgraduate work there, and for three years was a chaplain in the Revolutionary army. In July 1784 he established at Hartford, Conn., a weekly paper, the *American Mercury*, with which he was connected for a year. In 1786 he was admitted to the bar. He was a member of the group of young writers, known as the Connecticut or Hartford wits, who were motivated by patriotism to undertake the creation of a national literature; the group included John Trumbull (*q.v.*)

and Timothy Dwight (*see* DWIGHT family). Barlow's *Vision of Columbus* (1787), a poetic paean to America in nine books, brought the author immediate fame; it was characterized by great verve and enthusiasm but was marred by failure in poetic technique and confusion of thought.

In 1788 Barlow went to France as the agent of the Scioto Land company, and induced the company of Frenchmen who ultimately founded Gallipolis, O., to emigrate to America. In Paris he became a liberal in religion and an advanced republican in politics. He was a member of the London Society for Constitutional Information; published various radical essays, including a volume entitled *Advice to the Privileged Orders* (1792), which was proscribed by the British government; and was made a citizen of France in 1792. Thomas Paine had become his friend in England, and during Paine's Paris imprisonment Barlow effected the publication of *The Age of Reason.*

His career took an increasingly romantic turn in subsequent years. In 1795–97 he was sent to Algiers to secure a release of U.S. prisoners and to negotiate treaties with Tripoli, Algiers and Tunis. He returned to the United States in 1805 and lived near Washington, D.C., until 1811 when he became U.S. plenipotentiary to France, charged with negotiating a commercial treaty and securing restitution or indemnity of confiscated U.S. property. In that capacity he became involved in Napoleon's retreat from Russia and died of exposure at Zarnowiec, Pol., Dec. 24, 1812.

In 1807 Barlow published in a sumptuous volume *The Columbiad,* an enlarged edition of his *Vision of Columbus,* more mature than the original but also more pretentious, and one of American literature's great failures. He is now best known for his much-anthologized *Hasty Pudding* (1796), a pleasantly humorous pastoral poem inspired by homesickness for New England and corn-meal mush.

He also published religious verse, and his political writings in collected form went through several editions in his lifetime.

See James Woodress, *A Yankee's Odyssey: The Life of Joel Barlow* (1958), the first full-length biography; Leon Howard, *The Connecticut Wits* (1943).

BARMECIDES (properly BARMAKIDS), a noble Persian family which attained great power under the Abbasid caliphs in the 8th and early 9th centuries A.D. (*see* CALIPHATE). Barmak was the title of their ancestors as hereditary high priests of a Buddhist temple near Balkh, for a time a centre of resistance to the Arab conquest. Khalid ibn Barmak (d. 781 aged about 75) became a Muslim and was given high offices under the first three Abbasid caliphs. His son Yahya ibn Khalid was made vizier by Harun al-Rashid when the latter became caliph (786), Yahya having previously been his tutor and the deputy-governor (under Khalid) or governor of various provinces. From 786 to 803 Yahya, with his sons Fadl and Ja'far, controlled the affairs of the caliphate. They brought the administrative machine to greater efficiency, and under their direction the caliph's vast territories reached a supreme degree of power and prosperity, while art and letters flourished. An exaggerated picture of the colourful life of Baghdad at this period is given in the *Arabian Nights* (*see* THOUSAND AND ONE NIGHTS) and elsewhere. The Barmecides' fall was sudden. One night in Jan. 803, Yahya, Fadl and others were arrested and imprisoned, while Ja'far, who had been Harun's boon companion as well as an administrator, was executed. The chief reason was perhaps Harun's desire to be master himself.

The expression "Barmecide feast," for an imaginary banquet, comes from "The Barber's Tale of His Sixth Brother" (*Arabian Nights*), where a Barmecide has a series of empty dishes served to a hungry man to test his sense of humour. (W. M. WT.)

BARMEN, a former German city in the Prussian Rhine province, lies along the valley of the Wupper and was once famous for its textiles and red dyeing. In 1929 it was joined with the city of Elberfeld and neighbouring towns to form a modern industrial city known since 1930 as Wuppertal (*q.v.*).

BARMEN, SYNOD OF, a meeting of German Protestant leaders at Barmen in the Ruhr, May 1934, to organize Protestant resistance to National Socialism. Representatives came from established Lutheran, Calvinist and United churches, although some of the church governments already had been captured by men loyal to Hitler and others—notably in Württemberg, Bavaria and Hanover—had decided to limit their activities to passive resistance. The Pastors' Emergency League, headed by Martin Niemöller of Berlin-Dahlem, was the backbone of the active resistance (*Bekennende Kirche,* "Confessing Church"). Various unofficial men and movements, including leaders in the German Christian Students' movement (D.C.S.V.) and community religious emphasis weeks (*Evangelische Wochen*) led by Reinold von Thadden-Trieglоff also rallied to the cause. After Barmen, representative semilegal "synods" were held at Dahlem, Augsburg and Bad Oeynhausen, until the government of the third *Reich* arrested Niemöller (1937) and drove the movement underground.

At Barmen representatives of the major Protestant confessions adopted six articles that defined the Christian opposition to National Socialist ideology and practice. The major theological influence was that of Karl Barth. The articles did not attempt a well-rounded system, but adopted the classical form of the great confessions of faith, affirming major biblical teachings and condemning the important heresies of those who were attempting to accommodate Christianity to National Socialism. The synod was a major event in European church history, and pointed the way to the Stuttgart Declaration of Guilt (1945) and the postwar renewal of the church in Germany.

See *The Significance of the Barmen Declaration for the Oecumenical Church* (1943); F. H. Littell, *The German Phoenix* (1960).
(F. H. LI.)

BARMER, a town, formerly headquarters of the Mallani district of Jodhpur state, is now headquarters of the district of Barmer in Jodhpur division of Rajasthan, India. It is on the Northern railway from Delhi and Jodhpur to the frontier of Pakistan, and thence to Hyderabad. The population of the town rose from 6,064 in 1901 to 20,812 in 1951. It has an observatory. The present town is said to have been founded in the 13th century by a Raja Bahada, and to have been called after him Bahadamer (the meru or "hill fort" of Bahada), since contracted to Barmer. It is built on the side of a rocky hill, crowned by an old fort.

BARMER DISTRICT had a population of 648,734 in 1961. Situated in the Thar desert, it has an annual rainfall of five to ten inches. Its western boundary is also the border of Pakistan. There are several outcrops of stone, and millstones are manufactured and exported to the neighbouring districts. The total area is 10,174 sq.mi., of which one-half is under cultivation. Irrigation is carried on mainly from wells, which are generally deep. The soil is poor and sandy. (S. M. T. R.)

BAR MITZVAH, the Jewish religious ritual and family celebration commemorating the 13th birthday of a boy. This birthday according to tradition marks a boy's religious coming of age. He is now deemed responsible for the fulfillment of all the commandments (Bar Mitzvah means "son of" or "one responsible for the commandments"). The boy is called up to the reading of the scroll of the Law on the sabbath following his birthday, and after the services (nowadays often on the next day) there is a family feast at which, in former days, the "Bar Mitzvah" recited a learned discourse on the Law. The age of 13 as the mark of religious maturity is mentioned by Rabbi Juda ben Tema (2nd century), but the ceremony of calling the boy to the Torah on the sabbath and the family festivities are not mentioned till the middle ages.

Reform Judaism, after 1810, developed confirmation as a substitute for Bar Mitzvah. At this ceremony a whole class of boys and girls are confirmed in a joint ceremony, usually on the Feast of Shabuoth (Feast of Weeks). In the 20th century many Reform congregations restored the individual Bar Mitzvah, while retaining the joint confirmation for age 15 or 16. Many Conservative congregations have instituted Bas Mitzvah, an individual ceremony for girls. (S. B. FR.)

BARMOTE COURT (also BERGHMOTE, BARGMOTE, BARGEMOTE, BARMOOT), a court held in the lead-mining districts of northern Derbyshire, Eng., to determine customs peculiar to the industry and to settle disputes among the miners. Barmote courts, which were in existence in the reign of Edward I, covered two main districts where the crown is entitled to mineral duties: (1) the

King's field in the High Peak comprising seven liberties; and (2) the soke (*see* SOCAGE) and wapentake (*q.v.*) of Wirksworth. Obsolete customs were erased and procedure regulated by the High Peak (1851) and Derbyshire (1852) Mining Customs and Mineral Courts acts conferring similar powers on both districts. Each holds a great barmote court once a year, and the small barmote courts function more often; they are presided over by a steward, and officials are known as barmasters.

BARMOUTH (ABERMAW), an urban district and seaside resort of Merioneth, Wales, is situated on the north bank of the picturesque Mawddach estuary, 10 mi. W. of Dolgellau by road. Pop. (1961) 2,348. The modern town occupies most of the narrow littoral between the sea and the foothills of the Rhinog range. Above the town and overlooking Cardigan bay are 4.5 ac. of cliff-land (Dinas Oleu) which were the first property acquired by the National Trust (1895). Twelve cottages on this land were bought by John Ruskin in 1874 to implement the social ideals of his St. George's guild, which still administers them. The Early English parish church of St. Mary, Llanaber, 2 mi. N., is perhaps the most interesting church in the county. Barmouth, with its fine sandy beach, has attracted a steadily increasing number of tourists since the beginning of the 19th century. A railway bridge (1866) spans the estuary and there are services to the Welsh border via Dolgellau or Machynlleth. (W. H. W. T.)

BARN: *see* FARM BUILDINGS.

BARNABAS, SAINT, although not one of the Twelve, was the most important early Christian apostle to the gentiles with the exception of Paul. He is mentioned occasionally in the Pauline Epistles (Gal. ii, 1, 9, 13; I Cor. ix, 6; Col. iv, 10), and is a central figure in Acts xi, 19–xv, 41. Acts iv, 36 tells of the adding of the surname Barnabas (interpreted to mean "son of encouragement" or "exhortation") to his original name, Joseph. The actual etymology of Barnabas is in doubt (perhaps it is the Greek transliteration of pagan-Semitic Bar-Nebo; *i.e.*, "son of [the god] Nebo"); in fact, there is reason to question the entire picture of Barnabas given by Acts. One of the major problems is the apparent discrepancy between Gal. i, 15–ii, 14 and Acts (*see* PAUL, SAINT; ACTS OF THE APOSTLES).

The critical search for reliable information behind the account in Acts has produced the following results: (1) Barnabas was a Jewish Hellenist from a Cypriot family who joined the Jerusalem church soon after Jesus' death, sold his property and gave the proceeds to the community (Acts iv, 36–37). (2) First in the list of the Antiochian prophets (Acts xiii, 1), Barnabas was one of the Cypriots who founded the church in Antioch (Acts xi, 19–20). It is quite possible that Barnabas, who called Paul from Tarsus as his assistant (Acts xi, 25), was actually the first Christian missionary to deny the necessity of the Jewish Law for the gentile Christians. (3) After a period of joint missionary activity (Acts xiii–xiv), Barnabas and Paul went to Jerusalem in A.D. 48 and successfully obtained the recognition of a gentile Christianity that was free from the Jewish Law (Gal. ii, 1–10; *see* also Acts xv, 1–29). (4) Shortly afterward a serious conflict (Gal. ii, 11–13; compare Acts xv, 36–41) led to a definite breach with Paul, after which Barnabas sailed to Cyprus (Acts xv, 39). Barnabas then drops from the scene, except for a brief reference by Paul a few years later (I Cor. ix, 6). Nothing can be said about the time or circumstances of his death (the apocryphal *Journeys and Martyrdom of Barnabas* is a forgery from the 5th century A.D.; *see* APOCRYPHA, NEW TESTAMENT).

Subsequent church tradition finds Barnabas again in Alexandria, and ascribes to him the Epistle of Barnabas (*see* APOSTOLIC FATHERS), or pictures him in Rome and assumes that he wrote the Epistle to the Hebrews. In order to stress its independence, the Church of Cyprus, and later even that of Milan, claimed to have been founded by the apostle Barnabas.

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BARNABAS, EPISTLE OF, one of the "Apostolic Fathers," found in the 4th-century *Codex Sinaiticus* of the New Testament. *See* APOSTOLIC FATHERS.

BARNABITES (CLERICS REGULAR OF ST. PAUL), a religious order founded in 1530 by St. Antonio Maria Zaccaria (1502–39) and confirmed as an order by the Vatican in 1535 and 1579. In addition to monastic devotion, they give practical help to those in physical or spiritual need and are especially devoted to a study of the Pauline Epistles. In 1538 they acquired the ancient church of St. Barnabas in Milan (hence their name). They have monasteries in Italy, Austria, Belgium, Spain, and South America. *See* also ORDERS AND CONGREGATIONS, RELIGIOUS.

BARNACLE, generally the common name for any of the greatly modified marine crustaceans of the subclass Cirripedia. In a more restricted sense the name refers to the nonparasitic forms—the stalked or peduncled barnacles (family Lepadidae) and the sessile barnacles or acorn shells (Balanidae). Other members of the subclass include the parasitic barnacles, with even greater degeneration of body form (see *Parasitic Barnacles*, below).

General Description.—The stalked barnacles are most frequently found attached to driftwood and constitute one of the major groups of fouling organisms on hulls of ships in the open sea. The acorn shells also are important as fouling organisms, usually

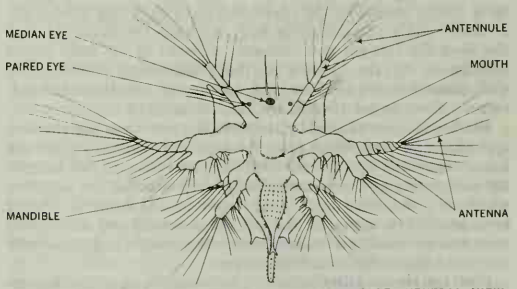


FIG. 1.—LATE STAGE NAUPLIUS LARVA OF A BARNACLE, VENTRAL VIEW, GREATLY ENLARGED

becoming attached while the ship is in coastal waters, but they are more frequently seen as the encrusting animals that may completely cover pilings, jetties and rocky areas within the intertidal zone. The shells of most species of sessile barnacles are composed of four to eight vertical wall plates that form a truncate cone, a membranous or calcareous basis that is attached to the substratum and four movable opercular plates (lids) on the free end of the shell, opposite the basis. All calcareous plates are connected at their interfaces by chitin and are lined internally by the fleshy mantle. In some of the stalked barnacles the body is well covered with hard, calcareous plates; in others the shell may be only partially calcified or almost absent, being represented by tiny vestiges. As originally postulated by Darwin in 1854 the

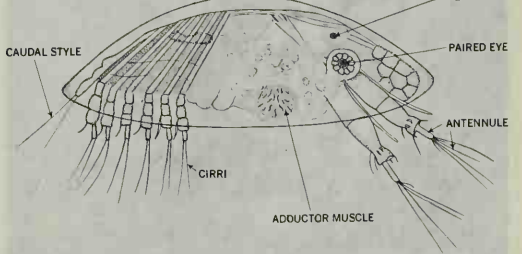
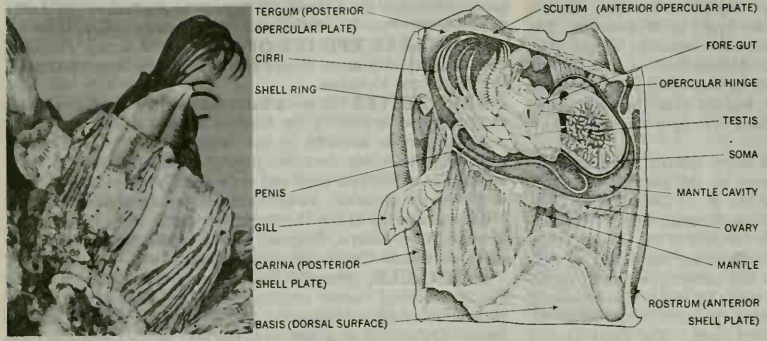


FIG. 2.—BIVALVED CYPRIS LARVA OF A BARNACLE, LATERAL VIEW, GREATLY ENLARGED



(LEFT) WILO WILLIAMS; (RIGHT) FROM "BIOLOGICAL BULLETIN"

FIG. 3.—(LEFT) ACORN BARNACLE (BALANUS TINTINNABULUM) WITH CIRRI EXTENDED; (RIGHT) ACORN BARNACLE WITH SHELL PLATES REMOVED FROM ONE SIDE, SAGITTAL VIEW

continuous growth of the shell results from the deposition of new matrix and calcium carbonate by the mantle at the edge of the old portions of the shell.

Enclosed by the shell is the body, or soma, which carries out the functions of feeding, respiration and reproduction. The body more closely resembles the crustacean form in having jointed appendages and a soft chitinous body covering (exoskeleton) that also lines the fore-gut and hind-gut. Growth of the body occurs periodically by the molting of the exoskeleton; however, the shell plates are not shed and the continuous growth of the calcareous plates is not affected by the molting cycle.

Feeding is accomplished by the sweeping motion of the thoracic appendages, or cirri, which have fine hairlike processes. When the lids are open, the cirri are extended into the water, the fine hairs of the cirri acting as a net, enmeshing plankton and other particles, which are then carried down to the mandibles and ingested. Paired eyes, which first appear in the late stage nauplii and are carried over into the adult, are located within the mantle and apparently function only as light-sensitive organs.

Distribution.—Distribution of barnacles is normally accomplished by movement of the tiny larvae with tides and horizontal water currents. Some species (*Balanus tintinnabulum* and *Elminius modestus*) have been distributed over wide areas and accidentally introduced into new areas by the movement of ships and amphibious aircraft to which adults were attached. In intertidal barnacles a definite pattern of vertical zonation in relation to tide may be observed in most areas of the world. Some species are limited in their distribution by the salinity of estuarine waters, by seasonal fluctuations in temperature and by competition for space with other intertidal organisms. Although many species of sessile barnacles are exclusively marine animals—found only in salinities of 30 to 35 parts per thousand—other species occur throughout a wide range of estuarine areas and are found in waters in which the salinity has been reduced to less than one part per thousand.

Many species will attach to any available surface, but some forms are extremely specific in their habitat. *Octolasmis mulleri*, a stalked barnacle, is found only in the gill chambers of certain marine crabs; and *Balanus galeatus*, a rock barnacle, is found always associated with the soft coral *Leptogorgia*.

ROBERT C. HERMES FROM NATIONAL AUDUBON SOCIETY

FIG. 4.—GOOSENECK BARNACLES (LEPAS FASCICULARIS)

Reproduction and Development.—Adult barnacles are usually hermaphroditic (both sexes in a single individual), although dwarf males have been described for a few species. Cross-fertilization between adults occurs in most forms, but self-fertilization can produce viable eggs in some species. The eggs upon being laid are retained as two flat, yellow layers in the mantle cavity of the adult, on either side of the body. As embryonic development progresses the eggs darken and are a slate-gray immediately prior to hatching. The larvae are hatched as free-swimming nauplii (fig. 1) and expelled from the adult through the opercular opening. A typical barnacle nauplius—with a shieldlike carapace, median eye and an abdominal process—has three pairs of appendages which are used for feeding on smaller planktonic organisms and also for swimming. In most barnacles the nauplii pass through a series of six stages, increasing in size and complexity with each molt. The final naupliar molt produces the bivalved cypris larva (fig. 2) which is free-swimming but does not feed. In the cypris six cirri are present, and the antennules are modified as cement glands by means of which the larvae attach to the substratum at the time of settling. The period of larval development may vary from about one to about eight weeks, depending upon water temperatures and available food. After attaching to the substratum the cypris metamorphoses into a "pinhead" barnacle and initiates development of the external calcareous shell.

In the natural environment predation of the larval stages by filter feeders accounts for a high percentage of mortality. The larvae are liberated in such large numbers in some areas that they constitute the major portion of the diet of some fish. The settled stages are also scraped from the substratum and eaten by sea urchins, carnivorous gastropods (*Thias lapillus*) and fish such as the sheepshead (*Archosargus probatocephalus*).

Control of Fouling Barnacles.—Although the development of antifouling paints has progressed considerably, many paints are effective only in certain waters and for limited periods of time. (*See* also PAINT.) (J. D. Co.)

Parasitic Barnacles.—Allied to the more normal Cirripedia just described are a number of more degenerate and, for the most part, parasitic forms. The most degenerate are the members of the order Rhizocephala, of which the genus *Sacculina*, a common parasite of crabs, is a familiar example. After its free-swimming stage, *Sacculina* attaches under the abdomen of a crab by a short stalk from which rootlike processes ramify throughout the internal organs of the host. The body is enveloped by a fleshy mantle with a small opening and is without appendages, mouth or alimentary canal, the only organs which are well developed being those of the reproductive system. Only the larval development allows *Sacculina* to be referred to the Cirripedia. (For the effect of *Sacculina* on its host, *see* SEX: *Parasitism.*) Largest of the Rhizo-

cephala is *Briarosaccus callosus*, found living on certain crabs of the family Lithodidae taken from more than 250 fathoms off the southeastern United States.

Classification.—Though complicated by the obscure relationship of parasitic forms to more normal cirripedes, the classification generally adopted is as follows:

Order Thoracica, with six pairs of cirri, divided into four suborders: Lepadomorpha, the stalked barnacles (*Lepas, Scalpellum, Mitella*); Verrucomorpha, asymmetrical sessile forms (*Verruca*); Brachylepadomorpha, sessile, fossil only, (*Pycnolepas, Brachylepas*); Balanomorpha, the sessile acorn shells and rock barnacles (*Balanus, Chthamalus, Coronula, Chelonibia*).

Order Acrothoracica, somewhat degenerate forms with fewer cirri, boring in shells and corals (*Alcippe*).

Order Ascothoracica, six pairs of cirri, only cirripede with definite, at times segmented, abdomen, parasitic on coelenterates and echinoderms; affinities obscure (*Laura, Dendrogaster*).

Order Apoda, no cirri, only known specimen described by Darwin; from mantle cavity of another cirripede (*Proteolepas*).

Order Rhizocephala, degenerate parasites of decapod Crustacea, only cirripedes without any alimentary canal; no trace of segmentation in adult, wholly without appendages (*Sacculina, Peltogaster*).

See also CRUSTACEA. (W. T. C.; W. L. St.)

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BARNARD, LADY ANNE (née LINDSAY) (1750–1825), Scottish author of the ballad "Auld Robin Gray," was born in Dec. 1750, at Balcarres castle, Fifeshire. In 1793 she married Andrew Barnard and went to the Cape of Good Hope with him when he became colonial secretary there in 1797. When the Cape was ceded to Holland (1802), they returned to London, where she lived until her death on May 6, 1825. She wrote "Auld Robin Gray" to the music of an old song. Her letters from the Cape to Henry Dundas, then secretary for war, were published as *South Africa a Century Ago* (1901).

See *Auld Robin Gray*, ed. by Sir Walter Scott (1825); D. Fairbridge, *Lady Anne Barnard at the Cape of Good Hope, 1797–1802* (1925); M. Masson, *Lady Anne Barnard* (1948).

BARNARD, EDWARD EMERSON (1857–1923), U.S. astronomer particularly noted for his work in celestial photography. He was born in Nashville, Tenn., on Dec. 16, 1857. He began his studies alone in boyhood. In 1887 he graduated from Vanderbilt university, after having charge of the observatory there for four years. In 1887 he was appointed astronomer at Lick observatory, and from 1895 until his death he was professor of practical astronomy and astronomer of Yerkes observatory, at The University of Chicago. He accompanied the U.S. Naval observatory eclipse expedition to Sumatra (1901). His contributions to observational astronomy were numerous and important. In celestial photography he obtained excellent results and discovered 16 comets, Jupiter's fifth satellite and the star (Barnard star) with the greatest known motion (1916). He was associate editor of the *Astronomical Journal* and the author of *Micrometrical Observations of Eros Made During Opposition of 1900–1901*.

A bibliography may be found in J. A. Parkhurst's "Edward Emerson Barnard," in *National Academy of Sciences—Report*, pp. 49–53 (1923). For further biographical material consult: *Royal Astronomical Society*, Monthly Notices, vol. lxxxv, pp. 221–225; Robert G. Aiken's "Edward Emerson Barnard (1857–1923)" in *Astronomical Society of the Pacific*, vol. xxxv, pp. 87–94.

BARNARD, FREDERICK AUGUSTUS PORTER (1809–1889), U.S. educator and for nearly 25 years president of Columbia college in New York city, during which time the college was transformed from a small undergraduate institution for men into a world-famous university. Barnard was born in Sheffield, Mass., on May 5, 1809, graduated from Yale college in 1828 and taught for several years in schools for the deaf-mute. Then he turned to college teaching in mathematics, science and English, first at the University of Alabama (1838–54) and later at the University of Mississippi (1854–56). He was president and chancellor of the University of Mississippi from 1856 to 1861, when he resigned because of his Union sympathies.

Earlier, Barnard had defended the traditional prescribed curriculum, with its emphasis upon the classics and mathematics as the best means of discipline of the faculties of the mind, opposing the introduction of utilitarian or professional subjects into the curriculum. But after he went to Columbia college, in 1864, Barnard changed his views. He urged Columbia to expand its curriculum and introduce the elective system into the last two years of college as the best means of developing advanced scholarship leading to graduate and professional education; besides, he argued, this was the best way to attract more students. Barnard was instrumental in establishing the school of mines and opening the university to women. Hence, Barnard college for women was named for him when it opened in 1889.

Barnard was a vigorous but somewhat prolix writer on political, economic and scientific as well as educational topics. He was a versatile man, a classical and English scholar, a mathematician, a scientist and a good public speaker. His annual reports to the Columbia trustees were particularly valuable as discussions of educational problems.

See also COLUMBIA UNIVERSITY.

See John Fulton, *Memoirs of Frederick A. P. Barnard* (1896); William F. Russell (ed.), *The Rise of a University*, vol. i, *The Later Days of Old Columbia College, From the Annual Reports of Frederick A. P. Barnard, President of Columbia College, 1864–1889* (1937). (R. F. Bs.)

BARNARD, GEORGE GREY (1863–1938), U.S. sculptor whose works were characterized by a vitality and individuality that sometimes made them subjects of controversy, was born at Bellefonte, Pa., on May 24, 1863. At 13 he was apprenticed to a jeweler and he then attempted his first sculpture. He studied at the Art Institute of Chicago in 1880 and at the École des Beaux Arts and the studio of Pierre Jules Cavelier in Paris between 1883 and 1887.

His first important commission was for a grave monument to the Norwegian poet Severin Skovgaard. In 1894 he exhibited at the Paris salon where his work created a sensation and made the reputation of the young sculptor. One of the works shown then was "The Struggle of the Two Natures in Man" (Metropolitan museum, New York). His most important work was the two colossal groups at the entrance of the Pennsylvania state capitol building at Harrisburg. Barnard made a collection of early Gothic sculpture and medieval architectural fragments which in 1925 was purchased by the Metropolitan museum. His vigorous statue of Lincoln (in Lytle park, Cincinnati, O.) was the centre of a storm of criticism when it was unveiled in 1917. His last work, the so-called Rainbow arch, remained uncompleted. He died in New York city on April 24, 1938. Collections of his work are at Swarthmore college, Swarthmore, Pa., and the Jefferson County Historical society, Madison, Ind.

See Lorado Taft, *History of American Sculpture*, rev. ed. (1930); Beatrice I. Proske, *Brookgreen Gardens Sculpture* (1943). (A. T. G.)

BARNARD, HENRY (1811–1900), U.S. educator, whose contributions toward the stimulation and direction of popular education in the United States were very great as well as lasting, was born Jan. 24, 1811, at Hartford, Conn. He graduated from Yale with honours but interrupted his preparation for the legal profession to take charge of an academy at Wellsboro, Pa. In 1835 he was admitted to the Connecticut bar. In the same year, while in Europe, he became interested in the new theories of European educators—in particular, J. H. Pestalozzi, F. W. Froebel and P. E. von Fellenberg—and after his return to the United States in 1836 he abandoned law practice to begin a career of educational administration.

As a Whig member of the Connecticut state legislature, 1837–39, Barnard was instrumental in drafting and securing the passage in 1838 of a measure that created a state board of "commissioners of common schools." His administration as first secretary of this board featured the founding of the *Connecticut Common School Journal* in 1838 and the first teachers' institute in 1839. He ac-

cepted a similar school position in Rhode Island in 1843. Following his survey of the state's common schools, he became its first commissioner of public schools and reorganized the Rhode Island school system. Further, he activated community libraries for school use, introduced a popular traveling model school for demonstration of classroom methods during teachers' institutes and established an educational periodical, the *Journal of the Rhode Island Institute of Instruction.*

Illness forced his resignation in 1849. In 1851 he returned to Connecticut as the state superintendent of schools and principal of the new state normal school at New Britain. When poor health again led to his resignation in 1855, he left a well-integrated school system.

From 1858 to 1861 Barnard was chancellor of the University of Wisconsin, Madison, and agent of the normal school regents. In 1866 he accepted the presidency of St. John's college, Annapolis, Md., and from 1867 to 1870 he was the first United States commissioner of education.

In addition to his annual reports as educational administrator, Barnard founded and edited three state school journals. His greatest contribution in this field, the *American Journal of Education,* established in 1855 and expanded to 32 volumes by 1882, was more of an encyclopaedia than a serial publication. It not only documented the pattern of thought in U.S. education during the 19th century's struggle for public schools, but also presented the best in foreign educational literature.

Barnard died at Hartford, Conn., on July 5, 1900.

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BARNARD CASTLE, an urban district, market town and holiday resort of County Durham, Eng., is picturesquely situated on the north bank of the river Tees, which forms the border with Yorkshire, at the eastern end of the Stainmore gap through the Pennines, 16 mi. W. of Darlington by road. Pop. (1961) 4,969. The area has been occupied since the Stone Age, and two Roman roads intersected where the town now stands. When the stone castle, which gave the town its name, was erected (before 1200) by Bernard de Balliol a feudal settlement grew around it. The town received its first charter about 1178 from Bernard de Balliol. In the castle was born John de Balliol, founder of Balliol college, Oxford, and father of the John de Balliol (*q.v.*) who was for a short time king of Scotland. The ruins of the castle, including a 14th-century round tower, stand on a low cliff overlooking the rocky Tees, there crossed by a medieval bridge. The town retains many 18th-century buildings including the town hall (1747). The 17th-century trades of tanning, harness making and stockings were succeeded by woolen manufactures bringing much wealth and, in the 19th century, by carpet weaving and rope and shoe-thread making. Modern industries include the making of penicillin, gloves, cloth and concrete products. Rokeby, 2 mi. S.E., is the chief scene of Sir Walter Scott's poem of that name, while 14th-century Raby castle lies 6 mi. N.E. and ruined Eggleston abbey 1 mi. S.E. The Bowes museum, built in 1869–92 by John Bowes, contains a famous collection of pictures and other works of art. Charles Dickens was inspired by the locality to write *Nicholas Nickleby* and *Master Humphrey's Clock.*

BARNARD COLLEGE, for women, in New York city, founded as an affiliate of Columbia college in 1889 and named after F. A. P. Barnard, became a part of the university in 1900. *See* COLUMBIA UNIVERSITY.

BARNARDO, THOMAS JOHN (1845–1905), founder and director of homes for destitute children, was born in Dublin on July 4, 1845, where his father, a German immigrant of Spanish descent, was a furrier. In 1862, during the Protestant religious revival in Dublin, Barnardo experienced conversion, and in 1866 he went to London to train as a medical missionary for China. It was as a medical student teaching voluntarily in "ragged schools" that he discovered the homeless waifs of London sleeping on roofs and in alleyways. Speaking of this at a missionary rally brought him offers of money and help and he founded his first home for destitute boys in Stepney Causeway in 1870. "Dr. Barnardo's Homes," or the National Incorporated Association for the Reclamation of Destitute Waif Children, as they became in 1899, met a real need and grew rapidly in number. The slogans of the movement—"No destitute child ever refused admission" and "The ever-open door"—did not prevent a high quality of child care and instructional training, shown in the success of these former waifs and strays in later life. Barnardo died at Surbiton, Surrey, on Sept. 19, 1905.

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BARNATO, BARNETT (BARNEY BARNATO) (1852–1897), English financier, who was one of the most colourful personalities associated with the development of the South African mining industry, was the son of a London Jewish shopkeeper, Isaac Isaacs. In 1873 he went to Kimberley in South Africa to join his brother Henry, a diamond dealer who had gone to Africa as an amateur entertainer under the stage name Barnato (which he and his brother had assumed in London). Barney too became a diamond broker, forming with Henry the firm Barnato Brothers in 1874. He began to buy up diamond mining claims in 1876 and the Barnato Diamond Mining company, which he formed in 1880, became the only serious rival to Cecil Rhodes's De Beers Mining company. The struggle for control of the industry ended in 1888 with Rhodes's victory and the amalgamation of the two companies as De Beers Consolidated Mines, in which Barney Barnato became a life-governor. The same year he entered the Cape Colony house of assembly as a member for Kimberley. Seeing the potentialities of the newly discovered Witwatersrand gold fields he began buying up claims and real estate there in 1889, and floated the Barnato Consolidated Mine's company and the Barnato bank. In 1895 his "bulling" operations saved the Rand from a serious slump. He did not participate in the Jameson raid conspiracy (Dec. 1895), and afterward strongly denounced the venture. On June 14, 1897, he jumped overboard on his way to England and was drowned. His son Woolf Barnato (1895–1948) was prominent in British motor racing circles. (M. F. K.)

BARNAUL, a town and administrative centre of the Altai *krai* of the Russian Soviet Federated Socialist Republic, U.S.S.R., is situated on the left bank of the Ob, at its confluence with the Barnaulka. Pop. (1959) 320,000. Founded in 1738 as a silver-refining centre, Barnaul became the hub of the Altai mining region. It is now an important industrial town, with engineering (power station boilers, presses, diesel motors, radios), timber working (saw-milling, matches, furniture, turpentine), textile and boot and shoe making and food processing (milk, meat and flour-milling). A large cotton mill was constructed after 1960. At Chesnokovka, across the Ob, rolling stock is built. Barnaul is an important communications centre on the navigable Ob, on the south Siberian and Turksib railways, with a branch to Bisk, and on roads to the Kolyvan-Rubtsovsk mining area and Novosibirsk. There are four institutes, pedagogical, medical, agricultural and agricultural engineering. (R. A. F.)

BARNAVE, ANTOINE PIERRE JOSEPH MARIE (1761–1793), one of the foremost orators of the Constituent Assembly during the French Revolution, was born at Grenoble, in Dauphiné, on Sept. 21, 1761. Having made a name for himself, first with a pamphlet on the military edicts of May 1788 during the dispute between the *parlement* of Grenoble and the French government, then as a supporter of J. J. Mounier in the resistance of the estates of Dauphiné to the government, he was elected a deputy of the *tiers état* to the estates general of 1789. There he distinguished himself as an impromptu speaker and as one who could present complex issues clearly and incisively. In the debates of Sept. 1789 on the legislative chambers and on the right of veto, he broke with Mounier and identified himself with the left. He, Alexandre de Lameth and Adrien Duport then grouped themselves together as the "triumvirate." Together they contributed substantially to the formation of the Jacobins, the constitution of which Barnave drew up. In 1790 he opposed Mirabeau on the

question of the king's right to make war and peace and up to November enjoyed a popularity that rivaled Mirabeau's, but his support of the planters' organizations in the West Indian colonies enabled Jacques Pierre Brissot to begin discrediting him (with the pamphlet *Lettre à M. Barnave*). Harassed by Brissot and Robespierre, the triumvirs lost ground on the left and tried to come to terms with the king's ministers after Mirabeau's death (April 1791). When the royal family was brought to Paris from Varennes, Barnave, as commissary of the assembly, came into contact with Marie Antoinette, was moved to sympathy by her situation and began a secret correspondence with her. His impassioned speech on the inviolability of the monarchy (July 15, 1791) carried the assembly, whereupon the triumvirs broke with the Jacobins and founded the club of the Feuillants. In Aug. 1791, however, they failed in their attempt to strengthen the royal power under the constitution. Continuing his correspondence with the queen during the first months of the legislative assembly, Barnave had two more interviews with her (first with Lameth, then alone).

Barnave left Paris for Grenoble in Jan. 1792. In Paris, however, the attack on the Tuileries, in August, led to the discovery of a document bearing his name and Lameth's, in which a project for a committee of ministers was outlined. Arrested in Grenoble on Aug. 19, 1792, Barnave was kept in prison for 15 months (during which he wrote his *Introduction à la révolution française*), sentenced by the revolutionary tribunal on Nov. 28, 1793, and executed the next day. His remark, "It is very interesting to start a revolution, but hard to be obliged to bring it to its conclusion," summarizes his career. There are editions of Barnave's works by A. Bérenger de la Drôme (1843); of his previously unpublished correspondence of 1792 by G. Michon (1924); and of his secret correspondence with Marie Antoinette by A. Soderhjelm (1934).

See E. D. Bradby, *Life of Barnave* (1915); J. J. Chevallier, *Barnave, ou les deux faces de la Révolution* (1936). (J. J. CH.)

BARNBY, SIR JOSEPH (1838–1896), English composer, organist and conductor who promoted an interest in choral music, was born at York, Aug. 12, 1838. He studied at the Royal Academy of Music, London, and subsequently became organist at a succession of London churches. He gave Bach's *St. Matthew Passion* at Westminster abbey in 1871 and, appointed to St. Anne's, Soho, in the same year, he conducted annual performances there of the *St. John Passion*. His choir was amalgamated in 1871 with the Royal Albert Hall Choral society, later the Royal Choral society. He gave the first performances in England of Dvořák's *Stabat Mater* (1883) and of a concert version of Wagner's *Parsifal* (1884). He became precentor of music at Eton in 1875, and principal of the Guildhall School of Music in 1892, and was knighted in the same year. His compositions consist chiefly of services, anthems and hymns, and part songs, of which the most popular was his setting of *Sweet and Low* (1863). He died in London on Jan. 28, 1896.

BARNES, BARNABE (1569?–1609), English poet, one of the Elizabethan sonneteers and the author of *Parthenophil and Parthenophe*, was the son of Richard Barnes, bishop of Durham. He was entered at Brasenose college, Oxford, in 1586 but took no degree and in 1591 joined the expedition to Normandy led by the earl of Essex. On his return he published *Parthenophil and Parthenophe* (entered on the Stationer's Register, 1593), containing sonnets, madrigals, elegies and odes, on which rests his claim to fame. In 1598 Barnes was prosecuted in the Star Chamber on a charge of attempted poisoning, but he escaped to the north. He also took part in the quarrels between Thomas Nashe and Gabriel Harvey (*qq.v.*) whose friend he was. His works include *A Divine Centurie of Spirituall Sonnets* (1595), *Foure Books of Offices* (1606) in prose and a play, *The Divil's Charter* (1607). At his best his poems, particularly the madrigals, have exuberance and occasional felicity of language; the sonnets show French influence.

BIBLIOGRAPHY.—*Parthenophil and Parthenophe* and *A Divine Centurie of Spirituall Sonnets* were included in *Poems of Barnabe Barnes*, ed. by A. B. Grosart (1875); *The Divil's Charter* was ed. by R. B. McKerrow, *Bang's Materialen*, vol. vi (1904). *See* also M. Eccles, "Barnabe Barnes," in C. J. Sisson (ed.), *Thomas Lodge and Other Elizabethans* (1933); J. G. Scott, *Les Sonnets élizabéthains* (1929); M. H. Dodds, "Barnabe Barnes," *Archaeologia Aeliana*, 4th ser., vol. xxiv (1946). (M. H. D.)

BARNES, ERNEST WILLIAM (1874–1953), Anglican bishop of Birmingham, a leader in the Church of England modernist movement, was born at Birmingham on April 1, 1874, and educated at Trinity college, Cambridge, where he subsequently became fellow, lecturer in mathematics and tutor. He was ordained in 1902. By 1915, when he was made master of the Temple, he had established a reputation for outspoken and provocative preaching which he maintained as canon of Westminster, 1918–24. Appointed bishop of Birmingham in 1924 on the recommendation of the prime minister, Ramsay MacDonald, he immediately attacked ritualistic practices and in 1929 evoked much protest by his refusal to install an Anglo-Catholic priest. His scientific approach to Christian dogma (exemplified in his Gifford lectures on *Scientific Theory and Religion*, 1933) brought him into open conflict with his fellow bishops; his controversial *The Rise of Christianity* (1947) was condemned by the archbishops of Canterbury and York. An uncompromising pacifist, he refused during World War II to take part in national days of prayer and later vigorously opposed the use of the atomic bomb and German rearmament. Barnes retired in May 1953 and died on Nov. 29, 1953.

BARNES, GEORGE NICOLL (1859–1940), British statesman, who was an active propagandist for trade unionism and socialism, was born at Dundee, Scot., on Jan. 2, 1859. He left school at 11, became an engineer, and was attracted to socialism through the influence of William Morris. Barnes was general secretary of the Amalgamated Society of Engineers from 1896 to 1908, and entered the house of commons in 1906 as member for the Glasgow division of Blackfriars (renamed the Gorbals in 1918). He thus became one of the original members of the parliamentary Labour party, of which he was chairman in 1910. He was made minister of pensions in Lloyd George's government (Dec. 1916) and resigned from the Labour party in 1918, when it withdrew its support from the coalition, in order to retain office until the conclusion of the treaty of Versailles. He was responsible for the status of the International Labour organization within the League of Nations and attended the first meeting of the League in 1920. After his retirement from parliament (1922), Barnes published his autobiography *From Workshop to War Cabinet* (1923). He died in London on April 21, 1940.

BARNES, JOSHUA (1654–1712), English scholar and translator of Greek authors, was born in London, Jan. 10, 1654. Educated at Christ's Hospital and Emmanuel college, Cambridge, he became regius professor of Greek at Cambridge in 1695. In 1675 he published *Gerania: a New Discovery of a Little Sort of People . . . Called Pygmies*, a whimsical sketch to which Swift's *Voyage to Lilliput* may owe something. Among his other works was an informative life of Edward III (1688) and editions of Euripides and Homer which, however, are far from authoritative. He also wrote under the pseudonym of Philargyrius. He died on Aug. 3, 1712, at Hemingford, near St. Ives, Huntingdonshire.

BARNES (BERNES), **JULIANA,** unidentified 15th-century English writer on hunting. The only documentary evidence regarding her appears at the end of her treatise on hunting in the *Boke of St. Albans* (1486 ed.): "Explicit Dam Julyans Barnes in her boke of huntyng," and the name is changed by Wynkyn de Worde (1496) to "dame Julyans Bernes." Attempts have been made to connect her with the Bourchiers, the first Lord Berners' family, but no such person is to be found in their pedigree.

The first and rarest edition of the *Boke* (1486) was printed at St. Albans by an unknown schoolmaster; Wynkyn de Worde's edition included a "Treatyse of fysshynge with an Angle," not contained in the St. Albans edition. The other treatises are on hawking, hunting and heraldry. That on hawking derives from "the Boke of Hawking after Prince Edward, King of England" (14th-century, but preserved in the 15th-century manuscript Harleian 2340). That on hunting, the only one specifically ascribed to Dame Juliana, is a versified adaptation of a translation of the Anglo-Norman *Art de Venerie* by Guillaume Twiti, huntsman to Edward II—with additions from the "Master of Game" by Ed-

ward, second duke of York, and other texts—largely concerned with terminology and procedure. The treatise on heraldry draws partly on Nicholas Upton's *De officio militari* (soon after 1430), partly on an anonymous compilation on coat-armour. An older form of the treatise on fishing was edited in 1883 by T. Satchell from a manuscript then in the Denison collection (later taken to the United States). A facsimile, *The Book of St. Albans*, introduced by William Blades, appeared in 1881. During the 16th century the work was very popular and was often reprinted.

See E. F. Jacob, "The Book of St. Albans" and A. L. Binns, "A Ms. Source of the Book of St. Albans," both in the *Bulletin of the John Rylands Library*, vol. xxviii, no. 1 (1944) and vol. xxxiii, no. 1 (1950). (N. D.)

BARNES, ROBERT (1495?–1540), English Protestant martyr, was a protégé of Thomas Cromwell and helped to spread Lutheran opinions in England. Born in Norfolk, he was educated at the universities of Cambridge and Louvain and became a member and later prior of the Austin friars, Cambridge. Under the influence of Thomas Bilney, he espoused reformist ideas and ruined a promising academic career when on Christmas Eve, 1525, he preached a sermon attacking clerical litigiousness and worldliness which got him into trouble with the university authorities and with Cardinal Wolsey. He abjured his heretical opinions but was kept away from Cambridge and confined at the Austin friars first in London and later in Northampton. He surreptitiously continued to disseminate his views, however, until in 1528 he escaped to Antwerp, whence he went to Wittenberg. There he formed an enduring friendship with Martin Luther and published theological writings as Antonius Anglus. In 1531 Thomas Cromwell secured him a safe conduct which enabled him (though liable to be burned as an abjured heretic who had broken penance) to visit England. Thereafter he traveled frequently between England and Germany, attempting to obtain diplomatic support for Henry VIII's new antipapal policy. But he seems never to have been properly in government employ; the king disliked his opinions and his mixture of cocksureness and abjectness, and Cromwell could not get him any notable reward for services in themselves not particularly useful. As was Cromwell's custom, he employed Barnes in accordance with his special qualifications, exploiting his close contacts with Luther and the Lutherans; but the reformer never entered into favour. His fall, when it came, was rapid. During Lent in 1540 he engaged in controversy with Bishop Stephen Gardiner, was forced to recant and then once more relapsed. The fall of Cromwell in June removed his single protector and on July 30, 1540, Barnes was burned as a heretic, with two other Lutherans. He was an ardent, rash and troublesome man, at heart sincere but somewhat unstable. His most important writings are *A Supplication to Henry VIII* (1531), *Vitae Romanorum pontificum* (1535) and *Confession of Faith* (1540), published in German as Luther's memorial to his English friend.

See E. G. Rupp, *Studies in the Making of the English Protestant Tradition* (1947). (G. R. E.)

BARNES, THOMAS (1785–1841), British journalist who as editor of the *Times* for many years established its reputation and founded the tradition of independent journalism, was born in London on Sept. 16, 1785. The son of a solicitor, he was educated at Christ's Hospital and at Pembroke college, Cambridge. In his early days in London he was an intimate friend of Leigh Hunt and of Charles Lamb. After studying in the chambers of Joseph Chitty, he abandoned the idea of being called to the bar and made his mark as a robust writer on literature, the theatre and politics in Hunt's *Reflector* and *Examiner* and in John Scott's *The Champion*, to which he contributed a series of literary portraits under the pseudonym "Strada." His political sketches in the *Examiner* were collected and published anonymously as *Parliamentary Portraits* in 1815. Meanwhile, he had already been contributing to the *Times* and in 1817 was appointed to the editorship which he held until his death. Despite ill-health and somewhat intemperate habits, Barnes brought the *Times* from comparative obscurity to the position of "the leading journal."

Barnes exerted his considerable influence in favour of the Reform bill and acquired for himself and his paper the nickname the "Thunderer." In 1834 he was described by Lord Chancellor Lyndhurst as "the most powerful man in the country." Barnes first collaborated with and then quarrelled with Lord Brougham and sponsored Disraeli's "Letters to Statesmen," signed "Runnymede" (1836–39). Barnes died in London on May 7, 1841.

See D. Hudson, *Thomas Barnes of The Times* (1943), which includes a selection from Barnes's essays ed. by H. Child; and the *History of The Times*, vol. i, *The Thunderer in the Making, 1785–1841* (1935). (D. Hn.)

BARNES, WILLIAM (1801–1886), English dialect poet and philologist whose linguistic theories and poetic practice influenced both Thomas Hardy and Gerard Manley Hopkins (*qq.v.*), was born Feb. 22, 1801, at Bagber near Sturminster Newton, Dorset. Barnes left school at 15 to work in a lawyer's office and was given tuition by local clergymen. He did wood engravings and wrote verses, publishing *Poetical Pieces* (1820) and *Orra, a Lapland Tale* (1822), and opened a school in 1823. The *Dorset County Chronicle* published his first Dorset dialect poems (1833–34). His name was on the books of St. John's college, Cambridge, as a "ten-year man," from 1838 until 1851, when he took his Bachelor of Divinity, having been ordained deacon in 1847 and priest in 1848. Poetry was his love, philology his passion. His many books included an Anglo-Saxon primer (1849), *An Outline of English Speech-Craft* (1878) and *Poems of Rural Life in Common English* (1868) as well as *Poems of Rural Life* (two series—1844, 1862; collected ed., 1879) and *Hwomely Rhymes* (1859) in dialect. His melodious poetry is essentially English in character—no other writer has given quite so simple and sincere a picture of the life and labour of rural England. A gifted linguist and metrist, he used the poetic techniques of many literatures yet wished to purge English of foreign elements. He was awarded a civil list pension in 1861 but taught at his school until in 1862 he was made rector of Winterbourne Came, where he died. Oct. 7, 1886.

Bibliography.—G. Grigson (ed.), *Selected Poems* (1950); Lucy Baxter, *The Life of William Barnes* (1887); Giles Dugdale, *William Barnes of Dorset* (1953).

BARNES, a municipal borough (1932) of Surrey, Eng., which under the London Government Act 1963 was joined on April 1, 1965, with Richmond and Twickenham to form the new London borough of Richmond upon Thames (*see* London). Barnes municipal borough, a residential area, includes Mortlake and East Sheen. Pop. (1961) 39,057. Area 4 sq.mi. It is in the parliamentary constituency of Richmond. The manor of Barn Elms was given by Aethelstan to the canons of St. Paul's who still have the rights of the manor in Barnes common (126 ac.). The manor house was the residence of Sir Francis Walsingham, Abraham Cowley (*qq.v.*), and Richard Hoare, the banker, and from 1884 to 1939 the club house of the Ranelagh club. Near the house was a cottage where meetings were held of the celebrated Kit-Cat Club, founded in the early 18th century by Jacob Tonson, who lived there. Sir Godfrey Kneller's portraits of members are now in the National Portrait Gallery, London. At the time of the Domesday survey the manor of Mortlake included East Sheen, Wimbledon, and Putney. Mortlake brewery, founded in the 15th century, stands on the site of the manor house opposite the winning post of the Oxford and Cambridge boat race. The once famous Mortlake tapestry works were opened in 1619 and closed in 1703.

BARNET, an urban district of Hertfordshire, Eng., which under the London Government Act 1963 was amalgamated on April 1, 1965, with Finchley, Hendon, East Barnet, and Friern Barnet to form the new London borough of Barnet (*see* London). Barnet urban district, a residential area including Arkley and Totteridge, is on the Great North Road, 11 mi. NNW of Charing Cross. Pop. (1961) 27,846. Area 6.7 sq.mi. Chipping Barnet parish church, much restored in the 19th century, dates from 1250 and the grammar school from 1573. There is also a college of further education.

BARNET, BATTLE OF, in English history, was fought around Hadley Green, now in East Barnet, on Easter day, April 14, 1471. Its result was momentous. In routing his Lancastrian opponents and in killing their leader, the earl of Warwick, Edward IV struck the Lancastrian cause a mortal blow. He completed its

destruction a month later at the battle of Tewkesbury.

Six months before Barnet, Edward IV, largely through his own mismanagement, had been driven to the Low Countries, when the exiled Warwick, for long the chief prop of his power, was reconciled with Margaret of Anjou and returned to restore Henry VI. Helped by Charles of Burgundy, Edward came back with 500 men to Ravenspur on the Humber on March 14, 1471. He then marched boldly to London, seized the luckless Henry VI and, on April 13, turned to meet his enemies, now concentrated under Warwick and advancing south from St. Albans. That day Warwick halted on a carefully chosen position less than a mile north of Barnet, near the junction of the road from Hatfield with the old road from St. Albans, and just beyond the narrowest part of the north-south ridge from Wrotham to Barnet, where it is crossed by another ridge, running east-west from Hadley Wood to what is now the new St. Albans road. His right flank, under the earl of Oxford, held the western arm of the cross ridge. The duke of Somerset, lately a deserter from Edward's side, commanded the centre astride the old St. Albans road at Hadley Green. Warwick himself was in charge of the left flank, concentrated north of Hadley church. Reaching Barnet late on April 13, Edward's troops drove the Lancastrian patrols from the town and, advancing to the north of it, closed up on Warwick's position. There they camped in battle formation within earshot of their enemy. The duke of Gloucester, the future Richard III, held the Yorkist right opposite Warwick; Edward with his brother, the duke of Clarence, was in the centre; while Lord Hastings faced Oxford on the Yorkist left. Warwick had about 15,000 men, while Edward mustered around 10,000.

After a night of desultory and ineffective Lancastrian shooting, Edward attacked early before the mist cleared. His left flank was quickly overwhelmed by Oxford and some of Hastings' men fled straight to London, bringing false news of a Yorkist catastrophe. But the Lancastrians carried the pursuit recklessly south of Barnet and, when Oxford at last returned to the field, his men attacked their own centre by mistake. Gloucester, meanwhile, had made steady progress against Warwick's left flank, and as confusion spread among the Lancastrians Edward launched his reserve, which tipped the scale. Warwick, seeing the day lost, fled but was caught and killed in Wrotham park. A contemporary who was there reckoned the slain at more than 1,000. (Gy. T.)

BARNETT, SAMUEL AUGUSTUS (1844–1913), English clergyman and social reformer in the East End of London, was born at Bristol on Feb. 8, 1844. After graduating from Wadham college, Oxford, he became curate of St. Mary's, Bryanston square, in 1867, and in 1872 vicar of St. Jude's, Whitechapel, one of London's poorest parishes. There he started evening schools for adults, provided music and other entertainment, served on the board of guardians and school committees, and discouraged outdoor relief (*i.e.*, in the home) as tending to pauperization. He also furthered the building of model dwellings, the establishment of the children's country holiday fund and annual loan exhibitions of fine art at the Whitechapel gallery. In 1875 Arnold Toynbee visited Whitechapel and two years later Barnett, who kept in touch with Oxford, formed a committee to organize university extension in London. An article by him in the *Nineteenth Century* of Feb. 1884, sketching the place of a university settlement in east London, led that same year to the foundation of Toynbee hall in memory of Arnold Toynbee (*q.v.*), with Barnett as its first warden. He became canon of Bristol in 1893 but retained the wardenship. In 1906 he was appointed a canon of Westminster. He died in London on June 17, 1913. Among his works is *Practicable Socialism* (1888; 2nd ed., 1894), written with the aid of his wife, Henrietta Octavia Rowland, who, in her younger days, was a co-worker of Octavia Hill. Subsequently, she joined in her husband's efforts for social reform and also wrote his biography, published in 1918. Barnett House at Oxford was founded for the study of social sciences in his memory. (G. Hu.)

BARNEVELT, JOHAN VAN OLDEN: *see* OLDENBARNEVELT, JOHAN VAN.

BARNFIELD, RICHARD (1574–1627), a minor English poet, some of whose work is in the manner of Shakespeare, was born at Norbury, Staffordshire, and baptized on June 13, 1574. In 1589 he went to Brasenose college, Oxford, where he graduated in 1592. His first work, *The Affectionate Shepherd*, was published in 1594; a second volume, *Cynthia, With Certain Sonnets* (1595), followed it two months later. "Cynthia," a panegyric on Queen Elizabeth I, claimed to be "the first imitation of the verse of that excellent poet Maister Spenser in his Fayrie Queene." In 1598 Barnfield published his third and last volume, *The Encomion of Lady Pecunia*, a satire on money. For the remainder of his life he lived as a country gentleman on his estate at Darlaston, Stone, Staffordshire, where he died early in March 1627.

Barnfield was probably Shakespeare's earliest imitator. The sonnets of his second volume are closer in manner to Shakespeare's sonnets than any others of the period. Two of the poems in his third volume—the sonnet "If Music and Sweet Poetry Agree" and the ode beginning "As it fell upon a day," both of which appeared in *The Passionate Pilgrim* in 1599—were long believed to be Shakespeare's work.

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BARNSLEY, a parliamentary and county borough in the West Riding administrative division of Yorkshire, Eng., 14 mi. N. of Sheffield by road. Pop. (1961) 74,650. Area 12.2 sq.mi. It is situated on rising ground west of the river Dearne and in the old parish of Silkstone, which has become an important local name.

In Domesday Book, Ilbert de Lacy held Barnsley by gift of William the Conqueror, and the overlordship remained in his family until the reign of Stephen, when it was granted by Henry de Lacy to the monks of Pontefract. In 1249, Henry III granted a Wednesday market (still held) at Barnsley and a fair on the vigil and feast of St. Michael and two following days, and Henry VIII granted them a new fair on the day of the Conversion of St. Paul and two following days. Before 1744 the chief industry was wire drawing, but this trade began to decrease about the end of the 18th century, just as the linen trade was becoming important. Barnsley's later development was due to its central position in the south Yorkshire coal field. The coal was used locally in textile mills and exported, with coke, to London. The majority of workers in Barnsley are still employed in the coal mines. Glass, engineering, paper, metal canisters, safety lamps, clothing and rubber products are subsidiary industries.

The parish church of St. Mary was built in 1821 on an early site; the free grammar school dates from 1665, and a philosophical society was founded in 1828. There are also a mining and technical college and a teachers' training college. Barnsley has two parks, Locke park and Cannon Hall park. Monk Bretton priory, a Cluniac foundation of 1157, retains a Perpendicular gatehouse, some Decorated domestic remains and fragments of the church.

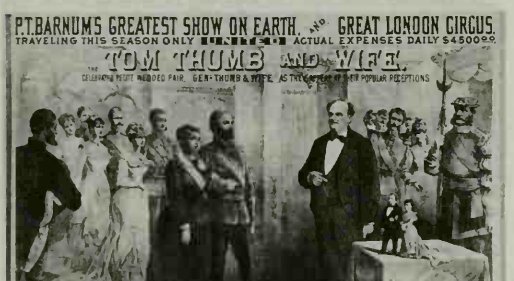
Barnsley was incorporated in 1869 and made a county borough in 1912. It was extended in 1921 and 1938.

BARNSTAPLE, a market town, seaport and municipal borough in the North Devon parliamentary division of Devonshire, England, 40 mi. N.W. of Exeter by road. Pop. (1961) 15,907. It lies on a wide plain surrounded by woods and hills on the north bank of the Taw estuary near the exit of the Yeo, about 10 mi. from the Atlantic, where a widened 15th-century stone bridge of 16 arches stands. Originally there was a settlement at Pilton a little to the northwest, one of Alfred's four Devonshire burhs against the Danes, but Barnstaple soon emerged as the main settlement before the end of the 10th century. The town (Beardastapol in 10th-century coins) was important enough to have its own mint in the time of King Aethelstan. The castle (now the municipal offices) was founded or reconstructed by Judhael of Totnes who obtained the manor in the reign of Henry I and founded a Cluniac priory. The town was walled when Henry I gave it its earliest authenticated charter; it was incorporated in 1557. Barnstaple, like Bideford, was a spinning centre for local and, later, Irish wool; as early as the reign of Edward III (1314) it was a naval port and in 1428 a royal port. For a while in the 17th and 18th centuries the town declined because of silt in the Taw mouth,

but in the 19th century coastal and foreign trade revived. The wool trade has gone but lace, gloves, furniture, light engineering products, pottery (Barum ware) and agricultural implements are made; the town is also an agricultural and tourist centre. The Friday cattle market, the Pannier market (twice weekly) for vegetables and the annual September fair are held by immemorial prescription. Of interest are the parish church of St. Peter (1318) with its timber-framed, leaded broach spire, the many 17th-century almshouses, and Queen Anne's walk, an ornate colonnade of 1704, near which is the Masonic lodge with a valuable collection of Masonic furniture. The North Devon technical college was opened in 1952.

John Gay, author of *The Beggar's Opera*, was born in Barnstaple and educated at the grammar school, formerly in the chapel of St. Anne (*c.* 1330). The chapel is now a museum.

BARNUM, PHINEAS TAYLOR (1810–1891), U.S. circus proprietor, was known as the greatest U.S. showman of his day. Born in Bethel, Conn., on July 5, 1810, he began his career in 1835 with the purchase and exhibition of Joice Heth, a Negro woman alleged to have been George Washington's nurse and over 160 years old. In 1841 he purchased Scudder's American museum in New York city, which, renamed Barnum's American museum, developed into a national showplace for freaks, improbable animals, curios, dioramas, models and "moral" plays. From 1841 to 1865, while he was director of the museum, Barnum toured Europe with Charles Stratton, the celebrated "General Tom



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ADVERTISING POSTER FROM P. T. BARNUM'S CIRCUS SHOWING BARNUM PRESENTING "GENERAL TOM THUMB" AND HIS WIFE TO QUEEN VICTORIA AND PRINCE ALBERT

Thumb"; engaged Jenny Lind for an American tour; excited New Yorkers with their first live hippopotamus; and in addition developed in East Bridgeport a model industrial and workers' community.

In 1871, at the age of 60, Barnum undertook with W. C. Coup and Dan Costello a novel circus and menagerie combination that, billed as "The Greatest Show on Earth," became a monumental enterprise when he was joined in 1881 by James Anthony Bailey, his foremost rival. Under Barnum's aegis, a second and later a third ring were added, delighting the public with an abundance of entertainment but causing performers to deplore his substitution of multiple spectacle for the concentration of attention traditional in European circuses.

Self-styled the "Prince of Humbugs," Barnum revelcd in his notoriety but adhered, nonetheless, to a strict moral code of showmanship, justified his practice of exaggerating claims by giving the public more than it paid for, maintained his shows free from all indecencies and led a highly respectable personal life. Although considered the father of modern publicity practices and the reputed author of statements like "There's a sucker born every minute," this impresario drew a sharp, if somewhat personal line between fraud and innocent humbug. Among other works, he was author of *The Life of P. T. Barnum, The Humbugs of the World, How I Made Millions* and *The Art of Money Getting*.

Barnum died on April 7, 1891, at Philadelphia, requesting with his last words the day's receipts of the circus. In 1907 the circus was sold to the Ringling brothers. *See* also CIRCUS.

See Morris R. Werner, *Barnum* (1923); Harvey W. Root, *The Unknown Barnum* (1927). (E. B. P.)

BAROCCI (BAROCCIO), **FEDERIGO** (FIORI D'URBINO) (*c.* 1535–1612), Italian painter, the leading artist of the central Italian school in the second half of the 16th century, was born in Urbino. His first master was Battista Franco. He visited Rome shortly after 1550 to study Raphael's works, and again in 1561–62, when he executed frescoes in Pius IV's country house. Otherwise he lived in Urbino and confined his work to altarpieces and devotional paintings. His early style reflects the influence of Raphael, and his large "Descent From the Cross" (1569, Perugia cathedral) is in the tradition of Florentine Mannerists such as Rosso and Daniele da Volterra though it is more violent in composition.

There remains the somewhat puzzling problem of the relation of his work to that of Correggio. He had probably never seen the great Correggios in Parma in the original, yet Correggesque motifs appear in his compositions. Warmth of feeling, tenderness of expression and a painterly as opposed to a draftsmanlike approach are common to the work of both artists. This is particularly evident in the many paintings by Barocci on the theme of the Madonna, two of the most famous being the "Madonna del Popolo" (1579, Uffizi, Florence) and the exquisitely beautiful "Nativity" (1597, Prado, Madrid). He was also out of the ordinary in the Mannerist period in making frequent and extremely sensitive drawings from life; but he used Mannerist devices such as fluttering draperies, compositions based on receding diagonals and an indefinite treatment of space. His distinctive use of colour is central Italian, not Correggesque, in origin—pale fugitive colours blended chiefly from vermilion pinks, mother-of-pearl whites and grays. He was an important precursor of the baroque.

See G. P. Bellori, *Vita di Federico da Urbino pittore* (1572), the first extensive account of Barocci's work; H. Olsen, "Federico Barocci," *Figura*, no. 6 (1955). (M. W. L. K.)

BAROCLINIC. The distribution of mass in a fluid is said to be baroclinic if it is not barotropic (*q.v.*), that is, when the density varies along surfaces of constant pressure. A baroclinic atmosphere at rest will not remain at rest; a circulation will develop in which the dense air sinks and the light air rises.

An important cause of baroclinic conditions is differential heating. The circulation initiated in such an atmosphere translates the potential energy released by the redistribution of density into kinetic energy of circulation.

In general, the wind in a baroclinic atmosphere varies with height. A special case of the baroclinic atmosphere is the "thermotropic" atmosphere in which the vertical wind shear vector has the same direction at all heights. Thermotropic atmospheres resemble the actual atmosphere and are useful in numerical weather prediction (*see* WEATHER FORECASTING). (H. A. A. P.)

BARODA, a city in Gujarat state, formerly part of Bombay state, India, the headquarters of Baroda district, is on the Viswamitri river, 66 mi. S.E. of Ahmedabad and 244 mi. N. of Bombay by rail. Pop. (1951) 211,407, (1961) 295,304. City corporation area 10.9 sq.mi. It is laid out with fine avenues, parks and buildings. Among its historic buildings is the Hajira (late 16th century), a relic of Mogul rule. The Mandvi gate in the centre of the old part of the city was built at the instance of the Maratha chief Damaji Gackwar in 1736 to commemorate a Maratha victory over the Moguls in Gujarat. The Bhadar palace, with a marble bow window of singular beauty, is a building of the Muslim period.

Modern Baroda was developed by the later rulers of the Gaekwar (Gaikwar) dynasty: Makarpura palace was constructed for Khanderao (1856–70), Nazarbagh palace for Malharrao (1870–75) and Lakshmi Vilas palace (1890) for Sayajirao III. The grounds of the last-named palace enclose the Navlakhi *wav* or step well, built in 1405 by Zafarkhan Sulemani, Muslim fief-holder of Gujarat. Under Sayajirao III, who ruled from 1875 to 1939, most of modern Baroda was built, including Pratap Vilas palace (1918),

now the railway staff college; Baroda college (1885); Kalabhavan building (1922), housing the university faculty of technology and engineering; Kirti *mandir* or temple, built to commemorate the benefactors of Baroda; Nyaya *mandir* (1895); Khanderao market (1907); Sursagar lake and Sayaji hospital. The city has a museum and picture gallery and a zoo, both set in a well-laid-out park of about 150 ac., Sayajirao's gift to his people. The Maharaja Sayajirao University of Baroda was founded in 1949: it has nine faculties, an oriental institute, polytechnic, library, students' union and halls of residence. The city also contains an affiliated college of the Shreemati Nathibai Damodar Thackersey Women's university in Bombay.

Baroda is connected by road and railway with Bombay, Ahmedabad and Delhi. In addition about 250 mi. of narrow-gauge railway link it with several parts of the district. It has an airfield but no regular service. The main industries are chemical, cotton and wool textile, metal manufactures and the crushing of castor beans for oil. A large quantity of pharmaceuticals is exported.

The earliest record of Baroda is in a grant or charter of A.D. 812 which mentions Vadapadraka as a hamlet attached to the flourishing town of Ankottaka. In the 10th century Vadapadraka displaced Ankottaka as the centre of this urban area. Vadapadraka seems also to have been known as Chandanavati, after Raja Chandan of the Dor tribe of Rajputs, who wrested it from the Jains. The name underwent periodic transformations, to Varavati (Gujarati "city of warriors"), Vatpatraka ("leaf of a banyan tree") and finally, by corruption, Baroda.

The history of Baroda can be divided into the Hindu period lasting until 1297; the period under the Muslim Delhi sultanate (to 1401 or 1403–04); the independent Gujarat sultanate period (to 1572–73); the period under the Mogul empire (to 1734); and the Maratha period from 1734 to 1947.

In 1451 Vadapadraka was plundered by Mahmud I Khilji, sultan of Malwa. The nucleus of the present town, built by Khalilkhan, son of Mahmud Begara, sultan of Gujarat (1459–1511), is enclosed by four gates. In 1734, taking advantage of the weakness of the Moguls, the Marathas plundered Gujarat. Pilaji Gaekwar wrested Baroda from the Muslims and in 1768 it became the capital of the Gaekwar family, one of the leading powers in the Maratha confederacy of the 18th century. The city became the centre of a progressive state under Sayajirao III and his able ministers. In 1802 the British established a residency in Baroda to conduct relationships between the East India company and the Gaekwars. By 1947, when it was closed and the British left India, this residency was also responsible for imperial relations with all the Gujarat and Kathiawar peninsula states.

Baroda District stretches from the Narbada river northward to the Mahi river. It corresponds roughly with the capital division or district of the former princely state of Baroda (the Gaekwar dominions), which also included large tracts in and beyond the Tapti valley to the south, in northern Gujarat, and in the Kathiawar peninsula. The population of the present district was 1,194,746 in 1951, 1,527,044 in 1961, and the area 2,955 sq.mi. The cash crops are cotton, tobacco and castor. Wheat, pulses, corn (maize), rice and garden crops are grown for consumption and export.

Villages in Baroda district were long provided with amenities not generally found elsewhere in India before the late 1950s: primary education was made compulsory under Sayajirao, and most villages have primary schools, *panchayats* or village "parliaments," libraries and co-operative societies.

Dabhoi, 17 mi. S.E. of Baroda by rail, has a vast ruined fort, probably of the mid-13th century, with four richly carved gateways largely intact. There are also three finely sculptured temples, one of which stands on a promontory in a large artificial lake or tank. Sankheda subdivision, in the east of the district, is noted for lacquer work.

Bibliography.—B. Subbarao, *Baroda Through the Ages* (1953); F. A. H. Elliot, *Rulers of Baroda* (1934); P. S. P. Rice, *Life of Sayaji Rao III*, 2 vol. (1931). (V. A. M. J.)

BAROJA, PÍO (1872–1956), Spanish Basque writer and leading novelist of his generation, was born in San Sebastián on Dec. 28, 1872, and died in Madrid on Oct. 30, 1956. He studied in Madrid and received a medical degree in Valencia. After serving as village doctor in the north of Spain, he spent two years administering a bakery owned by his family in Madrid. His first two books appeared in 1900: a collection of short stories, *Vidas sombrías* ("Sombre Lives"), preliminary statements of his later themes, and *La casa de Aizgorri* (Eng. trans., *The House of the Aizgorri*, 1958). Outstanding among nearly 100 novels are those reflecting city low life, such as his best-known trilogy, *La Lucha por la vida* (1904; Eng. trans., *The Struggle for Life*, 1922–24), and the novels on his native Basque country; *e.g.*, *Las inquietudes de Shanti Andía* (1911; Eng. trans., *The Restlessness of Shanti Andía*, 1959). A separate cycle of 22 novels deals with a conspirator relative and his 19th-century epoch. Baroja chooses to write about nonconformists and insurgents; in one period of 10 years he wrote 20 novels of vagabondage. His last books were six volumes of memoirs. His style is laconic and his dramatic suggestiveness depends on understatement. During the Spanish civil war, he narrowly escaped a Carlist fighting squad. Anti-Christian and nihilistic, Baroja was at odds with officialdom from the beginning of his career and he is buried in unhallowed ground.

(Av. K.)

BAROMETER, an instrument for measuring atmospheric pressure. The first record of the use of a barometer was given in 1643 by Evangelista Torricelli, who had been an assistant to Galileo. He was the first to advance correct ideas concerning the existence of atmospheric pressure and vacuums. Using mercury and a glass tube, Torricelli, with Vincenzo Viviani, constructed a barometer similar to the one shown in fig. 1. The glass tube was filled with mercury, the open end closed with a finger, and then the tube was inverted with the open end under the mercury of vessel B. When the finger was released the mercury dropped to the level A. Torricelli was convinced that the mercury in the barometer tube exerted a pressure at the bottom which exactly balanced the pressure of the air exerted on the free surface of the mercury at the same level, and that a vacuum existed in the space above A. He also stated that the height of the mercury column would be lower on a mountain where the air is rarer. These conclusions stirred up a controversy with the Scholastics, who insisted on the Aristotelian doctrine that nature abhors a vacuum, or *natura abhorret vacuum*.

About 1647 Blaise Pascal performed several experiments that finally convinced people of the correctness of Torricelli's ideas. Pascal made many mercury barometers, using tubes of different shapes and sizes; he also inclined the tubes and found that the vertical height of the mercury columns was always the same. In the city of Rouen, France, where Pascal lived, there was a large glassworks from which he obtained glass tubes about 46 ft. long. These were filled with water and wine, and Pascal found that the height of the columns was in the correct relationship with the mercury column. Since mercury is about 13.6 times as heavy as an equal volume of water, it follows that the water column should be about 13.6 times as high as the mercury column; that is, 34 ft. of water corresponding to 30 in. of mercury. In 1648 Pascal, who was a semi-invalid, had his brother-in-law, Florin Périer, take a barometer up the mountain Puy-de-Dôme. He found that the height of the mercury column decreased as the barometer was carried up the mountain while a barometer at the foot of the mountain showed no variation during the day. This experiment demonstrated that the height of the mercury column varied with the amount of air above it and had no relationship to nature's abhorring a vacuum.

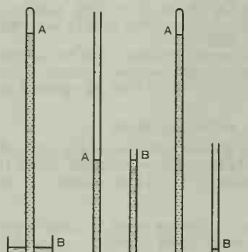

FIG. 1–3.—FUNDAMENTAL HYDROSTATIC PRINCIPLE OF MEASURING PRESSURE

Fundamental Principles.—Pressure is measured in terms of a force exerted on a unit of area.

Thus the pressure of the atmosphere is given as about 14.7 lb. per square inch or 1,000,000 dynes per square centimetre. This means that the atmosphere exerts a force of 14.7 lb. on each square inch of the earth's surface.

In the measurement of atmospheric pressure the fundamental idea is to balance this pressure against a column of liquid of which the height (h), density (d) and the value of gravity (g) acting upon it are known. If the atmosphere balances a column of mercury 76 cm. high and of density 13.6 g. per cubic centimetre at a place where the value of gravity is 980 cm. per second per second, then the pressure of the atmosphere is hdg, or 1,012,928 dynes per square centimetre.

Fig. 2 shows both ends of the tube open to the atmosphere so the levels A and B are the same. In fig. 3 the upper end A has been evacuated and sealed so that the difference of level between A and B gives the barometric height h as about 76 cm. or 30 in. of mercury. Actually the mercury evaporates into the space above A, and this mercury vapour exerts a pressure that is relatively small and can be neglected except when the atmospheric pressure is being measured very exactly. The apparatus shown in fig. 3 is essentially the same as that shown in fig. 1 except that the open vessel of mercury has been replaced by the U tube. Other liquids can be used for barometers and are used in special types, but mercury is the common one because of its high density and relatively small vapour pressure at ordinary temperatures.

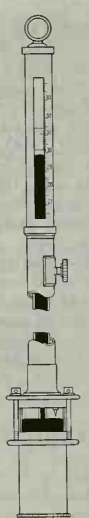

FIG. 4.—MERCURY BAROMETER (FORTIN TYPE)

An alternative type of barometer, called the aneroid or non-liquid barometer, is dependent on the elastic properties of a thin, flexible-walled, evacuated capsule in combination with a stiff spring. The credit for the invention of the aneroid is usually given to Lucien Vidie, who patented this instrument in 1844, but smaller instruments were in use much earlier. This instrument is not capable of giving the same high order of accuracy as a mercurial barometer, but it offers the advantage of considerably greater portability. (See *Aneroid Barometer*, below.)

International Barometer Standards.—In 1953 the executive committee of the World Meteorological organization adopted the following resolutions:

1. Standard temperature and density of mercury: the value of 0° C. shall be the standard temperature to which mercurial barometer readings are reduced for the purpose of relating the actual density of mercury at its observed temperature to the standard density of mercury at 0° C.

The standard density of mercury at 0° C. shall be considered to be 13.5951 g. per cubic centimetre [millilitre]; and for the purposes of calculating absolute pressures by means of the hydrostatic equation, the mercury in the column of a mercurial barometer shall be regarded conventionally as an incompressible fluid.

2. Standard (normal) gravity: Barometric readings shall be reduced from local acceleration of gravity to standard (normal) gravity. The value of standard (normal) gravity (symbol g_n) shall be regarded as a conventional constant,

$$g_n = 980.665 \text{ cm. per second per second}$$

(This is recognized by scientists as a gravity datum to which reported barometric data in millimetres or inches of mercury shall refer; it does not, however, represent the value of gravity at latitude 45° at sea level.)

3. Pressure units:

a. The millibar, defined as a unit of pressure equal to 1,000 dynes per square centimetre, shall be the unit in which pressures are reported for meteorological purposes.

b. In accordance with the provisions of paragraphs 1 and 2, a column of mercury at a standard temperature of 0° C. when subjected to an acceleration of gravity equal to standard (normal) gravity may be regarded as representing pressure due to the weight of mercury on a unit cross-section area (one square centimetre). When the mercury column under these standard conditions of temperature and gravity has a true scale height of one millimetre, it shall be considered to represent a unit of pressure called "one millimetre of mercury under standard conditions," with the symbol (mm. Hg)$_n$. When it is clear from the context that standard conditions are implied, the briefer term "millimetre of mercury" may be used in reference to this unit. In view of the provisions of paragraphs 1, 2 and 3*a*, a column of mercury having a true scale height of 760 mm. when subjected to standard conditions of temperature and gravity yields a pressure of 1,013,250 dynes per square centimetre = 1,013.25 millibars.

Consistent with the foregoing the following conversion factors obtain:

1 millibar (mb.) = 0.750062 (mm. Hg)$_n$
1 (mm. Hg)$_n$ = 1.333224 mb.

c. Analogous to the case outlined above under *b*, "one inch of mercury under standard conditions," symbol (in. Hg)$_n$, shall refer to the pressure due to the weight of mercury per unit cross-section area when the column has a true scale height of one inch; provided the mercury is at the standard temperature of 0° C. (32° F.) and is subjected to an acceleration of gravity equal to the standard (normal) value. When it is clear from the context that standard conditions are implied, the briefer term "inch of mercury" may be used in reference to this unit.

In cases where the conventional engineering relationship between the inch and millimetre is assumed (1 in. = 25.4 mm.), the following conversion factors obtain:

1 mb. = 0.0295300 (in. Hg)$_n$
1 (in. Hg)$_n$ = 33.8639 mb.
1 (mm. Hg)$_n$ = 0.03937008 (in. Hg)$_n$

In order to attain accuracy in the measurement of atmospheric pressure by means of a mercury barometer, the effects due to capillarity or surface tension must be made negligible and the mercury vapour above the mercury column must be removed. The latter is attained by means of a diffusion pump permanently attached to the top of the glass tube containing the mercury. Effects due to capillarity may be made negligible by using tubes with a bore diameter of four centimetres or more, and by vibrating the column to equalize the menisci before each observation. Corrections must also be made for the expansion of the scale for elevation above sea level and for gravity.

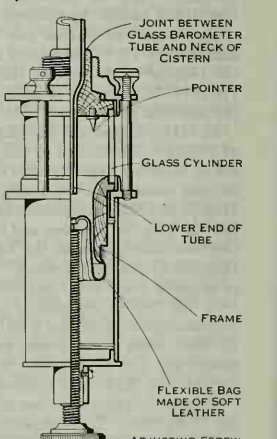

FIG. 5.—CISTERN OF MERCURY BAROMETER (FORTIN TYPE)

Chief Types of Barometers.—The different types of mercurial barometers vary largely with the methods employed to measure the difference in height between the levels A and B, shown in figs. 1 and 3. Both these levels change with variation of pressure. One of the earliest methods was to make the level B (fig. 1) in the reservoir adjustable to the zero of a fixed scale that was used to give a direct reading of the level of A above B.

A serviceable barometer of this type called Fortin's barometer was devised early in the 19th century. Early in the second half of the 20th century Fortin-type barometers were still in wide use along with many other types, a listing of which, taken from the United States weather bureau *Manual of Barometry*, is given below.

1. Cistern types, mercurial
   - *a*. Fortin-type (fixed scale; level of mercury in cistern adjustable to zero of scale)
   - *b*. Movable scale (movable scale whose zero is brought to level of mercury in cistern)
   - *c*. Fixed-cistern type (cistern not adjustable; fixed scale)
2. Siphon barometers, mercurial (cross-section areas equal for lower and upper mercury surfaces)
   - *a*. Nonadjustable regarding level of mercury with reference to zero of scale
   - *b*. Adjustable regarding level of mercury with reference to zero of scale
   - *c*. Wheel mechanism, float-controlled
3. Two-liquid, expanded-scale barometers
4. Weight barometers
5. Aneroid barometers

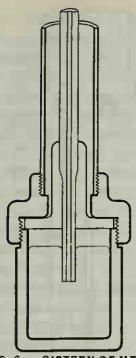

FIG. 6.—CISTERN OF MERCURY BAROMETER (KEW PATTERN)

6. Sympiesometer
7. Hypsometer
8. Recording barometers; barographs

Further information on these barometers can be found in the *Manual of Barometry* referred to above.

The Fortin Barometer.—A general view of a Fortin barometer is given in fig. 4. The distinctive feature of this type of instrument is Jean Fortin's arrangement for controlling the lower level of the mercury by means of a leather bag which forms the lower part of the reservoir of the barometer. By this means the mercury can be made to fill the tube and cistern on the instrument in case the barometer has to be transported. Fig. 5 shows the design of a Fortin cistern from which the mercury has been removed. The normal procedure in reading the instrument is to use the adjusting screw, at the lower end of the barometer, to raise the level of the mercury in the reservoir so as to just touch an ivory pointer. The latter is fixed to the ceiling of the cistern and serves as the zero point of the barometer scale. The barometric height is then determined by reading the level of the highest part of the mercury column by means of the scale and vernier. The scale is fastened to a metal tube that surrounds the glass tube and is suitably slotted so that the mercury level can be seen. In taking a reading the sighting edges, connected to the movable vernier, are aligned precisely to the top of the mercury meniscus, care being taken that the line of sight is horizontal, in order to avoid errors due to parallax. The inner diameter of the tube should be not less than $\frac{1}{4}$ in., and lead glass should be used in preference to Pyrex glass to reduce the possibility of a chemical reaction of the mercury with the glass.

The length of the graduated scale on the metal tube depends on the station at which the barometer is to be used. At sea level the maximum range of variation in atmospheric pressure is from about 31.1 to 27.3 in. of mercury. Consequently for use at stations near sea level a nominal working range of 31 to 27 in. (790 to 690 mm., or 1,050 to 920 mb.) is sufficient. If the barometer is to be used in a mine, the upper limit must be increased to allow for the increase in atmospheric pressure with the depth of the mine. The lower limit of the scale is governed by the maximum altitude at which the instrument is to be used.

Since the Fortin barometer is not a primary instrument, its instrumental errors must be determined by comparison with a standard barometer. These instrumental errors arise from the effects of capillarity or surface tension, imperfect vacuum above the mercury column, incorrect location of the zero of the scale, imperfect graduation of the scale, improper adjustment of the sighting edge to the zero line of the vernier, etc. It is necessary to know the temperature of the barometer, for this affects both the mercury and the metal scale. Despite this list of possible corrections the Fortin barometer proved to be a reasonably accurate instrument as well as a very convenient one.

FIG. 7.—TUBE OF A KEW PATTERN BAROMETER

The Kew Pattern Barometer.—This type of fixed-cistern barometer of the Kew (English) pattern yields direct measurements of pressure by means of a single setting on the top of the mercury column. No setting is made on the mercury in the cistern. If the cistern (*see* fig. 6) and the glass tube of the barometer are exactly cylindrical, the change in level of the mercury in the cistern, corresponding to a given change in atmospheric pressure, is a definite fraction of the change in level of the top of the mercury column. The value of this fraction depends on the ratio of the inner diameters of cistern and tube.

It follows that the movement of the mercury in the tube is always smaller than it would be if the mercury in the cistern were brought to a fixed point as in the Fortin barometer. Thus the scale on the Kew barometer must be contracted from a linear one, but the amount of this contraction is not large; a nominal pressure-inch of scale rarely measures less than 0.95 true inch. A Kew barometer, unless of exceptional size or design, is usually made portable by carefully tilting it until the mercury fills the glass tube completely. It may then be transported either horizontally or cistern upward, the latter position being preferred.

Mercurial marine barometers are often of the Kew pattern. Since the oscillation of the mercury produced by the motion of a ship is a serious obstacle in making an accurate reading, the glass tube is constricted so as to oppose the flow of mercury through it. The amount of constriction is arranged to compromise between the error due to oscillation, or "pumping" as it is technically called, and the error due to the lag of the mercury column in following the variations of atmospheric pressure. The glass barometer tube shown in fig. 7 illustrates the type commonly used. A funnel-type air trap at A is used to collect any air that may rise into the barometer tube from the cistern and to prevent it from reaching the space above the mercury column. The central portion S of the glass tube is usually of smaller diameter in all Kew barometers whether used on sea or land. In principle the main disadvantage of this instrument is that an accurate determination of the instrumental error and temperature correction factor requires pressure calibrations at two or more widely spaced temperatures.

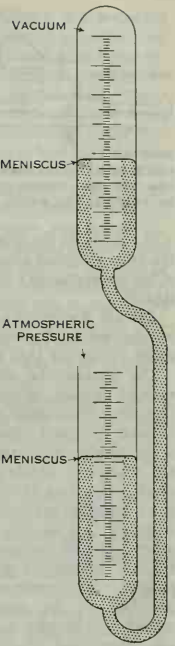

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FIG. 8.—SIPHON BAROMETER

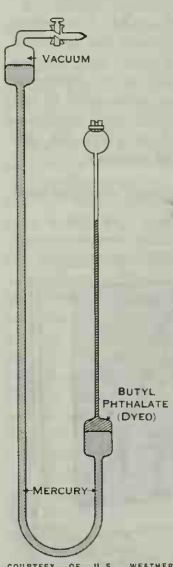

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FIG. 9.—TWO-LIQUID MAGNIFYING SIPHON BAROMETER

Siphon Barometer.—This type of barometer, shown in fig. 8, is essentially a U tube with unequal arms, the shorter arm being open to the atmosphere while the longer one is closed and the space above evacuated. The axes of the arms are collinear and the diameters of the tubes comprising the arms are equal. By these means the capillarity effects due to surface tension are nearly balanced out and the effect of imperfect verticality is made negligible. By using large-diameter tubes of one inch or more, evacuating the space above the longer tube with a diffusion vacuum pump and measuring the difference in levels of the mercury with a cathetometer, this instrument can be used as a primary standard barometer. For less accuracy, fixed scales with a vernier attachment may be used to measure the difference in heights. In one type of siphon barometer the level of the mercury in the open tube is adjusted to a zero point by means of a screw pushing on a flexible leather bag that forms the base of the U tube.

Two-Liquid, Expanded-Scale Barome-

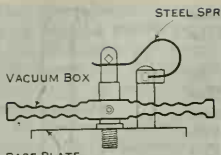

FIG. 10.—SECTIONAL VIEW OF VACUUM BOX AND CONTROL SPRING OF AN ANEROID BAROMETER

ter.—This type of instrument, shown in fig. 9, is used primarily for magnifying small changes in pressure, such as that between the lower and upper floors of a building. The change in level of the lighter liquid for a given change in the mercury level gives a measure of the magnification of the instrument. This magnification depends on the density of the lighter liquid (*e.g.*, butyl phthalate) relative to the density of mercury; and on the relative size of the cross-sectional areas of the tube containing the lighter liquid, of the upper mercury reservoir and of the reservoir containing both liquids.

Aneroid Barometer.—The aneroid barometer contains no liquid, is independent of gravity and is portable, so that it can be used under conditions that are prohibitive for mercury barometers.

The fundamental element of an aneroid barometer is a corrugated chamber formed by two thin metal diaphragms, or a series of such chambers; the chamber is technically called the vacuum box, since it is usually exhausted of air. One face of the vacuum box is bolted to the base of the instrument (*see* fig. 10) while the other is connected through mechanical linkage to a pen or scale pointer. Movements of the upper face of the vacuum box caused by changing air pressure are transmitted to the pen or pointer so that pressures can be read directly. The face of a precision aneroid barometer, of which the smallest scale interval corresponds to 0.02 in. of mercury, is shown in fig. 11. It is called a holosteric barometer to signify that it contains no liquids.

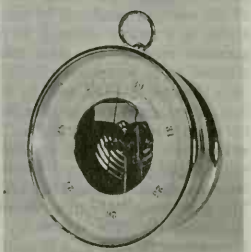

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FIG. 11.—TEMPERATURE-COMPENSATED ANEROID BAROMETER

An aneroid barometer must be calibrated against a standard mercury barometer. Though the aneroid barometer has extensive use because of its portability and relatively small size, it does not have the reliability of a typical mercury barometer. However, with careful construction and fairly frequent calibration it can be relied on to give measurements of consistently good accuracy. Fig. 12 shows a recording aneroid barograph in which the pen moves 2.5 in. for a pressure change of 1 in. of mercury.

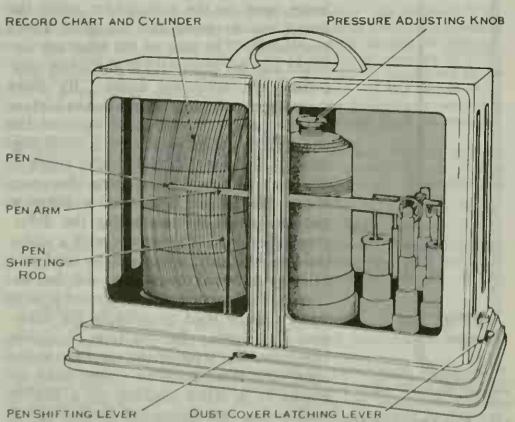

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FIG. 12.—MICROBAROGRAPH

Sympiesometer.—This instrument, shown in fig. 13, is a sensitive device that is useful for giving pressure variations on an expanded scale. The upper chamber (c) contains a gas, usually dry air, at a pressure less than atmospheric. A liquid, shown at (b), having a relatively small density and vapour pressure, such as dyed butyl phthalate, serves to isolate the upper chamber from the atmosphere. Temperature effects are largely taken care of by employing two scales: the fixed one (d) marked in °F., and a movable one (s) called the P scale, that can slide on the rod (r) by means of the knob (e). In making a reading, the P scale is moved so the fiducial mark (the arrow in the diagram) is at the ambient temperature (shown by the thermometer [a]) and the height of liquid column is read on the P scale. This instrument, which can give a sensitivity magnification of from 10 to 12 compared with the mercury barometer, cannot be used for direct barometric readings, but must be calibrated against a standard mercury barometer.

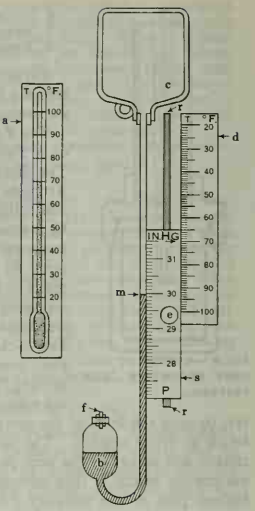

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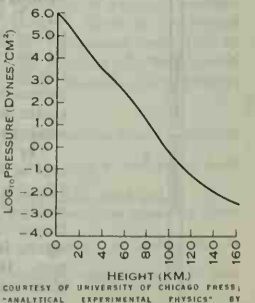
FIG. 13.—SYMPIESOMETER

Hypsometer.—With this instrument the pressure of the atmosphere is obtained from the temperature of a boiling liquid. The principle of the hypsometer depends on the fact that the saturation vapour pressure of a liquid at the temperature of the boiling point is equal to the ambient pressure on the liquid. It is necessary to know the saturation vapour pressure at different temperatures of the liquid. The saturation vapour pressure of water at 100° C. is 760 mm. of mercury, while at 50° C. it is 92.5 mm. of mercury. These temperatures are those at which water boils at the corresponding ambient pressures. Carbon disulfide has been used as the hypsometer liquid in upper atmosphere work to measure pressures in the range of 1.5 to 0.06 in. of mercury. The boiling point temperature is measured by means of a small bead thermistor.

Practical Uses of the Barometer.—A good mercurial barometer became an essential part of the equipment of most laboratories because of the number of different scientific measurements dependent on a knowledge of atmospheric pressure. Early in the second half of the 20th century, barometers and other instruments were used widely by weather bureaus and meteorological stations responsible for the collection of information required for weather forecasting. Barometric readings were regularly taken on land and at sea over large areas in order to map the distribution of high and low atmospheric pressure near the earth's surface. (*See* WEATHER FORECASTING: *Basic Practices.*)

A considerable amount of work is done with aneroid barometers in the investigation of the meteorology of the upper atmosphere. The aneroids are carried aloft in balloons or rockets, and in many investigations the pressure and temperature are given by radio signals that allow a continuous record to be made on the ground. Fig. 14 shows a graph of pressure and altitude taken in a rocket flight above White Sands proving ground, N.M. Since the pres-



COURTESY OF UNIVERSITY OF CHICAGO PRESS, "ANALYTICAL EXPERIMENTAL PHYSICS" BY FERENCE, LEMON AND STEPHENSON, 1936 (ENG ED.)

FIG. 14.—PRESSURE-HEIGHT CURVE MADE FROM A ROCKET FLIGHT

sure change was so large the logarithm of pressure was used. Thus the logarithm of pressure at zero altitude is given as 6, which signifies that the pressure is 10^6 dynes per square centimetre (1,000 mb.), which is about standard atmospheric pressure. The smallest pressure ordinate is about -3, which corresponds to a pressure of 10^{-3} or $\frac{1}{1,000}$ dyne per square centimetre, or 10^{-6} mb. If the temperature of the atmosphere had remained constant, the curve would have been a straight line.

While the common aneroid barometers used in homes are marked with meteorological designations such as fair, rain, storm, etc., it should be noted that a single barometric reading is not of significant value in predicting weather. Some indication of the trend in the weather can often be obtained by noticing whether the barometric pressure is rising or falling. This can readily be done by setting the adjustable pointer at today's barometric reading and noticing whether tomorrow's reading is higher or lower.

See U.S. Weather Bureau, *Manual of Barometry* (1957). Many references may be found in this manual. (F. A. G.; R. J. Sn.)

BAROMETRIC LIGHT, the luminous glow that appears in the vacuous space above the mercury in a barometer tube when the tube is shaken. It is a special case of the general effect that, if a sealed tube containing mercury and a rarified gas be shaken, flashes of light are produced. With the gas neon bright flashes of red light can be produced by shaking it with mercury, even when the pressure of the gas is atmospheric.

The barometric light is of interest as the first case of electrical discharge in gases at low pressure observed in the laboratory. The electrification is probably produced partly by the movement of the mercury over the glass surface, partly by the splashing of the mercury. Slight impurities in the mercury have a considerable influence on these effects and the barometric light, as ordinarily produced, is a complicated phenomenon which has not been analyzed in detail.

The barometric light was first observed in 1675 by Jean Picard, who noticed flashes of light in the Torricellian vacuum when his barometer was moved about. It was made the subject of many experiments by Francis Hauksbee, who published an account of his work in 1709. He proved that the phenomenon was produced by the motion of mercury in either a glass or a varnished vessel, so that the glass was not a necessary factor, and that a very low pressure of the air was not necessary, as the light was strong when the air in contact with the mercury was at a pressure of an inch or two of mercury. He recognized that the rarefaction of the air was one of the conditions of the phenomenon, and he further stated that the light was electrical in origin, a conclusion suggested by the similarity in appearance of the light to that which he produced in exhausted vessels by the help of his electrical machine. *See* Electricity, Conduction of: *Conduction in Gases.*

(E. N. da C. A.; X.)

BARON, MICHEL (1653–1729), French actor, the child of theatrical parents whose name originally was Boyron, was born in Paris. Orphaned at the age of 12, he joined the company of children known as the Petits Comédiens du Dauphin. He joined Molière's company in 1670, and later became a member of the company at the Hôtel de Bourgogne.

From that time until his retirement in 1691 he was undisputed master of the French stage, creating many of the leading roles in Racine's tragedies, besides those in two of his own comedies, *L'Homme à bonnes fortunes* (1686) and *La Coquette et la fausse prude* (1687). He retired in 1691, but in 1720 returned to the Comédie Française.

Baron died in Paris in Dec. 1729.

His son Étienne Michel Baron (1676–1711) was also an actor, and left a son and two daughters who all played at the Comédie Française.

BARON, now a title of nobility in Europe, but originally designating a tenant of whatever rank who held by tenure of barony direct from the king. Originally *baro* meant no more than "man" (as the Spanish word *varón* still does) and was so used in the Salic and other early laws. Gradually, however, the word came to mean a strong or powerful man, and thus a magnate. The connotation of baron differs considerably in the various countries of Europe.

France.—In the 12th century the term *barones,* in a restricted sense, was applied properly to all lords possessing an important fief, subject to the rule of primogeniture. Sometimes it included ecclesiastical lordships of the first rank. In the 13th century the register of King Philip Augustus places the *barones regis Francie* next to the dukes and counts holding in chief, the title being limited to vassals of the second rank. Toward the end of the century the title had come to mean that its bearer held his principal fief direct from the crown, and was therefore more important than that of count, since many counts were only mediate vassals. From this period, however, the title tends to sink in importance. In the 14th century the barons were ranked below counts and viscounts, though in power and possessions many barons were superior to many counts. In any case, until the 17th century the title of baron could only be borne by the holder of a territorial barony, and it was Louis XIV who first cheapened the title in France by creating numerous barons by royal letters. This process was completed by Napoleon's decree of March 1, 1808, reviving the ancient titles. By this instrument the title of baron was to be borne ex officio by a number of high officials; *e.g.,* ministers, senators, councilors of state, archbishops and bishops. The creation of barons continued by Louis XVIII, Charles X and Louis Philippe and, suspended at the revolution of 1848, was revived again on a generous scale by Napoleon III. Since the third republic the tolerant attitude of the French government toward titles, which it does not officially recognize, has increased the confusion by facilitating the assumption of the title on very slender grounds of right.

Germany.—In Latin documents of the middle ages the term *barones* for *liberi domini* was used, and in the 16th century the word *Baron* began to be used as a form of address for a *Freiherr,* or free lord of the empire. The style *Freiherr* (*liber dominus*) implied originally a dynastic status, and many *Freiherren* held countships without taking the title of count. When the more important of them styled themselves counts, the *Freiherren* sank into an inferior class of nobility. The practice of conferring the title *Freiherr* by imperial letters was begun in the 16th century by Charles V, was assumed on the ground of special imperial concessions by many of the princes of the empire, and was later exercised by all the German sovereigns.

Italy.—In the middle ages the barons had extensive powers of jurisdiction within their domains and could inflict the death penalty. There was a right of appeal, but it was of little value and in Sicily and Sardinia nonexistent. In the late middle ages the barons' powers became more extensive, especially in the south, and they had the right to mint money and wage private war. The title was recognized until 1945.

Spain.—In early medieval Navarre and Aragon "baron" described the senior nobility but later, perhaps under the influence of Castilian practice, it was displaced by *ricos hombres* ("rich men"). In Catalonia a baron was simply a magnate but in the later middle ages achieved a distinct status even more important than the French barons. Some nobles retained the title until it was abolished by the *cortes* of Cadiz in 1812.

England.—The word *baro* was introduced into England at the time of the Conquest but its numerous meanings make difficult an exact account of medieval tenure by barony. *Baro* could mean a "man" as in the phrase "*baron et feme*" or a "man" in the feudal sense of "vassal"; it might refer to the tenant in chief of a great lord, and it was also used of the tenants in chief of the crown. William I granted out estates (or "honours") in return for military service and the payment of a fee, or relief, by the tenant and his heirs on first entering upon the estate. These estates were all subject to strict rules of inheritance which maintained their identity and the relief, which was determined by the king, differed in each case, unlike that for the knight's fee which appears to have been fixed at £5. These honours or baronies were the basis of the early feudal army and also an important source of revenue to the crown.

In the 11th and early 12th centuries all tenants in chief were known as barons and their reliefs regulated more or less according to the size of their estates. By the year 1200, however, the *barones* were coming to be regarded as a distinct class whose customary relief was £100 irrespective of their estates. When this customary

relief of £100 was legally established by Magna Carta (1215), it became correspondingly important to a tenant in chief of the king holding less than 20 knights' fees (at £5 relief each) to establish that he held by tenure of knight service and not of barony. The criterion used to distinguish between these tenures is, however, not clear. One view holds that the extent of a lord's rights of legal jurisdiction determined the issue while another asserts that the size of his estate was a decisive factor. A third view, however, based on a study of early 13th-century law cases, suggests that the crown could prove that a man held by barony only by producing some record of enfeoffment or similar document bearing a reference to *baro* or *per baroniam*.

Thus all those who held direct of the crown by military service, from earls downward, might be "barons," but the great difference in their position and importance led to their being roughly divided into "greater" and "lesser" barons. Toward 1179 the *Dialogus de Scaccario* (II, x) distinguished their holdings as "greater" or "lesser" baronies, and by 1164 the practice of sending to the greater barons a special summons to the council already had arisen, while the lesser barons, as it is stipulated in Magna Carta, were to be summoned only through the sheriffs. This introduced a definite distinction, which eventually restricted the rights and privileges of peerage to the greater barons.

Thus far the barons' position was connected with the tenure of land. The great change in their status was effected when their presence in that council of the realm which became the house of lords was determined by the issue of a writ of summons, dependent not on the tenure of land, but only on the king's will. This change is now assigned by historians to Edward I, and the earliest writs accepted as creating hereditary baronies are those issued in his reign. Those who received such summons, however, were not as yet distinguished from commoners by any style or title. The style of baron was first introduced by Richard II in 1387, when he created John Beauchamp, by patent, lord de Beauchamp and baron of Kidderminster, to make him *unum parium et baronum regni nostri* ("one of the peers and barons of our realm"). But it was not till 1433 that the next baron was created. Such creations became common under Henry VI but "Baron" as a form of address could not evict "Sire," "Chevalier" and "Dominus." Patents of creation contained the formula "Lord *A* (and) baron of *B*," but the grantee still styled himself "lord" only, and to this day a baron is addressed in correspondence as "the Lord *A*," although other peers under the rank of duke are spoken of as "lords," while they are addressed in correspondence by their proper styles. To speak of "Baron *A*" is an unhistorical and quite recent practice. When a barony, however, is vested in a lady it is now the recognized custom to speak of her as baroness; *e.g.*, Baroness Berkeley.

The solemn investiture of barons created by patent was performed by the king himself until the reign of James I when the delivery of the letters patent without ceremony was declared sufficient in law. The usual limits of inheritance are to the grantee and heirs-male of his body; occasionally, in default of male issue, to a collateral male relative or to the heirs-male of a daughter; and, in the case of Lord Nelson (1801), to the heirs-male of a sister. In 1821 the barony of Rayleigh was the first to be bestowed upon a lady with remainder to the heirs-male of her body. The baron is now fifth in rank in the English peerage (*q.v.*).

Barons of the exchequer were formerly judges who were competent in causes between the crown and the subject relative to matters of revenue. John Selden conjectured that they were originally chosen from among the barons of the kingdom, but more probably they were officers of a branch of the king's *curia* which was theoretically composed of his "barons." The title has become obsolete since 1875, when the court of exchequer was merged in the high court of judicature.

Barons of the Cinque Ports were at first the whole body of freemen, who were so spoken of in royal charters (*see* CINQUE PORTS). The style was afterward restricted to the mayors, jurats and (up to 1831) members of the house of commons from the Cinque Ports. Their right to the title is recognized in many old statutes. It was their ancient privilege to bear a canopy over the sovereign at his or her coronation and retain it as their perquisite; a deputation attended the coronation of Queen Elizabeth II.

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(R. C. V. C.)

BARONET. Although the origin of this title has been the subject of speculation, it is not known why it was selected as that of "a new Dignitie between Barons and Knights" created by James I of England. The object of its institution was to raise money for the crown, but the money was professedly devoted to the support of troops in Ulster; that is, each grantee was to be liable for the pay of 30 men, at 8*d*. a day for three years. This amounted to £1,095, the sum paid for the honour. When it was instituted, in May 1611, the king covenanted that he would not create more than 200 baronets, and that only those who had £1,000 a year in landed estate and whose paternal grandfathers had borne arms should receive the honour. These qualifications, however, were soon abandoned. As an inducement to apply for it, it was made to confer the prefix of "Sir" and "Lady" (or "Dame"), and was assigned precedence above knights, though below the younger sons of barons. Eight years later (Sept. 30, 1619) the baronetage of Ireland was instituted, the king pledging himself not to create more than 100 baronets. Meanwhile, questions had arisen as to the precedence of the baronets and James, by decree (May 28, 1612), had announced that it was his intention to rank them below the younger sons of barons. As this had the effect of stopping applications for the honour, James issued a fresh commission (Nov. 18, 1614) to encourage them and granted, in 1616, the further privilege that the heirs apparent of baronets should be knighted on coming of age.

The baronetage of Nova Scotia was devised in 1624 for promoting the plantation of that province, and James announced his intention of creating 100 baronets, each to support six colonists for two years (or pay 2,000 marks in lieu thereof) and also to pay 1,000 marks to Sir William Alexander (afterward earl of Stirling), to whom the province had been granted in 1621. For this they were to receive a "free barony" of 16,000 ac. in Nova Scotia, and to become baronets of "his Hienes Kingdom of Scotland." Charles I carried out the scheme, creating the first Scottish baronet on May 28, 1625, covenanting that the baronets "of Scotland or of Nova Scotia" should never exceed 150, that their heirs apparent should be knighted on coming of age, and that no one should receive the honour who had not fulfilled the conditions; viz., paid 3,000 marks toward the plantation of the colony. Four years later (Nov. 17, 1629) the king granted to all Nova Scotia baronets the right to wear about their necks, suspended by an orange tawny ribbon, a badge bearing an azure saltire with a crowned inescutcheon of the arms of Scotland and the motto *Fax mentis honestae gloria*. As the required number could not be completed, Charles announced in 1633 that English and Irish gentlemen might receive the honour. Even so, he was only able to create about 120. In 1638 the creation ceased to carry with it the grant of lands in Nova Scotia, and on the union with England (1707) the Scottish creations ceased, Englishmen and Scotsmen alike receiving thenceforth baronetcies of Great Britain.

Irish baronetcies continued to be created until the Act of Union (1801), since which baronets have been created, not as of Great Britain or of Ireland, but as of the United Kingdom.

In 1827 George IV revoked, for all future creations, the right of baronets' eldest sons to claim knighthood. The eldest sons of baronets of prior creation, however, were not deprived of their rights, and in 1874 Ludlow Cotter, son of Sir James Lawrence Cotter, 4th baronet of Rockforest, was successful in his claim to be knighted on coming of age. However, when Sir Claude de Crespigny's son applied for the honour in 1895, his application was refused on the ground that the lord chancellor did not consider

the clause in the patent (1805) valid. Since then few claims have been made and they have all been refused, presumably on the ground that it was unconstitutional for a sovereign to bind his successors to confer titles in the future on persons unborn.

A fresh agitation was aroused in 1897 by an order giving the sons of life peers precedence over baronets, some of whom formed themselves, in 1898, into "the Honourable Society of the Baronetage" for the maintenance of its privileges. But a royal warrant was issued on Aug. 15, 1898, confirming the precedence of which the society complained. The society, however, continued in existence as the "Standing Council of the Baronetage" and succeeded in obtaining invitations for some representatives of the order to the coronation of Edward VII. A departmental committee at the home office was appointed in 1906 to consider the question of wrongful assumptions of baronetcies and the best means of preventing them. Following this, an official roll of the baronetage was established by royal warrant of Feb. 11, 1910, and was first gazetted on Feb. 23, 1914. Every person succeeding to a baronetcy must now exhibit to the registrar of the baronetage at the home office his proofs of succession. In 1929 baronets not of the Nova Scotia creation were given leave to wear, hanging from the neck by an orange ribbon with a blue border, a badge composed of a shield of the arms of Ulster, viz., a left hand gules (according to medieval custom "gules" is the name for red, represented by parallel vertical lines) on a silver field, surmounted by an imperial crown, the whole enclosed by an oval border. All baronets are entitled to display in their coat of arms, either on a canton or on a inescutcheon, the red hand of Ulster, except those of Nova Scotia, who display instead the saltire of that province. The precedency of baronets of Nova Scotia and of Ireland in relation to those of England was left undetermined by the Acts of Union. The premier baronet of England in the 1960s was Sir Edmund Castell Bacon, whose ancestor was the first to receive the honour in 1611.

See F. W. Pixley, *History of the Baronetage* (1900).
(J. H. R.; C. F. J. H.)

BARONIUS, CAESAR (1538–1607), Italian ecclesiastical historian and apologist for the Roman Catholic Church, was born at Sora in Latium, Oct. 30, 1538. He joined the Oratory in Rome in 1557, eventually succeeding S. Philip Neri as superior in 1593. Clement VIII, whose confessor he was, made him cardinal in 1596 and in the following year he became librarian of the Vatican. Spanish opposition prevented him from being elected pope in 1605. He died in Rome, June 30, 1607.

His major work, the *Annales Ecclesiastici* (1588–1607), undertaken in reply to the *Centuriae Magdeburgenses* and under the inspiration of S. Philip, consists of 12 folios narrating the history of the church down to the year 1198. Hailed by Roman Catholic writers as the "father of ecclesiastical history" Baronius was scorned by Protestant critics for his ignorance of Hebrew and poor knowledge of Greek. It was also claimed that he had made numerous factual errors. The chief merit of the *Annales* lies in its enormous accumulation of sources—some not previously published. It is, however, extremely biased. Just as the authors of the *Centuriae* were able to find in the Gospels everything that Luther had maintained, so Baronius found in them the justification of the Roman Catholic Church. Other works which aroused considerable interest were *Tractatus de monarchia Siciliae* (supporting the papal claims to Sicily) and *Paraenesis ad Rempublicam Venetam*, an attack on Venetian politics. The most useful edition of the *Annales* is by A. Theiner, 37 vol. (1864–83).

See A. Kerr, *The Life of Cesare Cardinal Baronius* (1898); B. Croce, *Teoria e storia della storiografia*, 3rd ed. (1927). (F. Di.)

BARONS' WAR, the name given in English history to the civil war of 1263–67. An attempt to achieve reform had been frustrated when the pope in 1261 absolved Henry III (*q.v.*) from his oath to observe the Provisions of Oxford (1258) and when, by the Mise of Amiens (1264), they were declared invalid by Louis IX of France. Led by Simon de Montfort, some barons took up arms and, in May 1264, captured the king at the battle of Lewes. From then until his death at the battle of Evesham in Aug. 1265, Simon de Montfort largely controlled England and made important administrative and parliamentary experiments. A settlement was achieved by the Dictum of Kenilworth (1266) and finally by the Statute of Marlborough (1267) which remedied some baronial grievances. *See* English History: *The Barons' War*; Evesham: *The Battle of Evesham*; Lewes: *Battle of Lewes*; Montfort, Simon de; Oxford, Provisions of.

BAROQUE AND POST-BAROQUE ARCHITECTURE. This article deals with the architecture of the baroque period and succeeding periods through the early part of the 19th century.

During the baroque perlod (*c.* 1600–1715) architecture, painting and sculpture were integrated into decorative ensembles. Architecture and painting became pictorial, and painting became illusionist. Baroque was essentially concerned with the dramatic and the illusory, with vivid colours, hidden light sources, luxurious materials and elaborate, contrasting surface textures, all of which were used to heighten visual impact and sensual delight. Baroque space with its directionality, movement and positive molding contrasted markedly to the static, stable and highly defined space of the High Renaissance and to the frustrating conflict of unbalanced spaces in the preceding Mannerist period. Baroque space invited participation and provided multiple changing views. Renaissance space was passive and invited contemplation of its precise symmetry. While a Renaissance statue was to be seen in the round, a baroque statue had a principal view with a preferred angle, or was definitely enclosed by a niche or frame. A Renaissance building was to be seen equally from all sides, while a baroque building had a main axis or viewpoint as well as subsidiary viewpoints. Attention was focused on the entrance axis or on the central pavilion and its symmetry was emphasized by the central culmination. A baroque building expanded to include the square facing it, and often the ensemble included all the buildings on the square as well as the approaching streets and the surrounding landscape. Baroque buildings dominated their environment; Renaissance buildings separated themselves from it. (*See* also Baroque Art.)

During the period of the Enlightenment, about 1715 to 1815, various currents of post-baroque architecture were developed. The principal current refined the robust architecture of the 17th century to suit elegant 18th-century tastes. Vivid colours were replaced by pastel shades; diffuse light flooded the building volume; and violent surface relief was replaced by smooth flowing masses with emphasis only at isolated points. Churches and palaces still exhibited an integration of the three arts, but the building structure was lightened to render interiors graceful and ethereal. Interior and exterior space retained none of the bravado and dominance of the baroque but entertained and captured the imagination by intricacy and subtlety. Post-baroque spaces were also active and provided multiple changing views, but participation was rendered difficult by their exceeding elegance. (*See* also Neoclassical Art.)

BAROQUE

After almost a century of delightful variations and painful refutations of the style of Bramante and his High Renaissance contemporaries, baroque architects in the 17th century made architecture a means of propagating faith in the church and in the state. Baroque palaces expanded to command the infinite and subjugate the infinitesimal. One of its practitioners said that architecture was an art of flattery. Ceilings of baroque churches, dissolved in painted scenes, brought the infinite to the worshiper and lifted him to heaven.

The work of Carlo Maderno (1556–1629) in Rome represented the first pure statement of the principles that became the basis of most of the architecture of the western world in the 17th century. A north Italian (Ticino canton in the Alps), Maderno worked most of his life in Rome where, about 1597, he designed the revolutionary façade of Sta. Susanna. Roman church façades in the late 16th century tended to be either precise, elegant and papery thin (S. Girolamo degli Schiavoni, 1587, by Martino Lunghi the elder) or disjointed, equivocal and awkwardly massive (Madonna dei Monti, 1580, by Giacomo della Porta). Maderno's Sta. Susanna façade is a totally integrated design in which each element contributes to the central culminating feature. Precision and elegance

were relinquished to gain vitality and movement. Disjointed and ambiguous features were suppressed to achieve unity and harmony. A towering massiveness was obtained by an increasing use of surface relief and pilaster rhythm toward the central motif, replacing the papery thin walls and hesitant massiveness of the 16th century.

The basic premises of the early baroque as reaffirmed by Maderno in the face and nave of St. Peter's, Rome (1607), were: (1) subordination of the parts to the whole to achieve unity and directionality; (2) progressive alteration of pilaster rhythm and wall relief to emphasize movement and activity; and (3) directional emphasis in interiors through culminating spatial sequences.

Maderno's revolutionary concepts caught the imagination of European architects. Within a few years the baroque became international, with buildings in France (St. Gervais, Paris, 1616), Flanders (St. Walbruge, Bruges, 1619, and St. Loup, Namur, 1620, both by Peter Huyssens), the Netherlands (the Mauritshuis, The Hague, 1633, by Pieter Post and Jacob van Campen), Spain (La Clerica, plans, Salamanca, 1617, by Juan Gómez de Mora), South America (cathedral of Lima, Peru, façade, 1626, by Arrona), Africa (church, Luanda, Angola, 1648) and Czechoslovakia (Wallenstein palace, Prague, 1623, by Andrea Spezza). The baroque rapidly developed into two separate forms: the strongly Roman Catholic countries (Italy, Spain, Portugal, Flanders, Czechoslovakia, south Germany and Poland) tended toward freer and more active architectural forms and surfaces; in Protestant regions (England, Holland and the remainder of northern Europe) the architecture was more restrained and developed a sober, quiet monumentality impressive in its refinement. The Protestant countries (and France, even though the state religion was Roman Catholic) sought the spirit through the mind. Architecture in the north was more geometrical, formal and precise—an appeal to the intellect. In the Roman Catholic south, buildings were more complex, freer and done with greater artistic licence—an appeal to the spirit made through the senses.

Italy.—The four great masters of the baroque in Italy were Giovanni Lorenzo Bernini (1598–1680), Francesco Borromini (1599–1667), Pietro da Cortona (1596–1669) and Guarino Guarini (1624–83). Bernini, also a brilliant sculptor, was notable for the design of the vast square and enclosing colonnade (*c.* 1656) of St. Peter's in Rome, and for the exquisite small marble-encrusted oval church of S. Andrea al Quirinale, Rome, 1658. The works of Borromini and Guarini, both of whom were from the north of Italy, are characterized by inventiveness, ingenuity and originality. Borromini's works present highly active concave and convex surfaces (S. Carlo alle Quattro Fontane, Rome, 1634–44), and his spaces are complex irregular ovals or hexagons (S. Ivo, Rome, 1642). S. Lorenzo in Turin, 1667, and the Palazzo Carignano, Turin, 1679, with their swelling forms, terra-cotta construction, exposed structural members and intricate spatial compositions, show Guarini's relation to Borromini. In contrast to Bernini, both Borromini and Guarini preferred monochromatic interiors. Cortona's robust façade of Sta. Maria della Pace, Rome (1656), forms a city square that is half dominated by the church itself.

Spain.—Spanish baroque was similar to Italian baroque, but with a greater emphasis on surface decorations that was in some measure probably due to pre-Columbian architecture in the Americas. Alonso Cano (1601–67) in his façade of the Granada cathedral (1667) and Eufrasio López de Rojas (d. 1684) with the façade of the cathedral of Jaén (1667) show to what degree Spain absorbed the concepts of the baroque while maintaining its native tradition. The greatest of the Spanish masters was José Churriguera (1665–1725), whose work shows most fully the interest in surface texture and decorative detail that reflected new world architecture. His lush stucco decorative detail (courtyard of the Jesuit college, Salamanca, 1720) attracted many followers, and Spanish architecture of the last half of the 17th century has been labeled "churrigueresque." Narciso and Diego Tomé (d. 1732) in the University of Valladolid (1715) and Pedro de Ribera (d. 1742) in the façade of the Provincial hospital in Madrid (1722) proved themselves to be the chief inheritors of Churriguera, whose style spread throughout the colonies (*e.g.*, cathedral of Cajamarca, Peru, 1682; cathedral of Zacatecas, Mexico, 1718).

Belgium and Holland.—Roman Catholicism, political opposition to Spain, and Peter Paul Rubens (1577–1640) were responsible for the astonishing full-bodied character of Flemish baroque. Rubens' friends Jacques Francart (1577?–1651) and Peter Huyssens (1577–1637) created an influential northern centre for vigorous expansive baroque architecture to which France, England and Germany turned. Francart's Béguinage church, Malines (1629), and Huyssens' St. Charles Borromeo, Antwerp (1615), set the stage for the full baroque of St. Michel, Louvain (1650), by Willem Hesius and the abbey of Averbode (1662), by Jean van den Eynde.

The architecture of the 17th century in Holland is marked by sobriety and restraint. Pieter Post (1608–69), noted for the Swanenburgh house, The Hague (1645), and the town hall, Maastricht (1656), with Jacob van Campen (1595–1657) who built the Amsterdam town hall (1648; now the royal palace), are the principal architects of the Dutch golden age. Dutch architecture exerted a strong influence on minor architects in France and England after the middle of the century.

Central Europe.—A stable political situation in central Europe and the vision of Rudolf II in Prague created, in the late 16th and early 17th centuries, an intellectual climate that encouraged the adoption of new baroque ideas. However, the Thirty Years' War and the defense against the encroachments of the expanding French and Ottoman empires absorbed all the energies of central Europe. The full baroque appeared in Germany, Austria, Czechoslovakia, Poland and Russia after 1680 but flourished only after the end of the debilitating War of the Spanish Succession (1713). Germany and Austria turned principally to northern Italy for their models, and Guarini exerted a decisive influence on J. B. Fischer von Erlach (1656–1723), Johann Lukas von Hildebrandt (1668–1745) and Jakob Prandtauer (1660–1726). Fischer von Erlach's collegiate church in Salzburg (1696) is particularly noteworthy and shows direct Italian inspiration, while the Karlskirche, Vienna (1715), shows him in his strong, original, mature phase.

In Czechoslovakia the full baroque was heralded by the work of the French architect Jean Baptiste Mathey (1630–95), who went to Prague from Rome in 1675. However, Christoph Dientzenhofer (1655–1722) transformed the face of Prague with his strong active buildings (*e.g.*, St. Nicholas, 1703) in baroque.

England.—Inigo Jones (1573–1652) virtually singlehandedly changed the course of English architecture from a tired Jacobean Mannerism (*e.g.*, Charlton house, Greenwich, 1607; Hatfield house, 1611) to something that is almost baroque. His Whitehall palace (1638) and Queen's chapel (1623) designs introduced English patrons to the prevailing architectural ideas of northern Italy of the late 16th century. Although he leaned heavily on Mannerist architects such as Andrea Palladio, Sebastiano Serlio and Vincenzo Scamozzi, Jones approached the baroque spirit by unifying his works with a refined compositional vigour. Sir Christopher Wren (1632–1723), in St. Stephen, Walbrook (1672), with its multiple changing views and spatial and structural complexity, presents English baroque in its characteristic restrained but intricate form. Wren's greatest achievement, St. Paul's cathedral, London (1675 *et seq.*), owes much to French and Italian examples, but the plan shows a remarkable adaptation of the traditional English cathedral plan to baroque spatial uses. Wren is notable for his large building complexes (Hampton Court, 1690, and Greenwich hospital, 1698) which, in continuing the tradition of Inigo Jones, paved the way for the future successes of Sir John Vanbrugh (1664–1726). Vanbrugh's Castle Howard (1699) and Blenheim palace (1705) mark the culmination of the English full baroque.

France.—The role of Salomon de Brosse (1571–1626) in the history of French baroque architecture is much the same as that of Jones in England and of Mathey in Czechoslovakia. His Luxembourg palace (1615) and château of Blérancourt (1614) were the basis from which François Mansart (1598–1666) and Louis Le Vau (1612–70) developed their succession of superb country houses.

François Mansart was the more accomplished of the two architects, and his Orléans wing of the château of Blois (1635) and Maisons-Lafitte (1642) set a standard of refinement, subtlety and elegance toward which architects for the rest of the century as-

pired, but never attained. Mansart's Val-de-Grâce (1645) and his designs for the Bourbon mausoleum (1664) established the full baroque in France; it was a rich, subtle baroque that was quiet in its strength and restrained in its vigour.

Louis Le Vau was Mansart's only serious competitor and in 1657 with his château of Vaux-le-Vicomte he fired the imagination of Louis XIV and his minister Colbert. Vaux, though exhibiting certain Dutch influences, is noted for its integration of Le Vau's architecture with the decorative ensembles of Charles Le Brun (1619–90) and the garden and landscape designs of André Le Nôtre (1613–1700). By serving as a model for Versailles, the complex at Vaux was perhaps the most important mid-century European palace. Versailles then became a model for all regal palaces in Europe until the end of the 18th century. Le Vau showed a sensitivity to the beauty of Italian forms that was unusual for a French architect and his Collège des Quatre Nations (1662) was clearly inspired by Cortona's Sta. Maria della Pace and by S. Agnese in Piazza Navona. Le Vau, Le Nôtre and Le Brun began working at Versailles within a few years of their success at Vaux, but the major expansion of the palace did not occur until after the end of the Queen's War (1668). In Versailles Le Vau showed his ability to deal with a building of imposing size. The simplicity of his forms and the rich, yet restrained, articulation of the garden façade mark Versailles as his most accomplished building. Upon Le Vau's death Jules Hardouin Mansart (1646?–1708), grandnephew of François, succeeded him and proved himself equal to Louis XIV's desires by more than trebling the size of the palace (1678 *et seq.*). Versailles became the palatial ideal throughout Europe and the Americas. A succession of grand palaces was built, including the following: Castle Howard and Blenheim palace; the palace of Würzburg (1719) by Balthasar Neumann (1687–1753); the Zwinger, Dresden (1711), by Matthäus Pöppelmann (1662–1736); the Belvedere, Vienna (1714), by Johann Lukas von Hildebrandt; the royal palace at Caserta, Italy (1752), by Luigi Vanvitelli (1700–73); and the royal palace at Madrid (1738), by G. B. Sacchetti (d. 1764).

J. Hardouin Mansart's Dôme des Invalides, Paris (1675), is unquestionably the finest church of the last half of the 17th century in France. The correctness and precision of its form, the harmony and balance of its spaces, as well as the soaring vigour of its dome make it a landmark not only of the Paris sky line but also of European baroque architecture.

POST-BAROQUE (18TH AND EARLY 19TH CENTURIES)

The relative similarity of approach among architects in the 17th century did not exist in the 18th century. Baroque spatial and organizational concepts underwent profound alterations. Simultaneously there was the birth of the rococo, a new approach in the decorative arts which in its search for freedom, lightness and airiness paralleled, to a degree, the spatial experiments in architecture. The decorative inventions and architectural evolutions which provided designers with a new vocabulary were, in a sense, complementary. But the middle of the century also saw the founding of a strong antibaroque, antirococo rationalist school that rejected categorically earlier principles. Rationalist architects held that baroque rules of beauty, harmony, balance and rhythm, as well as lush or elegant ornament and false or hidden structural systems, were fundamentally in error. Architecture, for the rationalists, was "to show nothing that did not derive from function," and was to conform "to the nature of the materials used."

Romanticism (in its adaptation of classic, Gothic and far eastern forms) was variously a reaction to rococo excesses, to rational unimaginativeness, and to the dreariness of an industrial society. It longingly sought escape in the fancied harmonies of another world.

Rococo Architecture

The early years of the 18th century saw the shift of the artistic centre of Europe from Rome to Paris. Pierre Lepautre, working under J. Hardouin Mansart on the interiors of the château of Marly (1699), invented new decorative ideas that became the rococo. Lepautre changed the typical late 17th-century flat arabesque, which filled a geometrically constructed panel, to a linear pattern in relief, which was enclosed by a frame that determined its own shape, no longer limited by architectural considerations. White- and gold-painted 17th-century interiors (central salon, Versailles) were replaced by varnished natural wood surfaces (château of Meudon, Cabinet à la Capucine) or by painted pale greens, blues and creams (Cabinet Vert, Versailles, 1735). The resulting delicate asymmetry in relief and elegant freedom revolutionized interior decoration and within a generation exerted a profound effect on architecture. Architects rejected the massive heavy relief of the baroque in favour of a light and delicate, but still active, surface. Strong, active and robust interior spaces gave way to intricate, highly elegant but restrained spatial sequences. In the early years of the century the revolution was under way in England with Thomas Archer's St. Phillip's church, Birmingham (1709), and in Italy with Filippo Raguzzini's facade of Sta. Maria della Quercia, Rome (1730), and G. B. Scapitta's Sta. Caterina, Casale Monferrato (before 1714). In its second phase (1715–30) the rococo was diffused throughout Europe. One of its principal practitioners, Nicolas Pineau (1684–1754), went to Russia in 1716 and introduced rococo ideas to the newly founded city of St. Petersburg (*e.g.*, Peter's study at Peterhof, before 1721). The rococo in Russia flourished in St. Petersburg under the protection of Peter I and Elizabeth. Peter's principal architect, Gaetano Chiaveri (1689–1770), who drew heavily on north Italian models, is most noted for the library of the Academy of Science (1725) and the royal churches of Warsaw and Dresden. Bartolomeo Rastrelli (1700–71) was responsible for all large building projects under the reign of Elizabeth (1741–62), and among his most accomplished designs in St. Petersburg are the Smolny cathedral (1748–55), and the turquoise blue and white winter palace (1754–62).

After Pineau returned to France, he, with Gilles Marie Oppenordt (1672–1742) and Juste Aurèle Meissonier (1675 or 1693–1750), created the full rococo by developing its asymmetrical aspect. Meissonier and Oppenordt should also be noted for their exquisite and imaginative architectural designs which unfortunately never were built (*e.g.*, façade of St. Sulpice, Paris, 1726, by Meissonier). The last phase of French rococo, dominated by Jacques Ange Gabriel (1698–1782), was conservative—less free and less asymmetrical. Gabriel's gracefully precise Petit Trianon at Versailles (1762) is his finest work, the high point of late rococo architecture, and perhaps the most accomplished building in France in the 18th century.

In architecture the simple dramatic spatial sequences or the complex interweaving of spaces of 17th-century churches gave way to a new spatial concept. By progressively destroying the Renaissance-baroque horizontal separation into discrete parts, rococo architects obtained unified spaces, emphasized structural elements, created continuous decorative schemes and reduced column sizes to a minimum. Ceilings of side aisles were raised to the height of the nave ceiling to unify the space from wall to wall (Church of the Carmine, Turin, Italy, by Filippo Juvara, 1732; Pilgrimage church, Steinhausen, near Biberach, Ger., by D. Zimmermann, 1727; St. Jacques, Lunéville, France, by G. G. Boffrand, 1730). To obtain a vertical unification of structure and space, the vertical line of a supporting column was often carried up through a broken entablature, through a pilaster applied to a pendentive, through a pilaster of the drum, and through a pilaster painted on the surface of the dome, through to the lantern itself (*e.g.*, Church of San Luis, Seville, Spain, 1730, by Leonardo de Figueroa). By 1742, to increase the vertical effect and the unification of space, main arches were raised, pendentives punctured, the drum eliminated and the dome ribbed and punctured (Sta. Chiara, Bra, Italy, by Bernardo Vittone, 1705–70). The entire building was often lighted by numerous small windows placed for dramatic effect or to flood the space with a cool diffuse light (Pilgrimage church, Weis, Ger., D. Zimmermann, 1746). The spectacular rococo of Germany and Austria, which by 1720 had begun to influence Italian architecture, was itself a fusion of Italian baroque and French rococo. Its chief monuments are to be found in the Roman Catholic regions

of the two countries. Johann Michael Fischer (1692–1766), Balthasar Neumann, and Zimmermann (1685–1766) were the most accomplished of the native architects while François de Cuvillés (1695–1777), Phillipe de la Guepière (1715–73) and Nicolas Pigage (1723–96) made the most important foreign contributions to mid-century architecture in Germany. Fischer's austere, dignified façade of the church at Diessen (1733) and Neumann's joyous, airy pilgrimage church at Vierzehnheiligen (1743) show Germany's international contribution to religious architecture through its fusion of the French and Italian directions. Two influential country houses, La Guepière's Solitude (1763), and Cuvillés' Amalienburg (1734), though graceful and refined, are but examples of French architecture on foreign soil.

In Spain the outstanding figure of the century was Ventura Rodriguez (1717–85) who, in his designs for the chapel of Our Lady of Pilar in the cathedral of Saragossa (1750), showed himself to be a master of the developed rococo in its altered Spanish form; but it was a Fleming, Jaime Bort y Melia, who brought the rococo to Spain when he built the west front of the cathedral of Murcia in 1733. A few years later the rococo was found in Peru where the church of Surco (attributed to a German Jesuit—Johan Rher) exhibits the typical studied odd placement of openings in large curved planal wall surfaces.

Rationalist Architecture

The rationalist revolt against the imagined excesses of the baroque and rococo necessitated a complete refutation of preceding aesthetic principles. Vasari praised Michelangelo for his use of ornamentation to cover defects of buildings or nature while Francesco Milizia (1725–98) condemned decoration as a "deceitful parasite." Baroque and rococo architects sought to devise buildings that would be characterized by unified and orderly conception; internal harmony and harmony with surroundings; composition of each part in relation to the whole; recognition and use of an architectural vocabulary and certain grammatical principles; and relatedness to man and his sensibilities. Mannerist architects violated grammatical principles but utilized the architectural vocabulary to create meaningful disharmony. In so doing they remained faithful to the prevailing aesthetic principles though only in a negative way. Rationalist architects, however, did not recognize the architectural principles of preceding ages and sought to devise buildings that exploited the precise simplified beauty inherent in pure geometrical forms without any reference to man. Unity as a guiding principle was replaced by diversity, with many points of emphasis. The harmony obtained by selecting from a family of forms was replaced by a fragmented, excited vitality obtained by freedom in the use of any geometrically derived forms.

In the early years the rationalists sought to combine many simple forms in a highly complex and involved manner which produced violent relief and an extremely active, unresolved surface character (Seaton Delaval, 1721, by Sir John Vanbrugh; Christ church, Spitalfields, 1723–29, by Nicholas Hawksmoor). Later in the century the pure forms became larger and more inclusive while the surface became simpler and less active (St. Chad's, Shrewsbury, 1791, by George Steuart; Ste. Geneviève, Paris, 1757–77, by Jacques Germain Soufflot; plans for a national theatre, Berlin, 1798, by Friedrich Gilly). Toward the turn of the century there were projects for entire buildings that were included within a sphere (Shelter for Rural Guards, *c.* 1780, by Claude Nicolas Ledoux) or a towering cone (Cenotaph, *c.* 1780, by Etienne Louis Boullée).

The intellectual basis for rationalist architecture was provided by the writings of T. Gallaccini (d. 1641), Louis Géraud de Cordemoy (1651–1722), Marc Antoine Laugier, Carlo Lodoli (1690–1761), Francesco Algarotti, Milizia, Friedrich Krubsacius (1718–90) and William Hogarth (1697–1764).

Romantic Architecture

Rococo architects valued Chinese lacquer panels for their brilliant colour and exotic uniqueness, but they did not attempt to produce an imagined idyllic setting with them. They used them to create delicate decorative ensembles like the Chinese rooms in the royal palaces at Turin and Stupinigi by Juvara (*c.* 1732). Late Gothic architecture, which was so similar to rococo in its lightness, delicacy and intricacy of structure, was also highly valued. Santin Aichel (1667–1723) in the church at Kladrau, Czech. (1712), and Horace Walpole in his residence Strawberry Hill (1748) attempted to capture some of the gay, transparent, veiled spaces and delicate surface decorations which were so precious to rococo sensibilities.

Romantic sensibilities, however, were excited by the vision of a society which could be evoked by its architecture, and architecture with a moral or ethical purpose was demanded. Romantic architects reacted against the reasoned skepticism and pompous artificiality of the rococo by idealizing earlier societies which were less complicated and more credulous. From its beginning in England, romanticism spread principally to the Protestant countries of northern Europe and North America. Romanticism was essentially Protestant, placing a high value on the emotions and on individual faith, as well as on the simple and the natural. With the romantics architecture became associative and was valued not so much for itself as for the literary visions it could evoke. Through the use of forms of earlier ages, romantic architects attempted to evoke visions of simple happiness and stable order which would inspire their contemporaries to strive toward proper ideals. Richard Mique (1728–94), in his Le Hameau (1780) at Versailles, through an informal grouping of modest farm buildings gave tangible form to Marie Antoinette's dream of a simple, honest peasant life. Fonthill abbey (*c.* 1795), by James Wyatt (1746–1813), was a residence in ecclesiastical garb, set in an informal park, which created an environment such as was thought to have existed when Christian principles were supposed to have guided the actions of men.

Neoclassical Architecture

The rebirth of interest in Greek and Roman architecture, generated perhaps by scientific archaeology, provided an ideal basis for the marriage of the previously opposed romantic and rationalist factions. The romantics saw in Greek architecture the expression of an ideal democratic state, proud of its freedom, the wisdom of its scholars, the production of its writers and artists, and its primacy in world affairs. The rationalists saw an apparently simple but highly sophisticated architectural expression that used large, simple, geometrical forms, reduced all elements to essentials, limited decorative features, and clearly stated its structural principles.

The marriage was internationally successful. In Russia two of the chief practitioners were Ivan Starov (1743–1808) and Andrei Voronikhin (1760–1814). Starov's Catherine hall in the Tauride palace (1783–88) and Voronikhin's Cathedral of the Virgin of Kazan (1801–11), both in St. Petersburg, are outstanding examples of their work. In Germany the chief neoclassical designer was Karl Friedrich Schinkel (1781–1841) who is justly noted for his fertile imagination (*e.g.,* Altes museum, Berlin, 1822–30). The rationalist architect Sir John Soane (1753–1837) in his Bank of England, London (1788–1808), provided the basis which Sir Robert Smirke (1781–1867) drew upon for his later neoclassical buildings (*e.g.,* British museum, London, 1825–27). The Madeleine, Paris (*c.* 1806), by Pierre Vignon (1763–1828) and St. Philippe-du-Roule, Paris (1774–84), by Jean Chalgrin (1739–1811) are two of the finest examples of the short-lived neoclassical interest in France.

In Italy, where romanticism was weakest, Roman architecture was revived by the sculptor Antonio Canova (1757–1822) and Ferdinand Bonsignore (1767–1843). Canova designed and built a tomb in his native Possagno (1819–30) that was modeled on the Pantheon, as was the Gran Madre di Dio in Turin (1818–31) by Bonsignore.

Outstanding examples in the United States are the Virginia state capitol, Richmond (1785–92), by Thomas Jefferson (1743–1826); the statehouse, Boston (1795–98), by Charles Bulfinch (1763–1844); the Bank of Pennsylvania, Philadelphia (1798), by Benjamin Latrobe (1764–1820); and the customhouse, Philadelphia (1819–24), by William Strickland (1787–1854).

Carignano palace, Turin, 1679, by Guarino Guarini (1624–83)

S. Carlo alle Quattro Fontane, Rome, 1633, by Francesco Borromini (1599–1667)

S. Andrea al Quirinale, Rome, 1658, by Giovanni Lorenzo Bernini (1598–1680)

THE BAROQUE IN ITALY

Sta. Maria della Salute, Venice, 1631, by Baldassare Longhena (1598–1682)

Sta. Maria della Pace, Rome, 1656, by Pietro da Cortona (1596–1669)

Colonnade forming the piazza in front of St. Peter's, Rome, 1656, by Bernini

PHOTOGRAPHS, (TOP LEFT, TOP RIGHT, CENTRE LEFT, BOTTOM) G. E. KIDDER SMITH, (TOP CENTRE, CENTRE RIGHT) ALINARI

BAROQUE AND POST-BAROQUE ARCHITECTURE

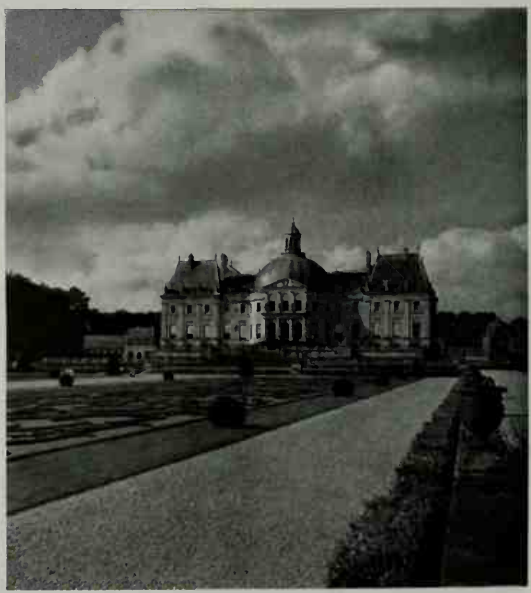
St. Paul's cathedral, London, 1675, by Sir Christopher Wren (1632–1723)

Dôme des Invalides, Paris, 1675, by J. H. Mansart (1646–1708)

St. Michel, Louvain, Belgium, 1650, by Willem Hesius

Pavilion of the Zwinger palace, Dresden, Germany, 1709, by Matthäus Pöppelmann (1662–1736)

Val de Grâce, Paris, 1645; plans and lower portion by François Mansart (1598–1666)



Gerdens and château of Vaux-le-Vicomte, France. Château by Louis Le Vau, 1657; gardens by André Le Nôtre, 1661

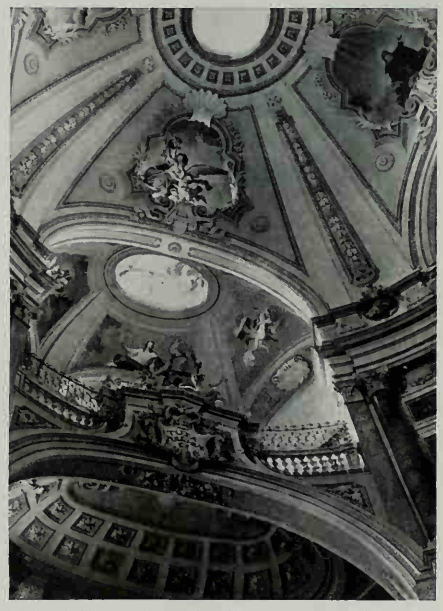
BAROQUE IN ENGLAND, FRANCE, BELGIUM AND GERMANY

BY COURTESY OF (CENTRE RIGHT) REICHSZENTRALE FÜR DEUTSCHE VERKEHRSWERBUNG, PHOTOGRAPHS, (TOP LEFT) A. F. KERSTING, (TOP CENTRE, BOTTOM LEFT) GIRAUDON, (TOP RIGHT) © A. C. L. BRUXELLES, (BOTTOM RIGHT) H. ROGER-VIOLLET

Parish church, Diessen, Germany, 1733, by Johann Michel Fischer (1692–1766)

Smolny cathedral, Leningrad (St. Petersburg), U.S.S.R., 1748, by Bartolomeo Rastrelli (1700–71)

West façade, cathedral of Murcia, Spain, 1733, by Jaime Bort y Melia



Interior, looking up at dome, Sta. Chiara, Bra, Italy, 1742, by Bernardo Vittone (1702–70)

ROCOCO STYLES IN GERMANY, RUSSIA, SPAIN AND ITALY

BY COURTESY OF (TOP RIGHT) SOCIETY FOR CULTURAL RELATIONS WITH THE U.S.S.R.; PHOTOGRAPHS, (TOP LEFT) DEUTSCHER KUNSTVERLAG, (BOTTOM LEFT) A. F. KERSTING, (BOTTOM RIGHT) RUDOLF WITTKOWER

BAROQUE AND POST-BAROQUE ARCHITECTURE

Petit Trianon, Versailles, France, 1762, by Jacques Ange Gabriel (1698–1782)

Royal hunting lodge, Stupinigi, Italy, c. 1732, by Filippo Juvarra (1678–1736)

Le Hameau, farm of Marie Antoinette, Versailles, 1780, by Richard Mique (1728–94)

Sanctuary of the cathedral at Ocotlán, Mexico, 1745, Spanish rococo style

Seaton Delaval, England, 1721, by Sir John Vanbrugh (1664–1726)

Customs house (2nd Bank of the U.S.), Philadelphia, Pa., 1819, by William Strickland (1787–1854)

ENLIGHTENMENT ARCHITECTURE IN EUROPE, ENGLAND AND AMERICA

BY COURTESY OF (TOP LEFT) FRENCH GOVERNMENT TOURIST OFFICE, LONDON. PHOTOGRAPHS: (TOP RIGHT) MONTALVO; (CENTRE LEFT, CENTRE RIGHT, BOTTOM RIGHT) WAYNE ANDREWS; (BOTTOM LEFT) A. F. KERSTING

URBAN DESIGN

Baroque.—The basic principles of Renaissance urban design, stated early in the Renaissance by Filarete, Alberti and Francesco di Giorgio, remained unaltered throughout the 17th century. Variations were made to provide for a particular desired spatial effect. The plan was adjusted to fit a realistic situation or varied to agree with the patron's economic condition, but the principles remained constant.

In Rome the basic street pattern was largely the creation of Domenico Fontana (1543–1607) who, under Pope Sixtus V in the years just before 1600, imposed an avenue pattern that linked all the major pilgrimage churches. The avenues were laid out over the most direct routes regardless of the terrain, and at the focal points (*i.e.*, piazzas in front of the major monuments) obelisks were erected. Fontana's meaningful emphasis on communication routes and gathering spaces became the model for most later large-scale urban designs or renovations. Christopher Wren's plan for London, submitted after the Great Fire of 1666, showed a series of avenues linking the major religious and commercial centres superimposed on a rational gridiron plan.

The regularized city square received its greatest development in France with the planning of the royal squares. The perfectly square Place des Vosges, Paris (1606), with its well-proportioned façade, shadowed arcades and balanced colour scheme, was the beginning of a series that culminated with the circular Place des Victoires, Paris (1685), and the Place Vendôme, Paris (*c.* 1690). Italian city squares tended to be either open, grand and monumental (St. Peter's square, Rome) or intimate, provocative and exciting (Sta. Maria della Pace, Rome).

18th Century.—Urban design in the 18th century placed greater emphasis on unity and direction through the subordination of lesser parts to the whole. Ideas introduced into garden planning by Le Nôtre became of fundamental importance and entire cities were laid out on his regularized axial schemes (*e.g.*, Washington, D.C., 1791, by Pierre L'Enfant). Spaces between the radiating avenues were divided either geometrically or on a gridiron pattern. New principles calling for a sequence of different spatial experiences were also introduced, as in the plan for Nancy (1752–55) by Emmanuel Héré (1705–63). In Italy outstanding examples are the splendid oval Piazza S. Ignazio, Rome (1727), by Filippo Raguzzini (d. 1771); the grand, solid military quarter, Turin (1716), by Juvara; and the Piazza del Popolo (1816), by Giuseppe Valadier (1762–1839). Notable among the many English examples of planned urban development are St. James's square, London (1726); the Circus (1764), and the Royal Crescent (1769), Bath, by John Wood the elder and the younger; and the Park Crescent, London (1812), by John Nash. In Reims, France, the solemn Place Royale (1756) by J. G. Legendre is deservedly noted, but perhaps the finest example of an 18th-century large urban pedestrian square is the Place Louis XV (now the Place de la Concorde), Paris (1755), by Jacques Anges Gabriel. On the banks of the Seine, in its original design, it served as a focal point for the gardens of the Louvre, for the street which led to the Church of the Madeleine, and for three radiating streets of the Champs Élysées.

LITERATURE

Treatises on the orders and on civil and military architecture which appeared in increasing numbers in the 16th century provided a theoretical basis for baroque architects. While many 16th-century architects published treatises on architecture (Vignola, Palladio, Serlio, Cesariano, Delorme, Du Cerceau, Dietterlin, Herrera and Vriedman de Vries) or prepared them for publication (Leonardo, Bramante, Raphael, Peruzzi, Ligorio and Ammanati), major 17th-century architects published very little. Borromini's two fragmentary volumes appeared years after his death, and Guarini's major contribution (though he brought out two volumes on architecture before he died) did not appear until well into the 18th century. It was only the highly successful book of Andrea Pozzo (four editions in 19 years) that kept Italian ideas in the foreground in the early years of the 18th century. Other Italian publications tended to be mere repetitions of previous ideas with the exception of the tardily published manuscript of T. Gallaccini. Gallaccini's treatise on the errors of Mannerist and early baroque architects became a point of departure for later rationalist theoreticians.

In France F. Blondel and A. Daviler published their notes for lectures given at the Academy of Architecture, but the most important publications were those of Freart de Chambray and Claude Perrault. Perrault was particularly interesting for his attack on established Italian theory. Other notable French works included the writings of R. Ouvrard, A. Felibien, P. Le Muet and J. Mauclerc. In England Sir Henry Wotton's book was an adaptation of Vitruvius, and B. Gerbier's was a compendium of advice for builders. Among the notable 17th-century German publications were the books by G. Boeckler, J. Furttenbach and J. von Sandrart.

In the 18th century there was a marked increase in the number of works devoted to antiquities. In the tradition of Palladio, Scamozzi, Duperac, Blondel and Desgodetz, works on various aspects of antiquity were published by R. Adam, J. Stuart and N. Revett, C. Cameron, J. Fischer von Erlach, D. Le Roy and G. B. Piranesi. There was also a large increase in the number of guide books but the treatises on architecture were fewer. In Italy only the works of F. Galli Bibiena and the two important volumes of B. A. Vittone rose above the general low level of theoretical thought. Particularly noteworthy in France were the works of J. F. Blondel, G. G. Boffrand, P. Bullet, S. Le Clerc and P. Nativelle. The books by J. Gibbs, W. Chambers, C. Campbell, B. Langley, W. Halfpenny and I. Ware in England are interesting but the remarkable success enjoyed by Palladio in his various English editions merits special attention.

See ARCHITECTURE; MODERN ARCHITECTURE; RENAISSANCE ARCHITECTURE; RUSSIAN ARCHITECTURE; *see* also Index references under "Baroque and Post-Baroque Architecture" in the Index volume.

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BAROQUE ART is that which falls between the Renaissance and the neoclassical periods, extending from the late 16th to about the middle of the 18th century. As a period the baroque embraces the styles beginning with that of late Michelangelo and Mannerism (*q.v.*) and ending with the rococo (*q.v.*). Two possibilities have been advanced for the derivation of the word. The older and more widely accepted one ascribes it to the Portuguese *barroco*, a large irregularly shaped pearl. Such a sphere, straining outward to the point of bursting, constitutes a valid analogy with some baroque architectural shapes and pictorial forms. A later and perhaps more plausible surmise derives the word from *barocco*, a term employed by Italian Renaissance philosophers to characterize extravagant or farfetched arguments in scholastic syllogisms.

As a style designation "baroque" was originally a derogatory term. It was so used by such late 19th-century admirers of Renaissance art as Jacob Burckhardt and John Ruskin to express their disapproval of what they considered to be odd, bizarre, grotesque, exaggerated and overdecorated. Heinrich Wölfflin in his *Renaissance und Barock* (1888), however, addressed himself to the problem of separating the baroque from the Renaissance both as a style and as a period. While "baroque" can still be used to indicate disparagement or approval, it is more generally used as a neutral term indicating the period rather than a particular form. At first confined to use in the history and criticism of the visual arts, "baroque" has been broadened to include the concurrent period in music. Its application to the literature and philosophy of the corresponding time is rare.

Baroque art, born as it was out of the Mannerist struggle to free itself from Renaissance stereotypes, is an art of restless oppositions, of uneasy equilibriums, of violent clashes, of polarities brought momentarily into precarious balances, and of passions brought briefly under control. In architecture the baroque is discernible at St. Peter's in Rome, especially in Michelangelo's vast conception in which all component parts—architectural, sculptural and decorative—were to be merged into a single unified whole. In the massive masonry of the apse the rising forces seem to struggle upward against the pull of mighty weights to culminate in the soaring dome. Underneath the dome the four spiraling columns, supporting Giovanni Lorenzo Bernini's gigantic canopy over the high altar, also carry the eye irresistibly upward. The baroque spirit continues in Carlo Maderno's nave and façade and outward into Bernini's Piazza Obliqua, which extends from a trapezoidal plaza into the spacious open elliptical area embraced by the monumental fourfold Doric colonnades.

In sculpture the baroque is found in the diagonal composition, textural contrasts and swift movement of Bernini's marble group, "Apollo and Daphne." In painting the baroque is revealed in El Greco's clashing colour harmonies; in Rubens' gusty canvases, sweeping designs and nervous visual rhythms; and in Rembrandt's mysterious but dramatic play of light and shade. In literature it is evident in the passionate but stylized poetic tragedies of Corneille and Racine, in which strong emotional forces are contained by powerful aesthetic and intellectual restraints, as well as in the rich imagery and grandiloquent language of Boileau, Dryden and Pope. In music the baroque is expressed in Giovanni Gabrieli's colossal tonal murals in which unequal sonorous masses, solo and choral forces, vocal and instrumental colours contend with one another; in the throwing back and forth of large and small volumes of sound in Corelli's *concerti grossi;* in the spectacular "scenes and machines" and intricate vocalisms of Italian and French opera; in J. S. Bach's free-moving, florid toccatas and the uncompromising intellectuality of the ensuing fugues; and in the rich-textured, jubilant sounds Handel draws from his oratorio choruses. In later phases of the baroque some of these tensions were resolved in such grandiose statements as the Versailles palace, the pompous pageantry of baroque opera and the theatrical illusionism of such churches as Vierzehnheiligen in southern Germany and the abbey church at Melk, Austria.

Wölfflin's famous five pairs of categories for distinguishing baroque art from that of the Renaissance, first formulated in his *Principles of Art History* (1915), still retain their usefulness as critical criteria. (1) Basing his theory on differing forms of representation, he first opposes the linear to the painterly. Renaissance art, he demonstrates, is dominantly linear with incisive lines and clear contours, while the baroque is primarily painterly (*malerisch*) by reason of its blurred outlines, merging images and greater reliance on chiaroscuro and colour. A painting by Dürer (1471–1528) contrasted with one by Rembrandt (1606–69) will clarify the point. (2) Plane *v.* recessional indicates differing concepts of space. Renaissance artists thought in terms of clearly defined horizontal planes and containment within a limited area, while those of the baroque emphasized composition in depth and suggested illusions of distance. Here the difference is illustrated by a comparison of Leonardo da Vinci's (1452–1519) "Last Supper" with a painting of the Last Supper by Tintoretto (1518–94), or the Pazzi chapel in Florence, which has a flat façade and low-relief decorative detail, with the Church of S. Carlo alle Quattro Fontane in Rome, which has a forward-backward movement and deep shadow effects. (3) Closed *v.* open form indicates the dis-

"Garden of Love" by Peter Paul Rubens (1577–1640), Flemish. In the Prado, Madrid

State bedchamber of the queen, Versailles, France; 17th century

Choir stall, church of the Benedictine monastery, Zwiefalten, Ger., by John Joseph Christian; 18th century

Italian harpsichord. Rome, 18th century. Painted decoration probably by Gaspard Dughet (1615–75)

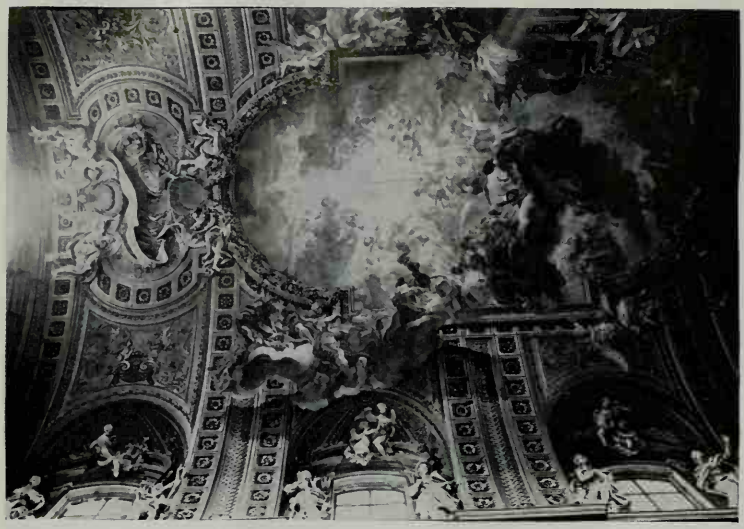
"Bacchanalian Revel before a Term of Pan" by Nicolas Poussin (1593/94–1665), French. In the National gallery, London

"St. Theresa in Ecstasy" by Giovanni Bernini (1598–1680), Italian. In the church of Sta. Maria della Vittoria, Rome

BAROQUE PAINTING, SCULPTURE AND MINOR ARTS

BY COURTESY OF (TOP RIGHT) FRENCH CULTURAL SERVICES, (CENTRE RIGHT) THE METROPOLITAN MUSEUM OF ART, ANONYMOUS GIFT, 1945, (BOTTOM LEFT) NATIONAL GALLERY, LONDON; PHOTOGRAPHS, (TOP LEFT) ANDERSON, ROME, (CENTRE LEFT) TONI SCHNEIDERS, (BOTTOM RIGHT) ALINARI

BAROQUE ART



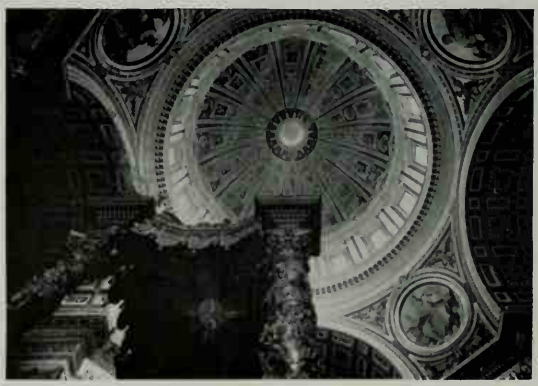
Interior view of the ceiling of the Gesù, Rome. Planned by Giacomo da Vignola (1507–73), completed by Giacomo della Porta (1541–1604), Italian

Cartel clock with Louis XIV clock-case by Charles Cressent (1685–1768), French

Marble bust of Louis XIV by Bernini. At Versailles

Inlaid writing desk by André Charles Boulle (1642–1732), French, for Elector Max Emanuel of Bavaria

Stairway and pool of the Palazzo della Róvere (now Palazzo Gavotti), Albissola Superiore, It.: middle of the 18th century



Interior view of the dome of St. Peter's, Rome, chiefly the work of Michelangelo (1475–1564). Bernini's bronze altar canopy is in the foreground

EXAMPLES OF THE BAROQUE IN FRENCH AND ITALIAN ART

BY COURTESY OF (TOP RIGHT) WALLACE COLLECTION, (CENTRE RIGHT) BAYERISCHES NATIONALMUSEUM, MUNICH, PHOTOGRAPHS, (TOP LEFT, BOTTOM LEFT, BOTTOM RIGHT) G. E. RIDDER SMITH, (CENTRE LEFT) ALINARI

tinction between a balance consisting of horizontal and vertical elements that delimit the pictorial space and keep the eye within the picture on one hand, and an instability consisting of diagonal accents and open backgrounds that beckon the eye beyond the picture on the other. A typical Renaissance church interior, for instance, will terminate in a well-defined apse, while the open apsidal arcades of Andrea Palladio's Venetian churches invite the eye into the indefinite space beyond. (4) Multiplicity *v.* unity is Wölfflin's next category. A Renaissance painting such as Botticelli's "Primavera" is based on fragmented vision in which the figures remain independent entities in spite of their harmonious grouping and balance arrangement, while an organic unity pervades a baroque example such as Rubens' "Garden of Love" in which all parts are subordinated to the single motivating rhythm that unites the whole. (5) Lastly, Wölfflin adduces absolute clarity *v.* relative clarity, or clearness opposed to unclearness. In the former all elements—line, dark and light, colour—are used to define and describe the structure of solid, three-dimensional forms, while in the latter each is used for its contribution to the dramatic theme.

Within the baroque itself, it is also useful to distinguish two divergent tendencies: the free and the academic. In architecture the impulse toward lavish ornamentation was held in check by the restraints imposed by the use of the classical orders; in sculpture Bernini's restless figures contrast with the repose of those of Antoine Coysevox and the violent movement of Rubens' canvases is opposed by the quiet grandeur of Poussin's pictures. Artists who were dominated by emotional forces insisted on a maximum of freedom in the execution of their designs, while those subject to the rigours of reason were willing to adhere to rules. The latter tendency was most apparent in France, where the academies of language and literature, architecture, painting and sculpture attempted to systematize the arts according to fixed principles. At best the academies upheld standards of craftsmanship, encouraged self-discipline and exercised a restraining influence on baroque extravagances; at worst they reduced art to a system of sterile conventions, suppressed individual expression and brought about aesthetic uniformity and regimentation.

Baroque art, for purposes of discussion, divides more readily according to sources of patronage than to geographical boundaries. The services of artists, for instance, were enthusiastically enlisted by Counter-Reformation forces and great monarchies to enhance the power and glory of church and state respectively. Similarly, art was used by the Reformation movement to establish a new religious tradition, and the rising middle class found in the arts an important adjunct to the enjoyment of the good life. Thus the four main sources of patronage for baroque art were the Counter-Reformation, the aristocracy, the Reformation and the bourgeoisie.

Counter-Reformation Baroque.—Following the Council of Trent (1545–63) the church mobilized its great resources for the propagation of the faith. Newly founded orders, such as the Society of Jesus, undertook building programs destined to have far-reaching consequences. In Rome, the mother church of the Jesuit order, the Gesù, exerted an enormous influence on church design. Planned by Giacomo da Vignola and finished after his death by Giacomo della Porta, it departed from the Renaissance tradition in many respects, notably in the striking volutes and spiraling scrolls that flank the upper story of its façade.

The full force of the baroque power to mold space into new and astonishing forms was felt during its climactic Roman phase from about 1630 to 1670. Departing from the neat rectangles, triangles, circles and other Euclidean forms favoured by Renaissance artists, Francesco Borromini's geometry in his Church of S. Carlo alle Quattro Fontane, as well as in his Church of S. Ivo, includes spheres, ellipses, parabolas, spirals and ovals. The interior of S. Carlo was organized over a flexible floor plan; its irregular walls strain upward toward an oval dome, the inner surface of which was designed with a combination of unusual geometrical figures. The façade is not flat and static in the Renaissance manner, but ripples like a stage curtain in a series of convex and concave surfaces. This undulating, in-and-out movement allows for a maximum play of light and shade over the irregular surface and over the statuary set in niches. Such a façade produced much consternation among Renaissance partisans. Burckhardt, for instance, spoke of it as resembling something that had been dried in an oven.

Bernini's tortured and turbulent "St. Theresa in Ecstasy" expresses at its best the baroque spirit in sculpture. What Michelangelo expressed with the nude body, Bernini expressed through the fluttering, wind-swept drapery by which he externalized the soul states of the saint as she was torn between earthly and divine love, tormented with sensual and spiritual aspirations, and simultaneously borne aloft on her own swirling gales of passion. Deep undercutting gives greater play to light and shade, and the dramatic, even theatrical lighting filtered through a concealed, yellow-glazed window, completes the illusion.

Counter-Reformation churches in general were light, spacious and cheerful. Interiors such as that of S. Ignazio in Rome were like theatres in which all the arts—sculpture, painting, music and liturgical drama—played major roles in divine worship. Here the designers succeeded in bringing the arts together in an all-embracing rhythmic unity that culminated in Andrea Pozzo's mural that covers the vaulting of the nave of S. Ignazio. In it the sky opens up, and by masterly foreshortening effects the saint is borne upward by a heavenly host, twisting and turning in ever-winding spirals to infinity. The indefinitely extended perspectives achieved the desired mystical illusion of endlessness. The interest awakened and sustained by such flights of the imagination broadened the popular base of the baroque. The style readily spread throughout the Counter-Reformation countries of the continent and was carried to the new world by the missionary orders and Spanish, Portuguese and French colonists. In Latin America the European style blended with the exuberant colour and character of the native arts to produce rich and distinctive variants of baroque architecture and sculpture.

Aristocratic Baroque.—The palace as the secular counterpart of the church assumed a vast complexity of design during the baroque period. The antecedents of this style are discernible in such conceptions as Michelangelo's proposal for the Farnese palace in Rome, which would have extended its axis with a bridge over the Tiber river to include some gardens on the other side, and in Palladio's Villa Rotonda near Vicenza, which crowns a hilltop and commands a view of the countryside in a manner that brings the architecture and surrounding landscape into a close relationship. The arts as an adjunct to the cult of majesty were first employed on a grand scale by Philip II of Spain in the construction of the Escorial (*q.v.*) near Madrid. This strange combination of royal palace, fortress, monastery, seminary, national archive and mausoleum, according to Philip's commission, was to express "nobility without arrogance, majesty without ostentation." The stark exterior walls enclose a complicated system of courts and cloisters culminating in a domed church, an adaptation of Michelangelo's original plan for St. Peter's. The extreme simplicity of Philip's apartments contrasts with the lavish ornamentation of the church and reception rooms to set up a true baroque tension. After Philip's time Spanish art was engulfed by the flood of the florid baroque called the churrigueresque.

In Paris the aristocratic baroque swells in a mounting crescendo from the Luxembourg palace, through Claude Perrault's large-scale new wing for the Louvre, to Jules Hardouin Mansart's vast, all-encompassing spatial composition at Versailles. In one direction a highway begins between the two wings of the palace and extends to the Champs Élysées and the Louvre in Paris. In the other the axis moves through the garden paths, past the grand canal that bisects the gardens, and onward toward the indefinite horizon. Mastering nature was the order of the day, and interior and exterior space were conceived as complementary to each other. Adding together the formal landscape architecture of André Le Nôtre, the sculptural elaborations of Pierre Puget and Antoine Coysevox, the interior designs of Charles Le Brun, the dramatic productions of Racine and Molière and the ballets and operas of Lully, the sum amounts to a complete image of the baroque universe with the sun king, Louis XIV, as its solar centre. This image of absolutism was incorporated into the architectural vocabulary, and every continental aristocrat was determined to build as pre-

tentious a version of Versailles as his means would allow.

Reformation and Bourgeois Baroque.—The Reformation movement and the rise of the middle class can be treated together for the sake of convenience, though the two are not identical since bourgeois patronage can be found in some degree anywhere. It happened to be most extensive and effective, however, in the Protestant countries. Since the more austere Protestant sects followed the Old Testament injunction against the making of graven images, the result was not propitious for the development of a thriving religious art. Since church commissions were no longer forthcoming, artists had to look to secular sources for support, and it became necessary to take into account the tastes of the middle-class many rather than the aristocratic few. Town halls, commercial buildings and domestic dwellings superseded churches and palaces; figurines, ceramic work and furniture superseded monumental statuary; small easel paintings, etchings and book illustrations superseded large murals and tapestries; the cult of the home superseded the cult of majesty; and realistic everyday scenes superseded recondite mythological compositions. The forms and subject matter of the Dutch school strikingly illustrate this shift in taste. In addition to genre scenes, landscapes and still-life studies, there are single and group portraits that tend to dignify the individual, his work and his domestic pursuits.

The drama of the baroque style was played against a backdrop of crucial social, religious, scientific and philosophical changes. The great geographical explorations of the late 15th and early 16th centuries were followed by colonization that started the flow of gold and silver from the new world into the coffers of Spain and Portugal; the establishment of East and West India companies similarly enriched France, England and Holland. The traditional internationalism of the church and its secular arm, the Holy Roman empire, was challenged by the rise of powerful national monarchies. The Reformation and Counter-Reformation split European countries asunder on religious grounds; the Christian world view collided with the new secularism; and the position of the landed aristocracy was threatened by the wealth of new merchant princes. The Copernican theory of a sun-centred rather than an earth-centred universe produced a shock reaction as men began to realize that the earth was no longer static but moving freely through space, and that man was no longer the sole centre of creation. Descartes' definition of the world as "matter in motion," Pascal's studies of conic sections, cycloid curves and theories of probability, Leibniz' dynamic mathematics allowing for the concept of infinity, and Newton's speculations on terrestrial and celestial mechanics were among the many attempts to come to terms with the new cosmic outlook.

Baroque art in this light becomes the aesthetic reflection of a new conception of the world and the exuberant affirmation of a modern dynamic attitude toward life. *See* BAROQUE AND POST-BAROQUE ARCHITECTURE; *see* also Index references under "Baroque Art" in the Index volume. (WM. F.)

BAROTROPIC. The distribution of mass in a fluid is said to be barotropic when the surfaces of constant density coincide with the surfaces of constant pressure. This article deals with the term as applied to atmospheric hydrodynamics. In the atmosphere, a barotropic mass distribution implies that constant-pressure surfaces coincide with constant-temperature surfaces, provided the small effect of moisture on density is neglected.

Since the distance between constant-pressure surfaces depends almost entirely on density, constant-pressure surfaces in barotropic layers are essentially parallel.

Because the geostrophic wind (*q.v.*) is determined by the slope of constant pressure surfaces, the geostrophic wind is invariant with height in a barotropic atmosphere, and since the geostrophic wind is usually a good approximation to the real wind, the horizontal wind distribution at a single level characterizes the wind distribution of a barotropic atmosphere.

In numerical weather prediction (*see* WEATHER FORECASTING), the actual atmosphere is frequently represented by an imaginary barotropic atmosphere which has the same velocity distribution as the actual atmosphere near the 18,000 ft level. Such a barotropic model has two advantages over more complicated models: observations are required at one level only, making possible large horizontal coverage, and the horizontal divergence is small, simplifying forecasting equations. As a result of the large horizontal coverage in barotropic models, there are fewer errors resulting from lateral boundary conditions than would be present in more complicated models. (H. A. A. P.)

BAROTSE, a people of south central Africa comprising about 25 tribes of about six cultural groups and numbering (1960) approximately 298,000. They inhabit the British protectorate of Barotseland (48,170 sq.mi.) in Northern Rhodesia, which is administered by a resident commissioner. Formerly the Barotse nation extended into other provinces of Northern Rhodesia and into Angola and the Caprivi strip. The tribes were all called Barotse as subjects of the paramount chief of the dominant Barotse tribe. This tribe was originally known as the Aluyi, and it ruled the basin of the Zambezi from the Kafue confluence to about 12° S. In 1838 the Aluyi were conquered by the Kololo, a horde of Basuto which had fled under the impact of wars in Zululand. In Kololo speech "Aluyi" became "Barotse." In 1864 the Aluyi defeated the Kololo; and "Barotse" has since become "Lozi" ("Malozi"). "Lozi" refers both to the dominant tribe and all its subjects. It is the name now used in most government and other publications, though "Barotse" survives on maps, in government ordinances and in common reference.

A Portuguese, Silva Porto, has left the first written record of Barotseland and David Livingstone visited it twice, during the Kololo regime. By 1954 missionaries, travelers, administrators, technical experts and an anthropologist had described both the re-established Malozi kingdom and modern conditions.

The Lozi.—The dominant tribe occupies the Zambezi course between 14° 35′ S. and 16° 25′ S. There the river has excavated a plain about 120 mi. by 25 to 35 mi. in the Kalahari sands which form the centre of Barotseland, though this stretches into adjacent physiographic regions. The products of the flood plain itself differ from those of the surrounding woodlands, and there is considerable trade. As the Zambezi's tributaries also centre on the plain, it is the ecological heart of the region, and this may explain why its inhabitants are dominant.

Lozi legends date their origin, in association with the Lunda and neighbouring tribes, by descent from their god, Nyambe, 11 generations and 19 kings ago. This genealogy cannot be used to date their arrival in the plain, probably from the northwest. The most to be said is that the kingdom has been established and has had wide sway over neighbouring tribes for at least two centuries.

The Zambezi floods every year and the vegetation alters with water conditions, while people and other creatures move with the flood's rise and fall. The people move between two sets of villages, in the plain and on the margin. They have made skilful use of varying water levels and of different soil and grass conditions to develop an elaborate economy of agriculture, animal husbandry and fishing. The necessity for co-operation to exploit these resources has produced intensive social cohesion among the Lozi, but they have always been short of labour and have constantly imported people from their subject tribes and serfs from raided foreigners. Possibly for this reason both they and their Kololo conquerors never dealt largely in the slave trade. These serfs had substantial rights in Lozi law, within a social hierarchy of aristocrats, commoners and serfs. Royalty and commoners intermarried, for the aristocrats could not raise their standards of living above their fellows. Tribute flowed to rulers from their subjects and was redistributed. Some rulers acted tyrannically, but in theory and practice they were "constitutional monarchs." The exercise of rule was divided between various rulers at the main and other capitals and in an elaborate system of councils at each capital. In modern administration there are five district councils and a national council which are self-perpetuating, with an advisory elected national body.

Missionaries.—In 1884 François Coillard of the Paris Evangelical mission established a station in the country, and it has had a potent influence, especially in education. By the mid-20th century many other sects were working among the Barotse.

British Suzerainty.—In 1890 and 1900 the Barotse paramount

chief Lewanika signed treaties with the British South Africa company by which he accepted British protection. He granted certain land and mineral concessions and abandoned certain powers. In 1906 serfs were liberated and in 1925 tribute abolished. In 1924 rule was transferred to the colonial office. British political influence steadily extended with the social and economic involvement of Barotse in southern Africa. Certain administrative difficulties arose under the treaty and some were resolved by Barotse agreement to the passing of the 1936 Barotse Native Authorities and Native Courts ordinances. Despite their acceptance of these, the Barotse retain a comparatively large measure of political independence. In other ways they are dependent on western economy, for money to buy European goods, etc. They sell cattle and fish and many of their men migrate for periods to work for industries. Revenue also comes in from the exploitation of Rhodesian teak forests by a sawmill at Livingstone. Attempts are being made to develop rice growing.

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BARQUISIMETO is the flourishing capital of the Lara state, Venez. Pop. (1961) 196,557. One of the older cities of the country, it was founded in 1552 by Juan de Villegas and called Nueva Segovia after his native city. On March 26, 1812, the city was totally destroyed by an earthquake. The modern city lies on the Barquisimeto river 170 mi. W.S.W. of Caracas and 101 mi. by rail southwest of the Caribbean port Tucacas. The railroad connecting Barquisimeto with Tucacas is an extension of what was probably the first railroad to be built in South America. Barquisimeto lies at an elevation of only 1,856 ft. and is swept by drying trade winds much of the year. The climate is healthful with a mean average temperature of 78° F.

The city, a commercial and industrial centre, is the hub of a network of highways extending in all directions, even southward into the Llanos, and it has been growing rapidly. It has modern housing, public buildings, a fine airport and an impressive hospital. Its rural district population averages from 25 to 60 persons per square mile. The surrounding land is utilized mainly for subsistence crops, but there are some coffee and cacao plantations that provide exports. (L. WE.)

BARR, AMELIA EDITH (née HUDDLESTON) (1831–1919), Anglo-U.S. novelist, best known for *Jan Vedder's Wife* (1885), a story set in the Shetland Islands. She was born in Ulverston, Eng., on March 29, 1831. In 1850 she married Robert Barr and four years later went with him to the United States, where they settled in Texas. There her husband and three sons died of yellow fever. Three daughters remained to her, and in 1869 she took them to New York city, where she was a teacher for two years and then wrote for magazines and newspapers. Her first novel, *Romance and Reality* (1872), was followed by more than 60 others. Her work is characterized by historical settings, generally English, Scottish or colonial American.

See *All the Days of My Life*, an autobiography (1913).

BARR, ARCHIBALD (1855–1931), Scottish engineer, noted for his share in the invention of the modern range finder, was born at Paisley, Renfrewshire, on Nov. 18, 1855. Having graduated in engineering at Glasgow university, he became assistant to the professor of engineering there. In 1884 he became professor of engineering at the Yorkshire college, later Leeds university, where he met William Stroud, who was professor of physics. Having read an advertisement from the war office for an instrument to measure range, within a week the two of them had evolved all the essential features of the famous Barr and Stroud range finder (*see* RANGE FINDERS: *Short Base Range Finders*). This entirely novel instrument was an immediate success, more than fulfilling the demands of the services. The two men founded the firm manufacturing optical and mechanical precision instruments bearing their name. In 1889 Barr was recalled to Glasgow university to the regius chair of engineering, which he occupied for 24 years. He became a fellow of the Royal society in 1923 and died at Milngavie, near Glasgow, on Aug. 5, 1931. (J. M. S.)

BARRA (Gaelic BARRAIDH, probably meaning "St. Barr's Island"), an island of the Outer Hebrides, Inverness-shire, Scot., lies about 5 mi. S.W. of South Uist. Pop. (1961) 1,467; area 34.9 sq.mi. including a number of smaller islands and islets. From Scurrival point, the tip of the northern peninsula, the island measures 8 mi. in length. At Eoligarry, on North bay, aircraft can land at low tide on the Traigh Mhor, or Great Cockle beach; there is an air service with Glasgow.

A road 12 mi. long runs around the island and there is a concrete pier on the south coast at Castlebay, the chief village. There are steamer connections with Mallaig and Oban.

The rock formation is gneiss and along the west coast are stretches of shell sand. Heaval, the highest hill, is 1,260 ft. above sea level and there are several small lochs. On Barra head, the highest point of Berneray island and the most southerly point of the Outer Hebrides chain, is a lighthouse on the 580 ft.-high rock. There are Danish duns (castles) on the hills, stone circles and ruined chapels, and Kishmul castle, the stronghold of the Macneils, one of the oldest Highland clans, stands on a rock in Castlebay. Hebridean folk traditions have survived with storytellers and singers and pure Gaelic is still spoken; 90% of the people are Roman Catholic. In the 20th century the decline of the herring fishery and the lack of industry have encouraged immigration to Canada and the Scottish mainland. By 1961 almost the only paid employment was in work on the roads or in the small cockleshell grit industry. Barra has a junior secondary school and six primary schools.

See J. L. Campbell (ed.), *The Book of Barra* (1936); D. Buchanan, *Reflections of the Isle of Barra* (1942).

BARRACKS. In the United States and some other countries, barracks are the buildings used for housing enlisted personnel of the armed forces, as distinct from quarters assigned to officers, married noncommissioned officers, or nurses. In Britain, and some other European countries, the word "barracks" is often a general term for all buildings that form part of the large military camps such as Aldershot (England). The term is normally applied to permanent peacetime buildings; temporary wartime quarters for troops have the term "camp" applied to them also. Some military posts in the United States are known as barracks, viz., Jefferson Barracks (Mo.) and Plattsburg Barracks (N.Y.).

Barrack Construction History.—Until about 1800, troops in central and western Europe were billeted or quartered in the homes of citizens, or sometimes in alehouses, inns, or unoccupied buildings. This system was a hardship on the people and was not popular. It was, for example, one of the abuses attributed to King George III by the Declaration of Independence. It was also subversive of discipline and exposed the troops to many temptations of both a moral and a political nature.

Though barracks had been built earlier in several parts of Ireland, it was not until 1792 that George III obtained parliamentary approval for the construction of permanent barracks in England. As the English barracks were used mainly in connection with the occupancy of fortifications, their construction was charged to the royal engineers but, in 1796, this work was transferred to a civil department of the government. In 1816, a civilian comptroller was appointed to supervise the construction and maintenance of military barracks, hospitals and storehouses on sites other than those occupied by fortifications. Bedsteads and hammocks were provided the men but, in some instances, bunks extending from wall to wall and occupied by as many as 30 or more men were found. Gradually kitchens were authorized where all food was prepared either by the soldiers in person or by certain ones selected for this purpose.

The civil department of the government relinquished control of military barracks in 1818 and their supervision was again assumed by the corps of royal engineers. In 1826 the School of Military Engineering, commanded by Col. Charles Pasley, included in its curriculum a course in practical architecture. During that period, Wellington directed the replacement of the wooden bedsteads, berths and bunks by double-decked, two-man iron beds; provision also was made for kitchens (known then as cookhouses) and for certain sanitary facilities known as ablution houses. Separate messes were later established for noncommissioned officers and provisions were made for athletics and other means of diversion for the soldiers. During the latter half of the 19th century, the British war office conducted an exhaustive inspection and study of quartering facilities, as a result of which many regulations were promulgated as to types of construction, quartering, cooking and sanitary rules, and provisions for the quartering of married men and their families. In 1904, a governmental civil department was again formed under a director, known as "director of barrack construction," but this agency functioned only until 1918, when it was abolished and the control of quartering and hospitals again reverted to the corps of royal engineers, where it has since rested.

Most of the barracks in Britain, including big military camps such as Aldershot, came into existence after the middle of the 19th century and owed their locations to the suitability of the surrounding country for training purposes. They were solidly built and proved reasonably suitable for modernization. Most of them were in pleasant surroundings and were near a large town where recreational facilities existed. The older British barracks consisted of two or three stories but many of those constructed after 1914 were on the bungalow principle. In general terms, the modernizing of British barracks took place in two stages. In the years before World War I, married quarters, canteens, and electric lights were added, and improvements were made in the cooking and feeding arrangements and in sanitation. The second stage began between World Wars I and II and continued into the 1950s. Canteens for all types of drink and food, and recreational areas were added to all barracks, as well as additional washing facilities and central heating. Stables for horses gave way to garages for motor transport. In many stations, good houses or flats for married officers were built.

Before World War I the history of barrack construction in the United States generally followed the practices of the British army. Troops were housed in tents, huts, and light frame structures, or in more permanent barracks made of tile, cement block, brick, or stone. All types, with the exception of the hut, were found in various parts of the country. The type of barrack construction chosen for a particular site depended upon climatic conditions, availability of materials, and the degree of permanency of the garrison or camp.

In the United States, Britain, and Europe, few barracks were built during the years that followed World War I. In all countries, uncertainties as to the strength and deployment of forces led to modernizing existing barracks rather than building new ones. The most modern barracks in Europe in the 1930s were those built in Germany after the Third Reich began to rearm.

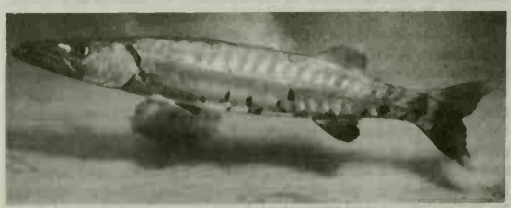
The outbreak of World War II set off a vast program of barracks construction and modernization, particularly in the United States. Huge training camps were established and provided with sufficient barracks to house the millions of trainees brought into service. The typical U.S. army barrack was a frame 2-story building with electric lights, sanitary facilities, and perhaps a small recreational room. The additional accommodations required for Britain's expanded army were generally provided in the form of temporary huts, most of which were dismantled soon after the war ended.

After World War II, barracks of permanent type construction were erected at permanent military installations to house the authorized peacetime complement of enlisted personnel. These structures were three stories high and, with normal maintenance and upkeep, had a useful life expectancy of 25 years. Exterior materials were brick, concrete masonry units, or concrete. Barracks of this type were designed to accommodate one or two companies of enlisted men. Two-company barracks provided duplicate facilities for each company. Squad rooms of 35-man capacity provided sleeping quarters for enlisted men in the lower grades. A large "day room" afforded recreational and lounging facilities for these men. Noncommissioned officers slept in private or semi-private rooms. Other facilities found in these barracks included company administration and storage areas, kitchens and mess halls, toilets and showers, and laundry rooms equipped with washers and dryers. Each barracks was heated by hot water convectors or radiators supplied by individual or central boiler plants. The designs of the various buildings provided numerous windows to insure maximum quantities of fresh air and natural light. Where climatic conditions warranted, forced mechanical ventilation or evaporative cooling provided additional comfort during hot weather.

In 1957, a new concept of U.S. army troop housing and administration was developed to preserve unit integrity at the battalion (5-company) level rather than at the company level. This concept led to the development of a new 2-company barracks design which differed from previous designs in that company administration, storage, and messing functions were divorced from the barracks and placed in separate buildings. The new barracks afforded greater privacy for the lower grades of enlisted men by providing 8-man squad rooms instead of the 35-man rooms. Each squad room was divided into two-bed cubicles by the use of closets and low partitions. Accommodations for enlisted women were the same as those provided for enlisted men of the same grade except for the addition of a reception room and minor cooking facilities.

Bachelor Officers and Nurses.—Bachelor officers of the U.S. army were quartered in single or multistory apartment-type buildings known as bachelor officers' quarters (B.O.Q.). These were either of temporary or permanent-type construction. Accommodations in temporary structures were necessarily more austere than those found in permanent-type B.O.Q.'s. Before World War II, each officer was assigned a suite of rooms consisting of a living room, a bedroom, and a bath. In some instances, structures included central dining and kitchen facilities for the total complement of officers housed. A central lounge was provided for recreational and entertainment purposes. During and after World War II, cost and area limitations resulted in reduced accommodations for each officer. Designs of some B.O.Q.'s provided a private bedroom and a semi-private bath for each occupant, plus a central lounge room. Quarters for nurses and women officers in other branches of the armed forces provided accommodations similar to those found in B.O.Q.'s except for the addition of limited cooking facilities.

BARRACUDA, the common name for many pikelike predatory fishes of the family Sphyraenidae. Typically, a barracuda has long, pointed jaws filled with teeth of razorlike sharpness and ranges in length from three to ten feet. Of about 20 species inhabiting the warmer seas, the Australian giant pike and the great barracuda (*Sphyraena barracuda*) (also called picuda, or becuna) are thought to represent the largest and most vicious types, while the smaller, slender barracuda off the coast of southern California has the highest food value. Though a fish of different habits, the barracuda is thought by some to be more dangerous than a shark. Many swimming tragedies attributed in the past to sharks have been since credited to the barracuda. Large barracudas are, for the most part, solitary; they lurk about tropical reefs, as the pike



BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

GREAT BARRACUDA (SPHYRAENA BARRACUDA)

does about the edges of pond or stream, and are often seen stationary in the water, or gliding slowly about, alert and watchful.

Barracudas approach fearlessly anything that moves in the water, as though from curiosity. Being capable of high speed, at least for short distances, they rush out and seize smaller fishes which chance within their range. They are also said at times to swim on the outskirts of schools of small fishes in shallow water, herding them and preventing their escape until ready to feed.

Fish is their normal food, and the risk to bathers from their attack, as from that by sharks, is doubtless exaggerated in the popular mind, but there unquestionably is a risk though it may be slight. Because it is not easily exhausted and springs about in the most reckless fashion, the barracuda makes an excellent big-game fish. The very trait that makes it dangerous to bathers—that of pursuing any moving object—renders it easy to hook.

(J. T. N.; X.)

BARRAGE, a term once used by engineers for a dam constructed across a river to check the flow and so deepen the current or even create a lake. In a military sense the term is used for the continuous line of artillery or rocket fire intended to hold up the advance of an enemy or protect the advance of the combatant's own troops.

BARRANDE, JOACHIM (1799–1883), French geologist and paleontologist who specialized in the study of the Lower Paleozoic era, was born at Saugues, Haute-Loire, on Aug. 11, 1799, and educated in the École Polytechnique at Paris. He was tutor to the grandson of Charles X, and when the king abdicated in 1830 Barrande accompanied the royal exiles to Prague.

The first volume of his important work, *Système silurien du centre de la Bohême* (dealing with trilobites), appeared in 1852; and from that date until 1881 he issued 21 volumes of text and plates. Two other volumes were issued after his death, in 1887 and 1894.

Barrande died at Frohsdorf, near Vienna, on Oct. 5, 1883.

BARRANQUILLA, a Caribbean port city of Colombia, South America, and capital of the department of Atlántico. It lies 450 mi. N. of Bogotá on the left bank of the Magdalena river about 10 mi. above its mouth. Population (1961 est.) 452,140. Founded in 1629, it long remained in obscurity while the coastal ports of Cartagena and Santa Marta flourished. Barranquilla's access to the sea was hampered by sand bars that partially blocked the Magdalena's mouth, but connections with sea trade developed in mid-19th century via satellite ports on nearby Sabanilla bay. For years a railroad ran to that bay, but the clearing of the river mouth in the 1930s made transshipment to the bay unnecessary. It was the steamboat traffic on the river that especially caused the rise of Barranquilla. Barranquilla was the uncontested leader of Colombia's ports from the late 19th century until after World War II. Afterward a relative decline in Magdalena traffic and the growth of road-borne commerce pushed Buenaventura on the Pacific coast into the leading position. Barranquilla nevertheless continued to handle much coffee and petroleum from the interior and cotton from the surrounding region. An important industrial centre, its products include textiles, beverages, cigarettes, cement, fats and oils, flour, rice and plastics. It has modern transportation, telephone, water and lighting services. Its residential areas range from mud huts to the modern El Prado suburb, an early and attractive experiment in planning which was developed by Karl C. Parrish, a U.S. engineer. The city is linked by road with Puerto Colombia on Sabanilla bay and with areas to the south via Cartagena. Daily air service is maintained to Bogotá and other important cities.

(T. E. N.)

BARRAS, PAUL FRANÇOIS JEAN NICOLAS, Vicomte de (1755–1829), the only original member of the French executive Directory to remain in office (1795–99) until Napoleon's *coup d'état* of 18 Brumaire, was born on June 30, 1755, of an ancient noble family of Provence. Before 1789 Barras gained military experience against the English in India. Elected deputy to the Convention for the *département* of Var (1792), he voted for the death sentence in the trial of Louis XVI. While on a mission to southeastern France, he took a leading part in repressing counterrevolutionaries after the recapture of Toulon from the British in Dec. 1793. His subsequent political career was significant chiefly because on three critical occasions he was invested with a virtual military dictatorship in Paris and because he actively contributed to the rise of Bonaparte. First, on July 27, 1794, he was nominated by the Convention as commanding officer of the national guard of Paris in the place of François Hanriot; in this capacity he arrested Robespierre at the Hôtel de Ville. Next, he was again appointed military commander during the crisis of Oct. 1795 when, with Bonaparte as his chief adjutant, he suppressed a royalist rising in the capital. Finally, having been elected a member of the Directory on Nov. 1, 1795, he was vested with dictatorial powers for the third time on Sept. 4, 1797, and for two years shared power with J. F. Reubell and L. M. de la Revellière-Lépeaux as a member of the ruling triumvirate of directors. Barras was partly responsible for Bonaparte's marriage with Josephine de Beauharnais—one of Barras' former mistresses—and for his nomination to the Italian command in 1796. His special department was the police, where his experience as a member of the Committee of General Security stood him in good stead. After the *coup d'état* of 18 Brumaire year VIII (Nov. 9, 1799) Barras was quickly discarded by Bonaparte, who mistrusted him. Removed from Paris, he was even exiled to Rome in 1813. Though he had voted for Louis XVI's death, he was able to remain in France under the Restoration, since he had not supported Napoleon during the Hundred Days. He remained faithful to his republican ideals, however, and in 1819 circulated a letter to all the newspapers entitled *Le Général Barras à ses concitoyens*. He died in Paris on Jan. 29, 1829. His *Mémoires* are ed. by G. Duruy, 4 vol. (1895).

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(Pr. Gv.)

BARRELL, JOSEPH (1869–1919), U.S. geologist who had few equals as a teacher of graduate students, was born at New Providence, N.J., Dec. 15, 1869. He was educated at Lehigh university and at Yale. From 1893 to 1897 and from 1900 to 1903 he taught at Lehigh and also practised mining engineering; from 1903 until his death he taught at Yale, for 11 years as professor of structural geology. His effectiveness as a teacher stemmed from his breadth of training, his thoroughness and his quantitative approach to problems. A great analyst, he used multiple working hypotheses. His career, cut short in its prime, reflected increasing interest in the broad, philosophical aspects of geology. He is best known for papers dealing with the differentiation of sedimentary rocks; an exhaustive treatise on isostasy, "Strength of the Earth's Crust" in the *Journal of Geology*, vol. 22 and 23 (1914–15); and the classic study, "Rhythms and the Measurement of Geologic Time" in the *Bulletin of the Geological Society of America*, vol. 28, pp. 745–904 (1917). He died at New Haven, Conn., on May 4, 1919.

(F. M. Fl.)

BARREL ORGAN. The term barrel organ is popularly understood to mean an instrument of street music in which a simple pianoforte action is worked by a pinned barrel turned by a handle. This is more correctly a "barrel piano."

In a true barrel organ, the barrel causes one or more ranks of organ pipes to play the tunes, the handle simultaneously actuating the bellows. The idea of the pinned barrel was known in the 16th century, generally used in conjunction with a clock mechanism. The handle-operated organ reached its greatest popularity during the late 18th and early 19th centuries, when such instruments were in regular demand and ranged from miniature bird organs used to encourage song birds, to large versions that played the psalms in village churches. Some of the latter remained in use until well into the 20th century.

Intermediate in size and reaching a peak of popularity about 1830 were the cabinet-sized domestic barrel organs, commonly supplied with one barrel for religious music and two for entertainment. Each wooden barrel is pinned with brass staples of varying length according to the lengths of the notes to be sounded. As the handle is turned, the staples raise levers that admit wind to the pipes as the melody and its harmony require. The levers are opposite their respective pipes and therefore well separated, leaving

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ITALIAN BARREL ORGAN: EARLY 19TH CENTURY

space for ten or more tunes to be set on a single barrel; the staples serving, for instance, the note G in the second tune are placed just to the left of those for G in the first tune, and so on, the tune being selected by shifting the barrel in its wooden carrier bodily sideways and holding it in correct alignment by a catch on the outside. A common provision of pipes was one or two stopped wooden ranks and an open metal rank at the octave. Domestic models often included a drum and cymbal, actuated by additional pins.

Modern musicians find barrel organs of particular interest because they preserve evidence of old styles of musical execution and ornamentation, and Arnold Dolmetsch studied a French treatise on barrel organ making and published the results of his researches in 1915 in *The Interpretation of the Music of the XVII and XVIII Centuries*, new ed. (1949). (A. C. Ba.)

BARREN GROUNDS (Barren Lands), a subarctic region of northern mainland Canada stretching westward from Hudson bay to the Great Slave and Great Bear lakes; its farthest extension southward is to lat. 59° N. along the Hudson bay coastal plain; it reaches northward to the Arctic ocean. The surface is a low, rolling plateau sloping gradually to the east and northeast from about 1,000 ft. The area forms part of the Canadian Shield and is underlain by Pre-Cambrian granite and granite-gneiss; the whole landscape was modified by the continental ice sheet which in its retreat covered the bedrock with glacial debris.

The plateau is crossed by many shallow rivers that wind through myriads of lakes often separated by streams in which rapids and falls occur. The main rivers draining northward are the Coppermine and the Back (*qq.v.*). The Dubawnt (*q.v.*), Kazan and Thelon drain the central area eastward to Hudson bay.

Although it lies north of the tree line, the region is not completely barren. Isolated clumps of stunted spruce occur in sheltered places, and thickets of willow and alder grow along some of the rivers. There is no continuous vegetation cover but grasses, sedges and herbaceous plants grow in the damper stretches of the plain. Rock surfaces are dominated by mosses and lichens. The ground is everywhere permanently frozen and only the top few inches melt during the summer months. The climate is characterized by long, rigorous winters, with temperatures averaging −25° F. in January, and short summers with an average July temperature of 50° F. Snowfall is moderate to light (30 to 40 in.) and about 5 in. of rain falls in the summer months. In July the surface is carpeted with an abundant vegetation enlivened by the bloom of many flowers. Warm weather, almost continuous hours of daylight and soil that is continually moist from the gradual thawing of the frozen ground promote rapid growth.

The region is the natural habitat of the barren-ground caribou. The other more numerous mammals are the arctic fox, musk ox, timber wolf, wolverine, muskrat and grizzly bear. The lakes and rivers abound in fish; the main species are lake trout, whitefish, northern pike and lake herring. The only inhabitants are the few Eskimo who live along the coasts and personnel at the few trading posts and scientific-research stations.

Samuel Hearne (*q.v.*) was the first to explore the Barren Grounds; in 1769–72 he traveled overland from Fort Prince of Wales (now Churchill, Man.) to the Coppermine river and Coronation gulf. During the 19th century the search for the ill-fated Franklin expedition led to several explorations in the north of the region. Systematic exploration and mapping began in 1893 when J. B. Tyrrell surveyed the Dubawnt and Kazan rivers, followed by Canadian government and mining company surveys.

(B. V. G.)

BARRÈS, (AUGUSTE) MAURICE (1862–1923), French writer and politician, whose individualism and fervent nationalism greatly influenced his generation, was born Aug. 19, 1862, at Charmes-sur-Moselle (Vosges), in Lorraine. Barrès always considered himself a Lorrainer, charged with the interpretation and the vindication of his own people. He was educated at the Collège de Malgrange and the Nancy *lycée* and in 1882 went to Paris and studied law. He made his literary debut with some ironical pamphlets which successfully displayed his intellectual *dandysme*. Ernest Renan paid him the compliment of being annoyed by his *Huit jours chez M. Renan* (1888).

He enhanced his reputation by the three volumes of *Le Culte du moi: Sous l'oeil des barbares* (1888); *Un Homme libre* (1889); and *Le Jardin de Bérénice* (1891). These novels provoked much ridicule in the press, but the humour, charm and *préciosité* with which he developed his theme of the cultivation of the ego and thus a harmonious inner life was hailed with delight by the younger generation. Many of the ideas which permeate his later works may be found in *Un Homme libre*. The section dealing with Lorraine was described by Ernest Lavisse as an admirable piece of historical psychology. The third novel, *Le Jardin de Bérénice*, showed great delicacy of feeling and subtlety of style and was inspired by the author's electoral campaign at Nancy as Boulangist candidate. He was only 27 when he was elected deputy, and from that time he led a life divided between literature and politics.

Intelligent, ardent, ambitious, modeling himself first on Benjamin Constant and then on Disraeli, Barrès, during the period between the end of Boulangism and the Dreyfus case, hesitated as to the wisest course to pursue. He stood for one of the Paris divisions as a Socialist patriot and was defeated (1896). He went through an anarchistic period, as is shown in the novel *L'Ennemi des lois* (1893). He traveled in Italy and in Spain. For about six months he edited a paper called *La Cocarde*. Charles Maurras (*q.v.*) was his colleague in this venture and together they roughly blocked out the future doctrines of the French nationalist party.

In 1897 he began the publication of the important trilogy, *Le Roman de l'énergie nationale*. The generation and milieu described are his own. His characters in *Les Déracinés* (1897) are types rather than living beings, but as a delineation of a period it may be ranked with *Le Rouge et le noir* and *L'Éducation sentimentale*. The second volume, *L'Appel au soldat* (1900), contains a vivid account of the Boulangist movement, and the third, *Leurs Figures* (1903), a picture of parliamentary life at the time of the Panama scandal (1889; *see* France: *History: The Third Republic, to 1914*).

The Dreyfus affair (1894–1906; *see* Dreyfus, Alfred), in which he took an active interest, made him a vehement nationalist. He assumed the position of spokesman for Lorraine and undertook the series entitled *Les Bastions de l'Est*. *Au service de l'Allemagne* (1905) describes a young Alsatian's year of military service in the German army and *Colette Baudoche* (1909; Eng. trans. 1918) tells the story of a young girl from Metz. World War I brought these books a rather artificial success as propaganda. Meanwhile, Barrès was writing admirable descriptions of travel: in France—*Les Amitiés françaises* (1903); in Greece—*Le Voyage de Sparte* (1906); in Spain—*Greco ou le secret de Tolède* (1911). They contain some of his best work and some of the finest prose in the language. In 1907 he was elected to the Académie Française.

World War I gave Barrès the chance of expressing his patriotism to the full and he redoubled his activities. He resumed his seat in parliament and did much for the maintenance of morale by writing an article for the *Écho de Paris* every day for four years. These articles, collected in 14 volumes under the title *Chronique de la Grande Guerre* (1920–24), though of historical interest and often showing high literary quality, did not retain their original popularity.

After the war Barrès carried on his role as defender of the French eastern front by a mediocre work, *Le Génie du Rhin* (1921). He returned to pure literature with his novel *Un Jardin sur l'Oronte* (1922), which derives its inspiration from his earlier travels in the east. These he described in *Une Enquête aux pays du Levant*, which appeared in 1923 on the day, Dec. 4, of the author's sudden death at Neuilly-sur-Seine, near Paris. He left much unpublished work. The materials for the memoirs on which he was engaged were published by his son under the title of *Mes Cahiers*, 14 vol.

(1929–57), and a further posthumous collection, *N'importe où hors du monde*, appeared in 1959.

He was, when he died, the most significant figure among contemporary French men of letters, even more so than Anatole France. The influence of his political thought had worn itself out, but his literary authority still swayed the younger generation. He had the power to charm. The prejudices, the narrowness and the egotism, with which he had been reproached, gradually disappeared. The qualities of sympathy and reverence always commanded his esteem and his epic of the countryside, *La Colline inspirée* (1913), reveals the springs of his religious life, which was to find its most poetical expression in the essays of *Le Mystère en pleine lumière* (1926). This latter book, which contains a dialogue with the sibyl of Auxerre and meditations on Joan of Arc, on Claude Gellée and on Eugène Delacroix, is generally considered as his spiritual testament. Like Chateaubriand he created but one living figure, himself, but into that figure he breathed the soul of contemporary France, and thereby captured the heart of his generation.

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(A. T.; X.)

BARRETT, LAWRENCE (1838–1891), U.S. actor, noted for his Shakespearean roles, was born in Paterson, N.J., April 4, 1838. His family name was Brannigan. He made his first stage appearance in Detroit, Mich., as Murad in *The French Spy* in 1853, and in 1857 first appeared in New York as Sir Thomas Clifford in *The Hunchback*. He served as a captain in the Civil War. From 1867 to 1870, with John McCullough, he managed the California theatre, San Francisco. Among his many parts may be mentioned Hamlet, Lear, Macbeth, Shylock, Richard III, Wolsey, Benedick, David Garrick, Hernani, Alfred Evelyn, Lanciotto in George Henry Boker's (1823–90) *Francesca da Rimini* and Harebell in *The Man o' Airlie*. He played Othello to Edwin Booth's Iago, and Cassius (in which role he won wide acclaim) to Booth's Brutus. He acted in London in 1867, 1881, 1883 and 1884. His Richelieu in Bulwer-Lytton's drama was considered one of his best parts. He wrote a life of Edwin Forrest in the *American Actors Series* (1881), and a sketch of Booth in *Edwin Booth and His Contemporaries* (1886).

He died March 20, 1891.

BARRIE, SIR JAMES MATTHEW (1860–1937), Scottish dramatist and novelist, who added a new character to the mythology of the English-speaking world with his creation of Peter Pan, the boy who refused to grow up, brought the supernatural to the stage at a time when the theatre was dominated by the concept of social criticism and gave impetus to the Scottish sentimental tradition in fiction, exemplified by the "Kailyard school" (*see* SCOTTISH LITERATURE).

THE MUSTOGRAPH AGENCY

STATUE OF PETER PAN IN KENSINGTON GARDENS, LONDON

Born in Kirriemuir, Angus, on May 9, 1860, the son of a weaver, Barrie studied at Edinburgh university and spent two years on the *Nottingham Journal* before settling in London as a free lance in 1885. His first successful book was *Auld Licht Idylls* (1888), sketches of life in Kirriemuir ("Thrums") in which he made Scottish manners appear quaint by broadening comedy into farce and drenching tragedy in tears. With *The Little Minister* (1891), a novel in the same style, he became a best seller. Barrie was always a master of situation and dialogue, but the mixture of clowning and sentimentality in his early prose is overrich for modern taste, and of his novels the late *Farewell, Miss Julie Logan* (1931), a superbly macabre tale, seems most likely to continue to satisfy critical opinion.

Barrie began writing for the stage in 1891, and after the successful dramatization of *The Little Minister* (1897) most of his work was for the theatre. Some of his dramatic triumphs were made with ephemeral whimsicalities, but at least four of his full-length plays—*The Admirable Crichton, Peter Pan, Dear Brutus* and *Mary Rose*—and a number of one-act pieces were of the highest quality.

Barrie's work brought him fame, fortune and honours. He received the Order of Merit in 1922, became president of the Society of Authors in 1928 and chancellor of Edinburgh university in 1930. He died in London on June 19, 1937.

To some extent Barrie's success depended on his appeal to the common human unwillingness to face the inevitability of change and growth. In him this amounted to an emotional failure: like Peter Pan, he remained a boy. An entry in his notebook for 1907 reads—"*Finest Dream in the World* . . . it is time before I knew anything of sorrow pain or death. Everyone I have loved is still alive."

Barrie never fully recovered from the shock he received, when six years old, from a brother's death; the horror of the experience was increased by his realization of its grievous effect on his mother, who dominated his childhood and retained that dominance thereafter—he wished to recapture the happy years before his mother was stricken. His "Thrums" stories were written from her early memories of Kirriemuir, and he made her the heroine (under her maiden name) of *Margaret Ogilvy* (1896), which describes her both as the mother of her family of ten, and as a "little mother" to her motherless brothers and sisters during her girlhood. His autobiographical novel, *Sentimental Tommy* (1896), on a boy who weaves a cloak of romantic fiction between himself and reality, again has a "Thrums" setting and a "little mother" heroine.

Barrie's marriage in 1894 to the actress Mary Ansell was childless. In 1897 he found another "little mother" in young Mrs. Sylvia Llewellyn Davies, and to her sons, through whom he began to live again the experience of childhood, he told his first Peter Pan stories, some of which were published in *The Little White Bird* (1902). The play *Peter Pan*, with its theme of heroic boyhood triumphant over the seedy, middle-aged schemer, Captain Hook, followed in 1904 and was revived thereafter in London during every Christmas season except 1940, a unique dramatic record.

But Barrie's idyl of boyhood re-experienced was followed by tragedy. His marriage ended in divorce in April 1910; Sylvia Davies, then a widow, died four months later; two of her sons, to whom Barrie acted as guardian, were killed. In *Mary Rose* (1920) he wrote a tragedy antithetical to *Peter Pan*, expressing the misery which a girl unable to grow up creates in her own life and in the lives of those around her; and *The Boy David* (1936), while glorying in the brave innocence of the young hero, is deeply sympathetic to the harassed manhood of King Saul, who was once such a boy as David.

During the period when he was idealizing childhood, Barrie took a disenchanted view of adult life. Sometimes his disenchantment was expressed humorously, as in *The Admirable Crichton* (1902), on the butler who becomes king of a desert island, with his former employers as serfs; sometimes satirically, as in *The Twelve-Pound Look* (1910), on the typist as the symbol of female emancipation; sometimes tragically, as in *The Will* (1913), on the defeat of love by the lust for wealth, and in *Dear Brutus* (1917), where nine men and women whose lives have come to grief are given a magical "second chance," only to wreck themselves again on the reefs of their own temperaments. The latter, with its subtle blend of wit, pathos, cruelty, pity, fantasy and realism, is the finest of Barrie's plays.

Barrie's letters, edited by Viola Meynell, were published in 1942.

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George Blake, *Barrie and the Kailyard School* (1951); R. L. Green, *Fifty Years of Peter Pan* (1954); Lady Cynthia Asquith, *Portrait of Barrie* (1954). (A. M. S.)

BARRIER REEF, the most remarkable coral formation in the world, lies off the northeast coast of Australia. It extends for about 1,250 mi., from Torres strait to beyond the Tropic of Capricorn off Rockhampton, Queensland, including the Capricorn and Bunker groups as extensions. "Reef" in the singular is, of course, a misnomer, for the barrier is made up of an enormous number of separate reefs. In the north they are more or less continuous, except for deep, narrow gaps. Farther south they are arranged more or less in echelon. The main outer barrier follows fairly closely the edge of the continental shelf—the 100-fathom line—and is only about 20 or 30 mi. from the coast as far as Cairns but about 200 mi. from it in the extreme south; there the continental slope is much gentler than in the north. A number of outlying reefs, Osprey, Flinders, Saumarez, etc., not part of the barrier, rise from depths of 400 to 1,000 fathoms. Within the barrier the long lagoon, generally less than 200 ft. deep, is broken by numerous small and large coral patches, which in the south (Swain reefs) may be many miles broad. The sand or shingle-and-mangrove cays on these patches display a horseshoe shape, convex to the southeast, as a result of spit-building activity by waves from that direction—the direction of prevalent winds. North of Cairns, especially, island reefs or "low wooded isles" show a definite pattern: low shingle ramparts, scarped on the inner side, to windward; a moat sloping up to a flat of dead reef or coral shingle; a sand flat, often colonized by mangrove and submerged at high tide; a leeward sand-cay, normally dry and sometimes partly indurated.

Bores on Michaelmas cay (16° 36′ S.) and Heron Island in the Capricorn group penetrated more than 425 ft. of coral and coral detritus to reach incoherent marine sands, either Recent or Pleistocene, to a total depth of 600 ft. on Michaelmas cay and 732 ft. on Heron Island; bedrock was not reached in either bore. However, most of the islands within the barrier are "high" or "continental" islands, solid rock and definitely outliers of the mainland. On the whole the evidence summarized by J. A. Steers suggests that the main lineaments of this very complex system are in large part controlled by coastal down-warping and faulting, roughly parallel or at acute angles to coastal trends. Submergence was not continuous and was accompanied by sedimentation in the lagoon. It seems likely that reef-building began in the Pleistocene with, doubtless, interruptions due to changes in sea level; in this case the greater solidity and continuity of the northern outer barrier might be due to more continuous growth caused by higher temperatures, relative to the south, during glacial lowering of sea level.

The scenic beauty of a high and deeply-indented coast and high offshore islands, especially in the southern half, and the fantastic variety of colourful marine life—now far more accessible than before because of the development of "skin-diving," spearfishing, and similar aquatic sports—have naturally led to a considerable tourist interest, especially at Hayman and other islands of the Whitsunday group between Townsville and Mackay.

BIBLIOGRAPHY.—The reefs have naturally attracted a considerable literature. On the more scientific side, *see* the Great Barrier Reef Expedition *Reports* (1925–42), a joint product of British, Australian and New Zealand scientists; T. W. E. David, *The Geology of the Commonwealth of Australia*, ed. by W. R. Browne, ch. 13 (1950); J. A. Steers, *The Unstable Earth*, 3rd ed., ch. 6 (1942), valuable for a general review of the coral reef problem. *See* also T. C. Roughly, *Wonders of the Great Barrier Reef* (1936); F. Reid, *The Romance of the Great Barrier Reef* (1954). (O. H. K. S.)

BARRIER TREATY, the name given to each of three treaties granting to the United Provinces of the Netherlands the right to garrison and govern certain towns along the southern borders of the Spanish (subsequently the Austrian) Netherlands. The treaty of Rijswijk (1697) had allowed the Dutch government to garrison some of the main fortresses in the Spanish Netherlands, thus forming a defensive barrier against France, but these fortresses had been overrun by France in 1701 in the War of the Spanish Succession. By the first Barrier treaty (Oct. 29, 1709), Great Britain agreed to support a restoration of the barrier and a considerable extension of it into French-occupied territory, while the states-general of the United Provinces undertook to guarantee the succession of the house of Hanover in Great Britain. This treaty, however, was eventually set aside by Great Britain, and the second Barrier treaty (Jan. 29, 1713), which was confirmed by the treaties of Utrecht and Rastatt at the end of the war, did not concede so much to the United Provinces. The details of the barrier were further modified by mutual agreement in the third Barrier treaty (Nov. 15, 1715) signed by Great Britain, the United Provinces and the Holy Roman emperor Charles VI, then the ruler of the Southern Netherlands. The Dutch were particularly disappointed at the overthrow of the first treaty because it had contained the provision that any commercial advantages secured by Great Britain from Spain should equally apply to the Dutch. This concession had been secured in return for a promise by the Dutch to continue the war against France until all Spain should have been won from the Bourbons; and when it proved impossible to carry out this last policy, the new British ministry of 1710 did not feel bound by the commercial concessions made by its predecessors.

See R. Geikie and I. A. Montgomery, *The Dutch Barrier, 1705–1719* (1930). (I. F. B.)

BARRINGTON, GEORGE (1755–1804), Irish adventurer notorious for his activities as a pickpocket in England in the 1770s and 1780s, and allegedly the author of several histories of Australia, where he later made good, was born near Dublin in 1755, probably the son of a silversmith called Waldron. Educated in Dublin, he joined a troupe of actors, taking the name George Barrington. They introduced him to the pickpocket's art and eventually he found his way to London (1773). His education and personality is illustrated by his entry into London society as a gentleman of wit and breeding. Exploiting this advantage, he operated at race meetings, theatres and even royal levees, and although he was arrested several times, his eloquence earned him exceptionally light sentences, none of which was fully served. When he was tried for the eighth time in Sept. 1790 he was sentenced to seven years' transportation. On his arrival in Australia he soon gained a position of authority; he was given a conditional pardon in Nov. 1792, and was made high constable at Parramatta, New South Wales, in Sept. 1796, with a full pardon, later becoming superintendent of convicts. Genuinely reformed, he earned praise from successive governors. He was retired on half pay because of ill-health in 1800, and soon after became insane. He died at Parramatta on Dec. 27, 1804.

Several legends grew up around Barrington, mainly because publishers used his name as an advertisement for several works, including *A Voyage to New South Wales* (1795) and *The History of New South Wales* (1802). There is no evidence that Barrington had any connection with them, nor did he write the "Barrington prologue" for which he was especially famous, with its well-known lines:

> True patriots all; for, be it understood,
> We left our country for our country's good.

This was written by a Leicester gentleman, Henry Carter (d. 1806), published in the *Annual Register* of 1801 and included in one of the works ascribed to Barrington.

See J. A. Ferguson, *Bibliography of Australia*, vol. i, pp. 13–17 (1941).

BARRINGTON, JOHN SHUTE BARRINGTON, 1ST VISCOUNT (1678–1734), English lawyer and theologian, who was a firm supporter of the extension of civil rights of Protestant dissenters, was the son of Benjamin Shute of Theobalds, Hertfordshire, and took the name Barrington on inheriting an estate in 1710. Having been sent by Lord Somers to win over the Scottish Presbyterians to acceptance of the union with England, his success was rewarded by the appointment of commissioner of the customs in 1708, but he was dismissed by the Tory administration of 1711. He came to the notice of George I through an anti-Jacobite tract he had written in 1713 and became member of parliament for Berwick-upon-Tweed (1715). He was given an Irish peerage as Viscount Barrington of Ardglass in 1720. He was expelled from the house of commons in 1723 for being closely, although unwillingly, involved in the Harburg lottery, one of the many unsound financial ventures of the time. He died on Dec. 14, 1734.

His youngest son SHUTE BARRINGTON (1734–1826) was bishop of Durham for 35 years after 1791.

BARRIOS, EDUARDO (1884–), Chilean novelist whose literary fame rests upon the clearness of his style, the stimulative power of his language and his ability to portray unique characters, was born in Valparaíso on Oct. 25, 1884. He was educated in Lima, Peru, and at the Chilean Military academy, in Santiago. After holding sundry jobs in several Latin-American countries, he settled in 1913 in Santiago, where he served in such important positions as minister of public education and director of the National library.

Barrios began his literary career with a collection of naturalistic stories, *Del natural* ("In the Naturalistic Style"; 1907), but he became better known with his later novels. These included *El niño que enloqueció de amor* ("The Love-Crazed Boy"; 1915), a strange psychological case of a boy in love with a young lady several years his senior; *Un perdido* ("A Down-and-Outer"; 1918), the life story of a hero whose weak character drives him to corruption and failure; and *El hermano asno* (1922; Eng. trans., *Brother Ass*, 1942), an unusual episode in the life of a mentally disturbed monk who attacks a girl in order to be despised by those who consider him a living saint. Barrios' most successful work was *Gran señor y rajadiablos* ("Grand Gentleman and Big Rascal"; 1948), a best seller in which the novelist attempted to portray rural life on a typical Chilean farm.

The author's personal experiences played an important part in all these novels as well as in his other works: *Páginas de un pobre diablo* ("Pages from a Poor Devil"; 1923), a collection of short stories; *Y la vida sigue* ("Life Goes On"; 1925), a series of autobiographical sketches; *Tamarugal* (1944), a novel dealing with life in the northern mining region of Chile; and *Los hombres del hombre* ("Men Within Man"; 1950), a novelistic study in human psychology. (H. Co.)

BARRIOS, JUSTO RUFINO (1835–1885), long-time ruler of Guatemala and advocate of Central American unity. He was born in Guatemala, studied law there and engaged in politics and revolutionary activities. He became army commander and the power behind the president in 1871 when the Conservative party was ousted. Barrios assumed the presidency in 1873 and held it until his death. He imposed internal peace and liberal measures upon his people, working through his obedient political machine of local governors. He fostered economic progress by the construction of railroads and telegraph lines and by attempts to diversify and expand agriculture and to organize an effective governmental revenue system. The president also sought to expand the school system and encouraged immigration. He drastically curtailed the power of the Catholic Church by acts such as the expulsion of the Jesuits, the closure of monasteries and the seizure of extensive church properties. Barrios intervened repeatedly in the affairs of the other Central American republics in an effort to restore the five-nation federation that had collapsed in 1838. When his political efforts failed, the dictator turned to military force in his attempt to compel a revival of Central American union. He was killed on April 2, 1885, while leading his troops in an invasion of neighbouring El Salvador. (T. F. McG.)

BARRISTER: *see* LEGAL PROFESSION.

BARRON, CLARENCE WALKER (1855–1928), U.S. financial editor and publisher, was born in Boston, Mass., July 2, 1855. Having been the financial editor for the *Boston Evening Transcript*, he saw a demand for daily financial news in bulletin form. As a result, he established the Boston News bureau in 1887 and the Philadelphia News bureau in 1897. In 1901 he acquired Dow, Jones and Co., which, under his leadership, became the principal financial news agency in the United States. At the same time, he acquired the *Wall Street Journal*, the nation's leading financial newspaper. To these several services he added *Barron's National Business and Financial Weekly*, in 1921, and in the meantime wrote several books. He died on Oct. 2, 1928. (H. J. Sc.)

BARROS, JOÃO DE (*c.* 1496–1570), called the Portuguese Livy, born probably at Vizeu, may be termed the first great colonial historian and a pioneer orientalist. He was also one of the principal Portuguese humanists and an outstanding civil servant. Educated in the heir-apparent's household, he became a good classical scholar and attracted King Manuel's attention by writing a precocious chivalresque romance, *Crónica do Emperador Clarimundo* (1520). Its verve and style induced the king to encourage him in his idea of writing an epic history of the Portuguese in Asia. Before this was printed (under Manuel's successor, King John III), Barros published several moral, pedagogical and grammatical works of such importance that he has been compared with Froebel as an educational innovator. His influence was certainly lasting, since his elementary ABC primer-*cum*-catechism, published in 1539 (partly for Indian converts from Malabar), served as a model for all such works, including those compiled by the Jesuits for their neophytes in Asia and America.

In 1522 King John III sent Barros to Guinea; apparently the only occasion on which he left Portugal. Soon after his return he was appointed treasurer (1525–28), and then for more than 30 years (1533–67) factor of the *Casa da India e Mina*, a post corresponding to crown agent for the Portuguese colonies. As factor of the India house, he spent his scanty leisure in compiling his great chronicle of the Portuguese discovery and conquest of the seas and lands of the east, eventually published as *Décadas da Asia*. The first draft was finished in 1539, but he was still making additions ten years later and publication did not begin until 1552. The second volume was printed in 1553, the third in 1563, but the fourth was not edited from Barros' unfinished draft till 1615. These volumes take the story only as far as 1538, but Barros' work was continued by Diogo do Couto, who carried it on to the end of the 16th century before his death in 1616.

Barros certainly made the best use of his official position when writing his *Décadas*. He consulted returned soldiers, merchants and administrators, apart from perusing all the official correspondence, and being directly concerned with the dispatch and return of the annual India fleets. He procured Persian, Arabic, Indian and Chinese manuscripts, engaging educated men of those nationalities to translate them. These manuscripts include the Persian chronicle *Shánámá* (since lost) of Turan Shah and an Arab one of Kilwa in east Africa, Barros' version of this being still the primary source for the pre-16th-century history of Kilwa. Barros also partly wrote a number of other works on the geography, commerce and navigation of the east, but these disappeared after his death (Oct. 20, 1570). He also helped to finance an expedition which tried to found a settlement in Brazil. He certainly earned his substantial pension, but died so heavily indebted that most of his heirs refused to accept their share of the ruined inheritance.

Opinions differ as to the merits of Barros' literary style, which he confessedly modeled on Livy, but his *Décadas* are of permanent value for their subject matter, although his position as an official historian prevented him from criticizing Portuguese actions closely.

BIBLIOGRAPHY.—There is no satisfactory modern edition of the *Décadas* and that most commonly consulted is the 24-vol. ed. of Barros and Couto published at Lisbon (1778–88) which includes standard biographies of both historians by Manuel Severim de Faria (d. 1655). *See* also António Baião, *Documentos inéditos sobre João de Barros* (1917); C. R. Boxer, *Three Historians of Portuguese Asia: Barros, Couto, and Bocarro* (1948). (Cs. R. B.)

BARROS ARANA, DIEGO (1830–1907), one of Chile's and South America's most eminent historians, was born in Santiago on Aug. 16, 1830. Because of ill-health, he gave up the practice of law and became a professor in the University of Santiago. Twice rector of that institution, he was instrumental in modernizing the university's curriculum. He served in congress and on boundary commissions and was associated with a number of newspapers and reviews. He had a trenchant pen, and one of his articles attacking Pres. Manuel Montt (*q.v.*) led to the young author's exile early in 1859. He thereupon did extensive research in Argentina, Uruguay and Brazil, and later in Spain, France and England. He was one of the first Latin-American historians to explore the rich Spanish archives and had the good fortune to discover an important unknown 16th-century poem on the war in Araucania. Barros Arana reached manhood during a period of growing nationalism in Chile, and his research and writing on the colonial and independence periods served to buttress the prevailing nationalist position. He is considered a painstaking investigator and annalist rather than

an interpreter. Though his bibliography includes scores of titles, his reputation as a historian rests upon his monumental *Historia general de Chile*, 16 vol. (1884–1902), written in the tradition of the best nationalist historians of 19th-century Latin America. Barros Arana died in Santiago in 1907. (J. J. J.)

BARROT, (CAMILLE HYACINTHE) ODILON (1791–1873), French statesman prominent as a liberal monarchist under the July monarchy, was born at Villefort (Lozère), on July 19, 1791, the son of a Lozère deputy to the Convention. In 1814 he was appointed barrister in the court of cassation. Having made his name as a defender of liberals, he was elected president of the Société "Aide-toi, le ciel t'aidera," an organization for promoting resistance, by legal means, against the reactionary government. During the revolution of July 1830, as secretary of the municipal commission at the Hôtel de Ville in Paris, he decided to support the proclamation of Louis Philippe as king of the French and was one of the three commissioners of the new government who escorted the former king Charles X to Cherbourg on his way into exile. Barrot was then appointed prefect of the Seine *département*. Elected deputy for Eure in 1830, he was for 18 years one of the most active and ambitious leaders of the opposition. He directed the party of the "dynastic left" and, from 1839, demanded the "broadening of the bases of the monarchy" by an electoral reform. During 1846–47 he was one of the managers of the "banquets" campaign to bring pressure on the government, in the hope that "a large and generous extention of the number of electors" would save France from a republican revolution. After the flight of Louis Philippe in 1848 he joined the moderate Republicans. Head of the first ministry called by Pres. Louis Napoleon on Dec. 20, 1848, and also minister of justice, he was dismissed in Oct. 1849, after the first contests between legislative assembly and the new president. After the coup d'état of Dec. 2, 1851, he was imprisoned for a few days and then retired to private life. In 1870 he refused to be again minister of justice. Instead the national assembly elected him a member of the new *conseil d'état*, of which he became vice-president in 1871. Odilon Barrot died on Aug. 6, 1873, at Bougival (Seine-et-Oise). His *Mémoires* were published posthumously in 4 volumes (1875–76).

See C. Alméras, *Odilon Barrot, avocat et homme politique* (1950). (JE. V.)

BARROW (BARROWE), **HENRY** (*c.* 1550–1593), English Independent, one of the early martyrs of Congregationalism, was born about 1550 at Shipdam, Norfolk, of good family, related to the Bacon family. Educated at Clare hall, Cambridge, after a youth of dissipation there and in London he was converted by the chance hearing of a sermon and became a strict Puritan. He became friendly with John Greenwood (*q.v.*) and by him was led into separatism. When Greenwood was arrested in 1586, Barrow visited him in prison but was apprehended himself on Nov. 19. He was examined several times before the high commission presided over by Archbishop John Whitgift, but refused to take the *ex officio* oath and was imprisoned with Greenwood. He was brought before the privy council, where Burghley called him "a fantastical fellow" with "a hot brain" and "a delight to be an author of this new religion." During a period of freedom in autumn 1592, Barrow and Greenwood associated with Francis Johnson and John Penry (*q.v.*) in forming their own church. Barrow was imprisoned again, however, and in 1593 he and Greenwood were tried before a civil court under the act of 1581 against writers of seditious books. Both were sentenced to death on March 23 and executed on April 6, 1593. In prison Barrow wrote several works, defending separatism and congregational independency, particularly *A True Description out of the Word of God of the Visible Church* (1589) and *A Brief Discovery of the False Church* (1590).

Barrow was the foremost representative of the church-democracy of separatism, carrying to their logical conclusion the principles of Robert Browne (*q.v.*). Barrow defined the church as "a company of faithful people, separated from the unbelievers and heathen of the land, gathered in the name of Christ." Its government, worship and discipline were to be taken from the New Testament only, it recognized no distinction of clergy and laity, and it set forth the pattern of ecclesiastical democracy, in which each local congregation was sovereign and autonomous, and the liberty of prophesying was secured to each individual. His church recognized fully the principle of "the people to be the orderers of things."

See H. M. Dexter, *The Congregationalism of the Last Three Hundred Years* (1876–79); F. J. Powicke, *Henry Barrow* (1900). (N. S.)

BARROW, ISAAC (1630–1677), English mathematician and minister, considered by his English contemporaries a mathematician second only to Newton, was educated at Charterhouse, Felstead, and Peterhouse and Trinity college, Cambridge, where he studied literature, science and philosophy. He traveled in France, Italy and the near east. On his return in 1659 to England he received ordination from Bishop Brownrig, and in 1660 he was appointed regius professor of Greek at Cambridge. In 1662 he was elected professor of geometry in Gresham college, London. In May 1663 he was chosen a fellow of the Royal society, at the first election made by the council after obtaining its charter. In 1664 he became first Lucasian professor of mathematics at Cambridge, resigning in 1669 in favour of his pupil, Isaac Newton. His uncle gave him a small sinecure in Wales, and Seth Ward, bishop of Salisbury, conferred upon him a prebend in that church. In the year 1670 he was created doctor in divinity by mandate; and, upon the promotion of John Pearson to the see of Chester, he was appointed to succeed him as master of Trinity college by the king's patent, Feb. 13, 1672. In 1675 Barrow was chosen vice-chancellor of the university.

Barrow was an able mathematician, who handled geometrical method admirably. In his *Method of Tangents* he approximated the course of reasoning by which Newton was afterward led to the doctrine of ultimate ratios; he introduced the differential triangle, and was the first to observe explicitly the reciprocal relation between differentiation and integration.

His major scientific works are: *Euclid's Elements; Euclid's Data; Optical Lectures*, read in the public school of Cambridge; *Thirteen Geometrical Lectures; The Works of Archimedes, the Four Books of Apollonius's Conic Sections, and Theodosius's Spherics, explained in a New Method;* and *Mathematical Lectures*. The above were all written in Latin.

The mathematical works of Barrow have been edited in Latin by W. Whewell (1860). An annotated English translation of Barrow's *Geometrical Lectures* was made by J. M. Child (1916).

See Percy H. Osmond, *Isaac Barrow, His Life and Times* (1944); also John Ward, *Lives of the Professors of Gresham College* (1740 ff.), and Whewell's biography prefixed to the 9th vol. of A. Napier's edition of Barrow's *Sermons* (1859). (I. B. C.)

BARROW is the term used in England for an ancient burial place covered with a large mound of earth or stones. In Scotland the equivalent term is "cairn" (*q.v.*); in the U.S., "mound"; and in Europe, "tumulus." The long or circular barrows found in England extend in time from Neolithic (*c.* 2000 B.C.) to late pre-Christian cultures (*c.* A.D. 600). They are most common in Wiltshire (*q.v.*).

BARROW-IN-FURNESS, a municipal, county and parliamentary borough of Lancashire, England, 34 mi. S.W. of Kendal by road. Pop. (1961) 64,824. Area 17.2 sq.mi. It is on the seaward side of the peninsula forming part of the district of Furness (*q.v.*), between the sandy estuary of the Duddon and Morecambe bay, where a narrow channel of the Irish sea, now bridged, intervenes between the mainland and the long, low island of Walney.

Barrow is of rapid modern growth through the working of veins of pure hematite iron ore in the district of Furness. At the outset Barrow merely exported the ore to the furnaces of south Wales and the midlands. By early 19th century this export amounted to a few thousand tons, and though it had reached about 50,000 in 1847 the population of Barrow was only 325. In 1841 the first iron works were erected, and the first section of the Furness railway was opened in 1846, connecting Barrow with the mines near Dalton; coke was later brought by rail from Durham. In the ensuing years a great increase in trade justified the opening of further communications, and from 1859 many ironworks were

instituted, and a great output of steel produced by the Bessemer process was begun. By mid-20th century the local ores were almost exhausted, and ores from Spain and elsewhere were being imported. Of other industries that followed, the shipbuilding works came to surpass the steel works in importance, but was founded on them. The first vessel was launched in 1873. Both naval and merchant vessels are built there, and one specialty of these yards (more than 130 ac. in extent) is the construction of submarines. Other industries include a paper-pulp factory, armaments, iron works and light industries. The docks system is adequate for modern requirements; there is also a graving dock.

Vickerstown, on Walney Island, is a residential suburb of Barrow, which is now a seaside resort with bathing and sailing. Barrow's educational facilities include grammar schools and a college for further education.

Ruins of antiquity remain within the boundary, notably the abbey of St. Mary of Furness (founded *c.* 1127) and Piel castle, from which Lambert Simnel in 1487 began his march to London to claim the throne of England. Barrow was incorporated in 1867 and became a county borough in 1888.

BARROW RIVER (An Bearrbha), flows for about 120 mi. from the centre of Ireland to the southeast, where it joins the Nore and, with the river Suir, forms the fine estuary of Waterford harbour. These rivers are aptly called the "three sisters" and all three in their middle and lower courses flow through gorges 50–100 ft. deep; above are broad lowlands from which mountain ranges rise. The upper course of the Barrow is quite different. Having its sources in mountain streams of the Slieve Bloom, a mountain range in counties Laoighis and Offaly (*q.v.*), the river flows through bogs and poorly drained lowlands in an easterly direction and then turns south into the wide and fertile lowland country between the Castlecomer uplands on the west and the hills and lowlands of County Wicklow to the east. In the last 15 mi. before the Barrow joins the Nore, it flows in a gorge 50–100 ft. deep with wooded sides, finally reaching a wide and frequently flooded lowland near New Ross; the charm of this area is accentuated by the views of Brandon mountain to the west and Mt. Leinster to the east. The Barrow was canalized to St. Mullins, the tidal limit, from 1759 onward and linked to the Grand canal from Dublin to the Shannon, but in 1954 barge traffic ceased. Market towns on the river include Athy (pop. [1961] 3,842), Carlow (pop. [1961] 7,707) and Graiguenamanagh-Tinnahinch (pop. [1956] 1,366). (T. W. Fr.)

BARRY, SIR CHARLES (1795–1860), English architect, designer of the British houses of parliament, was born in London on May 23, 1795, the son of a stationer. He was articled to a firm of architects until 1817, when he set out on a three years' tour of Greece, Italy, Egypt and Palestine to study architecture. In 1820 he settled in London. One of his first works was the church of St. Peter at Brighton, in 1826. In 1831 he completed the Travellers' club in Pall Mall, a splendid work, the first in the Italian style built in London. In the same style and on a grander scale he built in 1837 the Reform club. He was also engaged on numerous private mansions in London, the finest being Bridgewater house (1847). In Birmingham, one of his best works, King Edward's school, was built in the Tudor style between 1833 and 1836. For Manchester he designed the Royal Institution of Fine Arts (1824) and the Athenaeum (1836), and for Halifax the town hall. He was engaged for some years in reconstructing the Treasury buildings, Whitehall. But his masterpiece, notwithstanding all unfavourable criticism, was the houses of parliament at Westminster, London (1840–60), on which Augustus W. Pugin (*q.v.*) assisted him. Barry was elected associate of the Royal Academy in 1840 and a royal academician in the following year, and received many foreign honours. He was knighted in 1852. He died suddenly at Clapham, London, on May 12, 1860, and was buried in Westminster abbey. In 1867 appeared a life of him by his son, Bishop Alfred Barry (1826–1910).

See H. H. Statham, *The Architectural Genius of Sir C. Barry* (1901).

His son, Edward Middleton Barry (1830–1880), also an architect, was born on June 7, 1830. He was professor of architecture at the Royal academy from 1873 until his death. He completed his father's work on the houses of parliament, and Halifax town hall. Other buildings designed by him were Covent Garden theatre, Charing Cross and Cannon Street hotels, the Birmingham and Midland institute, new galleries for the National gallery and new chambers for the Inner Temple. He died on Jan. 27, 1880.

The youngest son, Sir John Wolfe Wolfe-Barry (1836–1918), civil engineer, who assumed the additional name of Wolfe in 1898, was born on Dec. 7, 1836. He was educated at Glenalmond, and articled as engineering pupil to Sir John Hawkshaw, with whom he built the railway bridges across the Thames at Charing Cross and Cannon street. In 1867 he worked on his own account. Among the works on which he was engaged were extensions of the Metropolitan District railway, the St. Paul's station and bridge of the London, Chatham and Dover railway, the Barry docks of the Barry Railway company near Cardiff, the lock entrance, dock and graving dock at Immingham, Grimsby, the extensions of the Surrey Commercial docks on the Thames, the Tower and new Kew bridges over the Thames. On the completion of the Tower bridge, in 1894, he was made a commander of the Bath, becoming knight commander of the Bath three years later. Wolfe-Barry served on a number of important royal commissions, notably on that on London traffic (1903–05), and was one of the two British representatives on the International Suez commission (1892–1906). He led in promoting (1901–02) the engineering standards committee for the standardization of certain engineering projects. He died at Chelsea on Jan. 29, 1918.

BARRY, JAMES (1741–1806), British painter and Royal academician whose career was marked by violent altercation with his contemporaries, was born at Cork, Ire., on Oct. 11, 1741. He was self-taught, and his work attracted the notice of Edmund Burke, who introduced him to Sir Joshua Reynolds and James ("Athenian") Stuart, whose architectural drawings he copied in oil. At Burke's expense Barry studied in Italy (1766–70) and returning to London in 1771, exhibited "Adam and Eve" (National gallery, Dublin), a painting correct in draftsmanship but deficient in colour and grace. He became an associate of the Royal Academy in 1772 and a full academician in 1773, continuing to exhibit at the academy until angered by the cool reception accorded his "Death of General Wolfe" in 1776, a painting aimed against Benjamin West's treatment of the same subject in contemporary dress in 1771. During 1777–83 Barry completed his monumental decorative scheme for the Great room of the Society of Arts, on the theme "The Progress of Human Culture." These classical history pieces were engraved and are, in their magnitude, unique in British 18th-century painting. Appointed professor of painting at the academy in 1782, Barry, embittered by neglect, violently attacked his colleagues and in 1799 was expelled from the Royal Academy. He died in London on Feb. 22, 1806.

See E. Fryer, *The Works of James Barry, Historical Painter, edited with a Memoir*, 2 vol. (1809). (D. L. Fr.)

BARRY, JOHN (*c.* 1745–1803), U.S. naval officer who won important naval engagements in the American Revolutionary War, was born in County Wexford, Ire., and bred to the sea. At the age of 21 he was a merchant shipmaster out of Philadelphia, and, at the outbreak of the American Revolution, he outfitted the first Continental fleet in the fall of 1775. Commissioned captain of the Continental brig "Lexington," on March 14, 1776, he early distinguished himself by capturing, after a sharp engagement, the British tender "Edward," the first prize brought into the port of Philadelphia. When Howe's army advanced across New Jersey, threatening Philadelphia in Dec. 1776, Barry volunteered as aide-de-camp to General John Cadwalader, commanding a Philadelphia brigade, and saw action at the second battle of Trenton, or Assunpink Creek, and at Princeton. Meanwhile, congress had ranked him as seventh captain on the seniority list, and commissioned him to the frigate "Effingham." Before she was ready for sea, in Sept. 1777, Howe's advance from Brandywine forced Barry to take the unfinished frigate up the Delaware, where he scuttled and sank her by orders of General George Washington. In the winter of 1777–78, Barry commanded a spectacular boat foray, which ran the British batteries at Philadelphia, and raided enemy shipping in Delaware river and bay. Ordered to Boston to command the frig-

ate "Raleigh," he was unfortunate in being sighted by a superior enemy force shortly after he put to sea in Sept. 1778. Chased for 48 hours, he was finally cornered off Wooden Ball Island, near the mouth of the Penobscot, where he fought a gallant but futile action against a British 64-gun ship and a frigate, and actually managed to get about one-third of his crew ashore in safety. In the fall of 1780, Barry was placed in command of the frigate "Alliance," his first assignment being to convey Col. John Laurens on a diplomatic mission to France. This he accomplished, taking several prizes on the way, and, on his return, had a spectacular engagement with two British sloops of war, which attacked him, by means of sweeps, while the "Alliance" lay becalmed off Newfoundland. Barry was wounded and the "Alliance" badly mauled when a slight breeze arose, and he turned the tables on his opponents by bringing his guns to bear and quickly subduing both of them. His second voyage to France was to take the Marquis de Lafayette home after Yorktown. On the final cruise of the "Alliance," beginning in Aug. 1782, Barry ranged the shipping lanes from Bermuda to Cape Sable, was caught in the fringe of a hurricane which had wrecked the British fleet homeward bound from Jamaica, and took four ships of the fleet, as well as a half-dozen other prizes. He put into Lorient to refit, and was delayed by a mutiny among his officers. Sailing just in advance of the completion of the peace negotiations, Barry touched at Martinique and Havana on his homeward voyage, picked up a bullion shipment at the latter port, and, in the Gulf of Florida fought the last engagement of the Revolutionary War, on March 10, 1783. Three British frigates sought to intercept him and he beat them off, badly damaging the frigate "Sybil." After a voyage to Canton in the China trade, Barry retired from the sea, but was recalled to active service as senior captain of the new U.S. navy, on June 4, 1794, and superintended the construction of the frigate "United States," which he commanded thereafter. In the quasi-war with France he twice was in command of all U.S. ships in the West Indies, and took a number of French privateers. In 1799–1800, he carried two of the U.S. commissioners sent by John Adams to try to arrange a peaceful settlement of the differences with France. He landed them at Corunna after a stormy passage. Retained on the list of captains after Pres. Thomas Jefferson's naval reduction of 1801, Barry was too ill to respond to a request that he command a squadron intended for the Mediterranean in 1802 to deal with the Barbary powers. However, his success in training young officers—Stephen Decatur (1779–1820), Richard Somers, Charles Stewart, Jacob Jones, John Trippe, etc., who later became celebrated in U.S. naval history—had already gained him the courtesy title, "Father of our Navy." The entire nation mourned his death in Philadelphia, on Sept. 13, 1803.

See M. J. Griffin, *The History of Commodore John Barry* (1897); and William Bell Clark, *Gallant John Barry* (1938). (W. B. Cr.)

BARRY, PHILIP (1896–1949), U.S. dramatist, was best known for comedies of life and manners among the socially privileged. Born in Rochester, N.Y., on June 18, 1896, Barry was educated at Yale university. After graduation in 1919 he entered George Pierce Baker's Workshop 47 at Harvard university. His play, *A Punch for Judy,* was produced by the workshop in 1920; *You and I*, also written as a student, won the Herndon prize, and played 170 performances on Broadway in 1923. Over the next 20 years a succession of plays included such comedies as *Paris Bound* (1927), *Holiday* (1929), *The Animal Kingdom* (1932), and *The Philadelphia Story* (1939), which ran for 417 New York performances. They are characterized by witty and graceful dialogue and humorous contrasts of character or situation; many of them use a triangle theme or conflicts between the generations to point up with almost tender satire various truths about human nature. In *White Wings* (1926), a fantasy considered by some critics Barry's best play; *John* (1927), a drama about John the Baptist; *Hotel Universe* (1930), a penetrating psychological study; and *Here Come the Clowns* (1938), an allegory of good and evil, Barry's thoughtful and even sad approach to life is apparent. Many critics felt that his final play, *Second Threshold* (1951), revised by Robert E. Sherwood after Barry's sudden death in New York city on Dec. 3, 1949, combined the two facets of his genius, his flair for social comedy and his preoccupation with more serious drama.

BARRY (Y Barri), a municipal borough in the Barry parliamentary division of Glamorganshire, Wales, 15 mi. S.S.W. from Cardiff on the Bristol channel. Pop. (1961) 42,039. A small brook named Barri runs there into the sea, whence the place was formerly known in Welsh as Aber-Barri; but the name of both the river and the island is supposed to be derived from Baruch, a Welsh saint of the 7th century, who had a cell on the island. His chapel, which still existed in Leland's time, was a place of pilgrimage in the middle ages. One of the followers of Robert Fitzhamon, about the end of the 11th century, built a castle at Barry, of which only a gateway remains.

Barry comprises the ecclesiastical parishes of Barry, Cadoxton, Merthyr Dyfan and a portion of Sully in which is included Barry Island (194 ac.), now, however, artificially joined to the mainland. The total population of this area in 1881 was 478, that of Barry village being only 85. The town's growth was entirely brought about by coal exporting during the last quarter of the 19th century. The great demand for steam coal at that time gave opportunities for a number of colliery owners, especially David Davies (1818–90), to secure an alternative port to Cardiff, with an independent railway to it from the coal fields. After failing in 1883, they obtained parliamentary powers for this purpose in 1884, and the first sod of the new dock at Barry was cut in November of that year. The dock was opened in 1889 and a second dock in 1898. In 1921 Barry docks were taken over by the Great Western railway and are now administered by the Cardiff Port authority. They are 114 ac. in extent, and have accommodation for the largest vessels afloat. Imports include timber, grain, sand, oil and general cargo; the chief export is coal and others are cement, flour, steel products, etc. At the docks are flour mills, timber ponds and oil storage tanks.

After 1918, in particular, Barry, together with Barry Island with its sandy beaches, lying immediately west of the docks, became a favourite seaside holiday place. Barry was incorporated in 1939. At Rhoose, a little to the west, is an airfield with service to Dublin. The Bulwarks, a prehistoric camp by the sea, is nearby.

BARRYMORE, the name of a distinguished U.S. theatrical family. Ethel Barrymore (1879–1959), noted for distinctive style, voice and wit, was born in Philadelphia, Pa., Aug. 15, 1879. Her father was Maurice Barrymore (1848–1905), actor and playwright, who changed the family name from Blythe to Barrymore. Her mother was the actress Georgiana Drew Barrymore, daughter of Louisa Lane Drew (Mrs. John Drew, Sr.), who managed the Arch Street theatre in Philadelphia and starred with Joseph Jefferson. Her uncles were John and Sidney Drew. (*See* also Drew [Family].)

Miss Barrymore and her brothers, John and Lionel, originally sought careers away from the theatre, Ethel as a pianist, John as an artist, Lionel as an artist and composer, but all three eventually turned to acting. Miss Barrymore made her professional debut in 1894 in Montreal in a company headed by her grandmother and Mr. and Mrs. Sidney Drew. For three years she understudied and played walk-on parts on Broadway and in touring companies headed by John Drew, then went to London in *Secret Service* with William Gillette. In 1897 and 1898 she scored a London success with Sir Henry Irving in *The Bells* and *Peter the Great*. She played in *Rosemary* with John Drew and Maude Adams in 1896 and was starred for the first time on Broadway in 1901 by Charles Frohman in *Captain Jinks of the Horse Marines*.

Miss Barrymore's notable plays include: *Alice-Sit-by-the Fire* (1905), *Mid-Channel* (1910), *Trelawney of the Wells* (1911), *Déclassée* (1919), *The Second Mrs. Tanqueray* (1924), *The Constant Wife* (1928), *The Kingdom of God* (1928), *Scarlet Sister Mary* (1931), *Whiteoaks* (1938) and *The Corn is Green* (1942). In 1928 she opened the Ethel Barrymore theatre, named in her honour, with *The Kingdom of God*.

She also appeared in vaudeville, on radio and on television and made a number of motion pictures. Her first film was *The Nightingale* in 1914; the most noteworthy were *Rasputin and the Empress* (1932) and *None but the Lonely Heart* (1944). *Rasputin* was the only work in which she appeared with her brothers.

She was married to Russell Griswold Colt in 1909 and divorced in 1920. Her children were Samuel Pomeroy Colt, John Drew Colt and Ethel B. Colt (Mrs. Romeo Miglietta). She died in Hollywood, Calif., June 18, 1959.

LIONEL BARRYMORE (1878–1954), noted on stage for such plays as *Peter Ibbetson* (1917), *The Copperhead* (1918) and *The Jest* (1919), was born April 28, 1878, in Philadelphia, and died Nov. 15, 1954. He became a motion-picture and radio actor and is perhaps best remembered for his *Dr. Kildare* series and his radio performances in Dickens' *A Christmas Carol*. Arthritis forced him to spend his last years in a wheel chair.

JOHN BARRYMORE (1882–1942), stage and film actor, called the "great profile," was born in Philadelphia on Feb. 15, 1882. He appeared on Broadway in *The Jest* (1919), *Richard III* (1920) and set a record with *Hamlet* in 1923. He died May 29, 1942.

BIBLIOGRAPHY.—Ethel Barrymore, *Memories* (1955); Gene Fowler, *Good Night, Sweet Prince*, biography of John Barrymore (1944); Lionel Barrymore and Cameron Shipp, *We Barrymores* (1951).
(C. S.)

BAR-SALIBI, JACOB (d. 1171), who took the name Dionysius at his episcopal consecration, was a voluminous writer in Syriac, the most outstanding in the Jacobite (Monophysite) church in the 12th century. A native of Melitene (Malatya), he was made bishop of Marash in 1154, and a year later of Mabbog also. In 1166 he was transferred to the metropolitan see of Amid (Diarbekr), where he remained until his death on Nov. 2, 1171. The lengthy list of his works includes poems, prayers, homilies, liturgies, a commentary on the six *Centuries* of Evagrius with the text translated into Syriac, a treatise against heresies, expositions of the Syrian Eucharistic service and doctrine and commentaries on the Old and New Testaments. The Old Testament commentary, a compilation rather than an original composition, gives a material or literal exposition and a spiritual or mystical exposition of the deeper meaning. For the Wisdom books and some others there are commentaries on both the Peshitta and Hexaplar texts. The New Testament commentary, less developed except in the Gospels, also deals with the text at two levels.

See A. Baumstark, *Geschichte der syrischen Literatur*, pp. 295–298 (1922). (W. D. McH.)

BAR SAUMA, RABBAN (*c.* 1220–1294), Nestorian ecclesiastic and traveler, whose diary is an important historical source, was born in Peking *c.* 1220 of a Christian family of Uighur descent. After spending several years in a monastery in China, Bar Sauma started with his disciple Marcus on a pilgrimage to Jerusalem, but on reaching Armenia they were persuaded to abandon their journey and both accepted ecclesiastical appointments.

In 1287 Bar Sauma agreed to go to Europe as the ambassador of Arghun, the Mongol ilkhan of Persia. His task was to obtain support for a war against the Muslims in Syria and Palestine. It seems he had instructions also from the patriarch Jaballaha III (his former pupil Marcus). In Constantinople Bar Sauma was received by the emperor Andronicus II Palaeologus. In Rome, where the papal throne was vacant, he had conversations with some of the cardinals, who examined his faith. But Bar Sauma made it clear that he did not wish to be drawn into theological discussion. He went on to Paris where he was given a friendly welcome by the French king Philip IV, and in Gascony he visited Edward I, the king of England. The plea of Arghun was favourably received by both kings, but no practical agreement was reached. Returning through Rome, Bar Sauma received presents and letters for the ilkhan and the patriarch from the newly elected pope Nicholas IV. In Persia he was appointed chaplain to the royal court. Later he retired to Maragheh in Azerbaijan, where he died in 1294.

During his travels Bar Sauma, an intelligent observer, kept a diary in Persian. This was used by the anonymous compiler of a history of Bar Sauma and Jaballaha, written in Syriac (Eng. trans. by E. A. Budge, *The Monks of Kublai Khan*, 1928). (G. V. F.)

BART, JEAN (1650–1702), French privateer and naval officer, renowned for his achievements in Louis XIV's wars, was born at Dunkerque on Oct. 21, 1650, of a family with a long tradition of privateering. His personality and his career were bound up with his birthplace, but not limited by it, and he won not only local but national fame. Dunkerque is a port advantageously situated on the trade routes of the English channel and the North sea and well-defended by sandbanks, reefs and shoals, and Bart was a successor of the *capres* whose profession was privateering, who knew every detail of the coast and who thought nothing of enemy blockades. His first experience of war was under the Dutch admiral M. A. de Ruyter, but he returned to Dunkerque when the Dutch War of 1672–78 broke out. In command of small privateering vessels he fought six battles and took 81 prizes, and was made lieutenant by Louis XIV as a reward.

The War of the Grand Alliance (1687–97) started badly for Bart. After a terrible fight the "Railleuse" and "Les Jeux," commanded by Claude de Forbin, were crushed by superior English vessels. Taken prisoner, Bart escaped from Plymouth with Forbin and rowed for 52 hours until he reached the French coast. Promoted captain, he commanded the "Alcyon" at the battle of Beachy Head (1690) and afterward a division at Dunkerque. He stood high in the esteem of the king and occasionally went to Versailles. Fair-haired, tall and awkward, but proud and with a great deal of common sense, he was not the ignorant lout portrayed in the sarcastic writings of his colleague Forbin and the courtiers.

Bart was Vauban's adviser when he fortified Dunkerque and its defender during the English attacks of 1694 and 1695. In June 1694, when France was threatened by famine, he gave battle to a Dutch squadron off the Texel, boarded and took the enemy flagship and so recovered from the enemy a convoy of 96 ships of wheat from Russia and Poland which he succeeded in bringing almost intact to Dunkerque and Le Havre. The king then made him a member of the nobility, as the combat had been "*très glorieux pour lui, très utile à l'état*" ("of great glory to him, of great service to the state").

In the spring of 1696 Bart surprised a large merchant fleet near the Dogger bank, but was in his turn surprised by a strong squadron. He set fire to his prizes and proudly sailed off, weaving his way through the shoals among the English and Dutch ships. Given command of a squadron, he escorted the prince de Conti (François Louis de Bourbon), candidate for the Polish crown, to Gdánsk (Danzig) in 1697, passing six frigates through a tight blockade. By the end of the war his division had destroyed 30 warships and captured 130 merchant ships in addition to those taken in the battle of the Texel. Bart died suddenly on April 27, 1702. A sailor of astonishing skill and daring, he is still especially commemorated at Dunkerque. (L. NI.)

BARTAS, GUILLAUME DE SALLUSTE: *see* DU BARTAS, GUILLAUME DE SALLUSTE.

BARTENSTEIN, JOHANN CHRISTOPH, FREIHERR VON (1690–1767), Austrian statesman who was the trusted counselor of the emperor Charles VI and the empress Maria Theresa, was born at Strasbourg on Oct. 23, 1690, the son of a university professor. He studied philosophy and law at Strasbourg and in 1712 went to Paris to study history at the Benedictine monastery of St. Maur. In 1714 he moved to Vienna where he worked for a time as a tutor. In 1716, however, he entered the provincial administration of Lower Austria, having been first received into the Catholic Church. In 1725 he married into a noble Austrian family and in 1726 joined the imperial chancellery. In 1727 he became protocol secretary of the secret conference of the emperor's councilors on foreign affairs. In this position he was the creator of the political system based on the guarantee of the Pragmatic Sanction (*q.v.*) and his was the controlling hand in the negotiations resulting in the marriage of Maria Theresa to Francis Stephen of Lorraine. In 1733 Bartenstein became privy secretary of state and was created *freiherr* (baron).

During the troubled years that followed Charles VI's death (1740), Bartenstein was regarded by Maria Theresa as her most trusted adviser and in this capacity he vigorously opposed any concessions to Prussia. In 1753 he was obliged to hand over foreign affairs to W. A. von Kaunitz, becoming vice-director of the ministry of the interior and finance. Besides this he worked on the educational program and also as history tutor to Joseph II. He took part in the organization of the royal and state archives.

Bartenstein was an outstanding jurist who perhaps overesti-

mated the effectiveness and reliability of treaties in foreign affairs. He was an honest servant of the state and dynasty with a remarkable memory and a bureaucrat's efficiency. He left a large fortune on his death, in Vienna, on Aug. 6, 1767.

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BARTH, HEINRICH (1821–1865), a distinguished German geographer, historian and linguist and one of the greatest explorers of Africa of all time, was born at Hamburg on Feb. 16, 1821. He was educated in the classics at the University of Berlin and his earliest travels, 1845–47, were undertaken in the lands bordering the Mediterranean sea. The results were published in 1849 in a book entitled *Wanderungen durch die Küstenlanden des Mittelmeeres* (*Wanderings along the Punic and Cyrenaic Shores of the Mediterranean*). Barth was then a competent linguist in modern European languages, speaking German, French, Spanish, Italian and English together with Arabic which he had acquired for his first journey.

He was giving lectures at the University of Berlin in 1849 when it was suggested that he should join James Richardson, who had previously traveled in north Africa and the Sahara, in an expedition to the western Sudan which the British government had agreed to support. Contact between Barth and Richardson had been made through the Chevalier Bunsen, Prussian ambassador in London, and the German geographers Alexander von Humboldt and Karl Ritter. A second German, Adolf Overweg, a geologist and astronomer, also joined the expedition. Richardson was inspired by humanitarian and commercial motives; Barth and Overweg were interested in scientific exploration. They left Tripoli to cross the Sahara early in 1850. Richardson died a year later in Bornu and Barth assumed command of the expedition. He first of all explored the countries south and southeast of Lake Chad, discovering the upper reaches of the Benue at Yola. Overweg died in Sept. 1852 and Barth then began his great journey westward to reach Timbuktu in Sept. 1853. He remained there six months, returned to Bornu in Dec. 1854, reached Tripoli in August and London in Sept. 1855. His journeys, lasting more than five years, totaled over 10,000 mi. In spite of ill-health and the loss of his colleagues he persisted in his travels which ranged more widely than any previously in that part of Africa. He was the first European to return with an account of the middle section of the Niger, which had been traveled by Mungo Park but from whom no record had survived. In keeping records he was most assiduous and laid down his routes with great accuracy by dead reckoning, being unable to take astronomical observations.

Within a very short time after his return from Africa Barth published the results of his journeys in German and English in five great volumes—*Travels and Discoveries in North and Central Africa* (1857–58). They remain one of the most comprehensive works on the western Sudan, containing not only the day-to-day details of travels but an immense amount of detailed anthropological, historical and linguistic information. Barth's travels received little attention from the general public and thereafter he remained a relatively neglected explorer. In recognition of his work he was made a commander of the Bath and received a financial reward from the British government. He was awarded the patron's gold medal of the Royal Geographical society, was made a foreign associate and addressed the society in 1858.

He was made professor of geography at Berlin in 1863 and was president of the Berlin Geographical society. Following his return from Africa he continued to travel widely in Asia Minor (1858), Spain (1861), Turkey (1862), the Alps (1863), Italy (1864) and Turkey (1865). He died in Berlin on Nov. 25, 1865.

A two-volume edition of Barth's *Travels* was published in London in 1890. His great work *Collection of Vocabularies of Central African Languages* (1862–66) was not completed.

See G. von Schubert, *Heinrich Barth, der Bahnbrecher der deutschen Afrikaforschung* (1897) and H. Schiffers, *Der Grosse Reise* (1952). (R. M. P.)

BARTH, KARL (1886–), Swiss Protestant theologian, distinguished for the revolution he wrought in 20th-century Protestant theology by his uncompromising advocacy of the traditional Christian motifs of divine grace and freedom, was born in Basel, Switz., on May 10, 1886, the son of a pastor and professor of theology, Fritz Barth. He studied at Bern, Berlin, Tübingen and Marburg, where he was deeply influenced by the liberal theologian Wilhelm Herrmann. Subsequently he taught theology at the universities of Göttingen (1921), Münster (1925), Bonn (1930) and Basel (after 1935). After initial qualms about entering the ministry he served as Reformed Church pastor in Geneva (1909–11) and Safenwil, Switz. (1911–21).

During the period of his pastorate Barth's theological outlook changed drastically. World War I quickened his hope of a total reconstruction of society, away from militarism and the selfishness of early 20th-century industrial capitalism. It was a religious hope, for even at this early stage he had a strong conviction of divine predestination, not so much of individuals as of the social organism. By contrast, however, the theology of his university career was extremely individualistic. With Friedrich Schleiermacher (*q.v.*) and Herrmann he thought that the divine Spirit is directly present to the inner, spiritual man. This communion may be subjected to no external authority, not even that of the Bible. The interpretation of external events is necessarily left to secular scientific and historical understanding.

It was impossible to join this theological outlook to Barth's social convictions. Furthermore it did not contribute to his understanding of the task of the preacher who had to confront his communicants, in all the puzzlement of their lives, with the radical message of the Bible, which brings into question all human values, standards, philosophies and certainties. It seemed to Barth that by means of this radical challenge the Bible exacerbates the puzzlement in the human condition to the point of unbearable tension and at the same time shows this total crisis forth as divine judgment on man's sin. And yet, mysteriously, inexplicably or—as Barth would have it at that time—paradoxically, this divine judgment is the reverse side or veil of an equally radical, affirmative and sin-forgiving divine grace.

Barth's revolutionary break with theological liberalism, which became epoch-making for Protestant theology as a whole, is embodied in the second edition of *Der Römerbrief* ("Commentary on Romans," 1922). It marks the beginning of what is usually referred to as dialectical or crisis theology. Barth, influenced by Sören Kierkegaard (*q.v.*) among others, stressed the severe indirectness and startling novelty of the divine-human relation. Christ is neither an experienceable fact in the inner life nor an object of cultural and religious reflection. God, who is manifest in Christ, is the unapprehended, creative source of all being and knowledge from whom we are estranged. Truly to know Him is rather to be known by Him and to abide willingly in the distance of faith from Him. This death-bound universe, at its points of origin and limitation or crisis, is related radically to the transcendent source of all life. The great paradox that both symbolizes and consummates this relation is the death and resurrection of Christ, touching time decisively.

The second edition of *Der Römerbrief* coincided with the beginning of Barth's academic teaching career, which forced him to exchange the oracular and critical for a systematic and constructive mode of thought. After 1927 he broke with Kierkegaard and Existentialism. Thereafter he was engaged, in his monumental *Kirchliche Dogmatik* (1932–), in developing a dogmatic theology based solely on the incarnate Word of God as the concrete reality and norm underlying and enabling all finite being and knowing. In Jesus Christ the Triune God, the bestower of faith, becomes an object for human apprehension. Christ, who is both the electing God and the man elect from eternity, is the coincidence of divine judgment and mercy, since He, the elect, has taken God's rejection of sinful humanity on Himself. Thus man's predestination is an act of divine graciousness taking place in Jesus Christ. Barth affirms that all created life, cultural and political reality are founded on Christ. This affirmative attitude toward creation he combines with an equally decisive rejection of every

theological endeavour to understand creation apart from Christology. On this issue he has been in intense debate with the Existentialist theologian Rudolf Bultmann (*q.v.*) and with Roman Catholic natural theology.

After his break with liberalism Barth consistently stressed the concrete reality and the sovereign freedom of God. Both are set forth wholly and exclusively in the man Jesus of Nazareth in whom God is "God-for-us." But in the days of *Der Römerbrief* Barth saw the radical "No" toward creation of the same sovereign, free grace that later, in the *Kirchliche Dogmatik*, he came to see as the foundation of God's covenant with men and the supreme "Yes" to all creation. Barth's critics say that this radical affirmativeness is bought at the price of the relative independence and spontaneity of the creature, that it amounts to a false identification of Jesus Christ with all reality, and that this identification in turn rests on many unexamined philosophical presuppositions.

During the Nazi period in Germany Barth was one of the chief leaders of resistance to the Nazification of the church. This stand broadened later into a theological decision to resist Nazism as a political system. The Hitler government deprived him of his post in Bonn in 1935. After the war Barth denied the necessity for a similar theological decision against Communism, although he rejected it as a political system.

Some of Barth's major works include *Das Wort Gottes und die Theologie* (1924), Eng. trans., *The Word of God and the Word of Man* (1928); *Fides quaerens intellectum: Anselms Beweis der Existenz Gottes*, 2nd ed. (1958), Eng. trans., *Anselm: Fides Quaerens Intellectum* (1960); *The Epistle to the Romans*, Eng. trans. of the 6th ed. of *Der Römerbrief* (1933); *Church Dogmatics*, Eng. trans. of *Die Kirchliche Dogmatik* (1936, 1955–); *Against the Stream* (1954); *Christ and Adam* (1957). *See* also NEO-ORTHODOXY.

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(H. W. FR.)

BARTH, PAUL (1858–1922), German philosopher and sociologist, considered society as an organization, in which progress is determined by the power of ideas. He was born Aug. 1, 1858, in Baruth in Silesia. He was professor of philosophy and education in Leipzig from 1897. Barth's *Philosophy of History of Hegel and the Hegelians* (1896) and his broad *Philosophy of History of Sociology* (1897) were outstanding works. He developed for the first time in German not only a history of the various sociological systems but also, in his critique of Hegel, the different philosophic systems of history (anthropological, political, individualist, collectivist and ideological).

Barth edited the *Quarterly of Scientific Philosophy* from 1899 until 1916. His *Elements of Education and Teaching Based on Psychology and Philosophy* (1906; trans. into Italian, Spanish and Russian) was concerned chiefly with moral education and was designed to replace the old textbooks based on Johann Herbart's philosophy. Barth also wrote *History of Education in the Light of Sociology and History of Ideas* (1911) and *The Necessity of a Systematic Moral Teaching* (1922). He died in Leipzig on Sept. 30, 1922.

BARTHÉLEMY, JEAN JACQUES (1716–1795), French scholar, writer and numismatist, author of *Voyage du jeune Anacharsis en Grèce*, one of the most widely read books in 19th-century France, was born at Cassis, Provence, Jan. 20, 1716. He studied theology with the Jesuits and became an *abbé*. Of a gentle and scholarly disposition, he found the life congenial but, lacking a vocation, renounced it at the age of 29 and set off for Paris. In 1744 he became assistant to the keeper of the royal collection of medals, succeeding him in 1753. In 1755 he accompanied the French ambassador, the comte de Stainville (later duc de Choiseul), to Italy, where he spent three years in archaeological research. Choiseul and his wife had a great regard for him and after his return to France helped him obtain valuable preferments. He wrote a number of learned antiquarian works, but his fame rests on *Voyage du jeune Anacharsis en Grèce, vers le milieu du quatrième siècle avant l'ère chrétienne* (1788: Eng. trans. 1794), which he began in 1757. The hero is a young Scythian who goes to Greece for instruction and returns to his native country where, in his old age, he describes his experiences. This loose plan enabled Barthélemy to use his wealth of learning to describe the laws, government, religion, philosophy, art and antiquities of ancient Greece. A long introduction records early Greek history and there are dissertations on Greek music, Athenian literature and the life and society of the surrounding states. Barthélemy's well-documented and well-written introduction to Hellenic culture rekindled interest in Greece and provided suitable reading for generations of French schoolchildren. He was elected to the Académie Française in Aug. 1789. Arrested in 1793, he spent 16 hours in prison but was released on orders from the Convention. He died April 30, 1795, in Paris.

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(R. NI.)

BARTHÉLEMY SAINT-HILAIRE, JULES (1805–1895), French philosopher and statesman, was born in Paris on Aug. 19, 1805. After working at the finance ministry (1825–28) he became a journalist. For signing the journalists' protest on July 28, 1830, he was imprisoned for a few days until the overthrow of Charles X. Under Louis Philippe he continued his journalism and was one of the founders of *Le Bon Sens*. His main interests, however, were philosophy, languages, history, sociology and political economy. In 1832 he began a monumental translation of Aristotle, published in 35 volumes (1833–95).

Barthélemy Saint-Hilaire became professor of ancient philosophy at the Collège de France in 1838 and a member of the Académie des Sciences Morales et Politiques in 1839. After the revolution of 1848 he was elected deputy for Seine-et-Oise, but withdrew after the *coup d'état* of Dec. 1851. To supplement his academic pension he worked as a woodcutter near Meaux till he obtained a post on *Le Journal des savants*. Accompanying Ferdinand de Lesseps to Egypt in 1855, he was appointed secretary of the company being formed to construct the Suez canal, but resigned in 1858. He described his journey in *Lettres sur l'Egypte* (1856).

Re-elected deputy for Seine-et-Oise in 1869, Barthélemy Saint-Hilaire sat with the moderates in opposition to Napoleon III. In Feb. 1871 he was among those who proposed that Adolphe Thiers become head of the executive power and was appointed his unpaid secretary. A senator for life in 1875, he became vice-president of the senate (1880) and minister of foreign affairs under Jules Ferry (1880–81). He died in Paris on Nov. 24, 1895.

In addition to his Aristotle and several studies of oriental religions, Barthélemy Saint-Hilaire published a translation of Marcus Aurelius (1876), *Fragments pour l'histoire de la diplomatie française 1880–81* (1882), *L'Inde anglaise, son état actuel, son avenir* (1887), *Étude sur François Bacon* (1890) and *Victor Cousin, sa vie et sa correspondance*, 3 vol. (1895).

BARTHOLDI, FRÉDÉRIC AUGUSTE (1834–1904), French sculptor, creator of the famous statue of "Liberty Enlightening the World" in New York harbour, was a native of Colmar in Alsace where he was born on April 2, 1834. Bartholdi created various works connected with America. Apparently of a somewhat commonplace imagination, the artist surpassed himself in the "Lion of Belfort" (in Belfort, France), his masterpiece, which may be regarded as the best of a number of patriotic sculptures inspired by the French defeat of 1870–71. He died in Paris on Oct. 4, 1904. *See* LIBERTY, STATUE OF.
(A. K. MCC.)

BARTHOLIN, the name of a distinguished Scandinavian family, whose members achieved renown in medicine, science and the humanities during the 17th and 18th centuries (*see* Table).

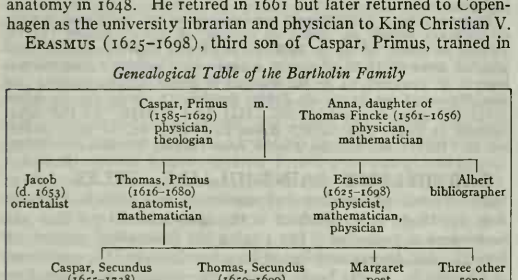
CASPAR, Primus (Gaspard Bartholinus) (1585–1629), the first

noted member of the line, was born in Malmö, Swed. He studied philosophy at Basel, Greek at Montpellier and anatomy at Naples and Padua; at the University of Padua he was a student of Fabricius ab Aquapendente. He took his medical degree in 1610, and from 1613 to 1624 served as professor of medicine in Copenhagen. After a serious illness he devoted himself to the study of divinity, became canon of Roskilde and professor of theology at Copenhagen, a position he held until his death at Sorö in Zeeland.

THOMAS, Primus (1616–1680), Caspar's second son, was born in Copenhagen and died in Hagested, Den. Associated with the Dutch school of anatomists, he was the first to give a full description of the entire lymphatic system, including the thoracic duct, in man. He also wrote in support of William Harvey's theory of blood circulation. His *Bartholinus Anatomy* was published in London in 1668. Thomas, Primus, was professor of mathematics in Copenhagen for two years before he assumed the chair of anatomy in 1648. He retired in 1661 but later returned to Copenhagen as the university librarian and physician to King Christian V.

ERASMUS (1625–1698), third son of Caspar, Primus, trained in

Genealogical Table of the Bartholin Family



medicine, is known chiefly for his mathematical studies, observations on snow crystals and discovery of double refraction.

CASPAR, Secundus (1655–1738), the eldest son of Thomas, Primus, was born in Copenhagen and studied anatomy in Holland under Frederik Ruysch and Jan Swammerdam and in Paris under G. J. Duverney. Stimulated by Duverney's discovery of the vulvovaginal glands in the cow, Caspar, Secundus, described these structures (the Bartholin glands) in the human as the source of the fluid that issues from the woman's genitals under sexual stimulation (*De ovariis mulierum et generationis historia* [Rome, 1677]). Bartholin's name is also associated eponymically with a duct of the sublingual salivary gland. He devoted his later years to politics, and in 1731 was elevated to the nobility. (HD. ST.)

BARTHOLOMAEUS ANGLICUS (BARTHOLOMEW THE ENGLISHMAN) (fl. *c.* 1220–1240), Franciscan encyclopaedist, was born in England. He has occasionally been confused with a later English Franciscan, Bartholomew de Glanville, who was active about 1360. Bartholomew the Englishman became a professor of divinity at the University of Paris and about 1225 joined the recently founded Franciscan order. In 1231 he went to Magdeburg in Saxony on business connected with his order.

Bartholomew was famous for centuries after his death as the compiler of a very well-known and highly esteemed encyclopaedia, *De proprietatibus rerum* ("On the Properties of Things"). Though primarily interested in scripture and theology, he included all the customary knowledge of his time; and, in addition, was the first writer to make conveniently available the views of Greek, Jewish and Arabic scholars on medical and scientific subjects. The immense popularity of this pioneer work is shown by the very large number of manuscript copies of it to be found in European libraries and by the fact that it was regularly hired out to scholars at the University of Paris. There were 14 printed editions of the work even before 1500. It was translated into English by John of Trevisa and printed by Wynkyn de Worde about 1495, and it also appeared in other vernaculars. Very popular reading in Tudor England, it had much influence on English thought and writing in the 16th century. (E. MCD.)

BARTHOLOMÉ, PAUL ALBERT (1848–1928), French sculptor whose works, particularly his funerary art, made him one of the best known of modern French sculptors, was born at Thiverval, near Paris, on Aug. 29, 1848. He began his career as a painter and did not turn to sculpture until 1886. He had no formal training, but he made a careful study of nature and the masterpieces of the past. His reputation was established with the "Monument aux Morts" (1895) which was set up in the Père Lachaise cemetery, Paris. It is a piece of architectural sculpture on a grandiose scale with a number of mourning figures in differing postures of grief, and decidedly non-Christian in feeling, though destined for a Christian cemetery. This success led to a number of funerary monuments. In his later period he tended toward a somewhat Rodinlike impressionistic sculpture. There was a great deal of modulated chiaroscuro and pictorial quality in his many feminine nudes. He died in Paris on Oct. 31, 1928. (A. K. MCC.)

BARTHOLOMEW, SAINT, one of the 12 Apostles, mentioned only in the four Apostle lists (Mark iii, 18; Matt. x, 3; Luke vi, 14; Acts i, 13), always in the second of the three groups of four names. Nothing more is known about him from the New Testament. The name is an Aramaic patronymic, meaning "son (*bar*) of Tolmai" or "Talmai," so that he may have had another personal name. Because it is such a name, and because he was always associated with Philip in the Gospel lists, a 9th-century tradition identified him with Nathanael (*q.v.*), whose call with that of Philip is recounted in John i, 43–51. This identification sought to explain how Bartholomew, an otherwise unknown personage, could be mentioned as one of the Twelve, while Nathanael, whose call is explicitly described by John, does not figure in the lists. His full name would then be Nathanael bar Tolmai.

Eusebius in his *Church History* relates that when Pantaenus of Alexandria visited India in the 2nd century he found the Hebrew "Gospel According to Matthew," which had been left behind by Bartholomew. His missionary activity is recorded also for Ethiopia, Mesopotamia, Parthia, Lycaonia and Greater Armenia. He is traditionally said to have been martyred (either flayed alive, beheaded or crucified) at Albanopolis or Urbanopolis in Armenia at the command of King Astyages after the conversion of King Polymios. His relics are said to have been transferred ultimately to the Roman Church of St. Bartholomew on an island in the Tiber. His feast is now celebrated in the Latin Church on Aug. 24, in the Greek Church on June 11; it varies in other Eastern rite churches. *See* also APOSTLE. (J. A. FL.)

BARTHOLOMEW, a family of Scottish cartographers. JOHN BARTHOLOMEW (1831–1893) was born in Edinburgh, the son of a map publisher. He was for some time assistant to the German geographer, August Petermann, until in 1856 he took up the management of his father's firm. Among his numerous publications were the series of maps of Great Britain reduced from the ordnance survey to scales of ½ in. and ¼ in. to 1 mi. Relief was shown on these maps by contours and systematic layer colouring, a method introduced into British cartography by his son JOHN GEORGE BARTHOLOMEW (1860–1920). He produced survey atlases of Scotland (1895) and England and Wales (1903), and initiated a great physical atlas of which, however, only two volumes were published, the *Atlas of Meteorology* (1899) and the *Atlas of Zoogeography* (1911). He also began compiling *The Times Survey Atlas of the World,* the best British atlas of its period, published in 1922 by his son JOHN BARTHOLOMEW (1890–1962). The firm has published in numerous editions reference and educational atlases and many maps in its distinctive style. John Bartholomew edited the new *The Times Atlas of the World* (1955, etc.). (G. R. CE.)

BARTHOU, JEAN LOUIS (1862–1934), French Conservative statesman and man of letters, was born at Oloron-Sainte-Marie on Aug. 25, 1862. He practised as a lawyer in Pau and in 1889 was elected deputy. He became minister of public works in Charles Dupuy's cabinet (1894), in which Raymond Poincaré also made his debut. Minister of the interior in F. J. Méline's cabinet (1896), he returned to the ministry of public works in 1906 under Ferdinand Sarrien, to remain there under Clemenceau. As prime minister from March to Dec. 1913, Barthou secured, against the opposition of the left, the passing on July 19, 1913, of the three years' service bill. He was minister of state in Paul Painlevé's cabinet (1917), minister of war under Aristide Briand

(1921) and minister of justice under Poincaré (1922). In 1922, moreover, he represented France at the Genoa conference, entered the senate and was appointed chairman of the reparations commission. In July 1926 he came back to the ministry of justice in another Poincaré cabinet. Foreign minister in the coalition ministry presided over by Gaston Doumergue (1934), he visited Warsaw, Prague, Bucharest and Belgrade, to discuss plans for an eastern pact. On Oct. 9 of the same year, he was assassinated in Marseilles together with King Alexander of Yugoslavia. A shrewd politician and a first-class debater, Barthou was also a great booklover. He was elected to the Académie Française in 1918. Among his many books were *Mirabeau* (1913); *Les Amours d'un poète* (1919), on Victor Hugo; *La Politique* (1923); and *Promenade autour de ma vie* (1933). (J. C. DE C.)

BARTLESVILLE, a city of northeast Oklahoma, U.S., the seat of Washington county, is on the Caney river, 18 mi. from the Kansas state line. It grew from a settlement started in the late 1870s near a trading post operated by Jacob Bartles. Oklahoma's first commercial oil well was drilled at Bartlesville in 1897, the year of the city's incorporation.

Oil contributed most to the city's growth. It is the home of Phillips Petroleum, Cities Service and National Zinc companies and many smaller industries. The 19-story Price Tower, designed by Frank Lloyd Wright and dedicated in 1956, is the city's most distinctive building. Woolaroc museum, established by oilman Frank Phillips and housing a collection including more than 50,000 regional items, is 11 mi. west of Bartlesville.

Bartlesville has had a council-manager form of government since 1927. For comparative population figures *see* table in OKLAHOMA: *Population.* (W. A. SE.)

BARTLETT, JOHN (1820–1905), is best known for his *Familiar Quotations* (1855), which went through nine editions in his lifetime and appeared in a 13th (centennial) edition in 1955. He was born in Plymouth, Mass., on June 14, 1820, and at the age of 16 became an employee in Cambridge, Mass., at the university bookstore, where he became so versed in book knowledge that the advice "Ask John Bartlett" became common on the Harvard campus. Eventually owning the store, he published the first edition of his *Familiar Quotations,* based largely on the notebook which he kept for the benefit of his customers. Later editions, greatly expanded, were published from the fourth on by Little, Brown and Company, Boston, which Bartlett joined in 1863. Bartlett also wrote books on chess and angling, and, after many years of labour, a *Complete Concordance to Shakespeare's Dramatic Works and Poems* (1894), a standard reference work which surpassed any of its predecessors in the number and fullness of its citations. He died at Cambridge, Mass., on Dec. 3, 1905.

See J. D. Marshall, "John Bartlett and His Quotation Book," *Wilson Library Bulletin,* 30:250–252 (Nov. 1955).

BARTLETT, JOHN RUSSELL (1805–1886), U.S. bibliographer, made his greatest contribution to linguistics with his pioneer work, *Dictionary of Americanisms: a Glossary of Words and Phrases Usually Regarded as Peculiar to the United States* (1848). It went through four editions, and was translated into Dutch and German. He was born at Providence, R.I., on Oct. 23, 1805. Appointed commissioner for the survey of the boundary between the United States and Mexico in 1850–53, he wrote as a result *A Personal Narrative of Explorations and Incidents in Texas, New Mexico, California, Sonora and Chihuahua* (2 vol., 1854). As secretary of state of Rhode Island, he rearranged and classified the state records, and prepared bibliographies and compilations on state history. Bartlett assisted John Carter Brown in acquiring and cataloguing his noted book collection, now in the John Carter Brown library on the campus of Brown university (Providence, R.I.).

He died in Providence, on May 28, 1886.

BARTLETT, PAUL WAYLAND (1865–1925), U.S. sculptor, whose animal, historical and symbolic subjects were done in the French romantic tradition, was born in New Haven, Conn., on Jan. 24, 1865. When 15, he began to study at Paris under Emmanuel Frémiet, modeling animals. He won a medal at the Paris salon of 1887. The greater part of his life was spent in France. Among his early works are: "The Bear Tamer," in the Metropolitan museum, New York; the equestrian statue of Lafayette, in Paris; and the equestrian statue of George B. McClellan in Philadelphia. Of his later works the most notable is the group in the pediment over the house wing of the Capitol, Washington, D.C. He was made a commander of the Legion of Honour before his death in Paris on Sept. 20, 1925.

See Lorado Taft, *History of American Sculpture,* rev. ed. (1924). (A. T. G.)

BARTÓK, BÉLA (1881–1945), Hungarian composer, pianist and folklorist, one of the dominant and most original figures in music in the first half of the 20th century, was born at Nagyszentmiklós, Hung. (now Sinnicolau Mare, Rum.), March 25, 1881. He showed musical talent early, and was taught by his mother. In 1894 he began more serious studies in Pozsony (now Bratislava) and in 1899 entered the Hungarian Royal Academy of Music in Budapest to study piano with István Thomán and composition with Hans Koessler. In 1903, under the influence of Richard Strauss, he wrote a patriotic symphonic poem, *Kossuth.* In 1905 he first became aware of genuine Hungarian peasant music (then almost unknown to musicians), in which he found the idiomatic basis for the national musical style that he wanted to create, and in 1906, with his lifelong friend Zoltán Kodály, he published a first small collection of peasant tunes, with simple piano accompaniment. In 1907 he was appointed to the piano-teaching staff of the Hungarian Royal Academy of Music and in 1908 he produced what he later regarded as his first representative works, including the String Quartet No. 1. His one-act opera, *Duke Bluebeard's Castle* (1911), in which the melodic style is based on the characteristics of Hungarian folk music, was rejected in a competition and also by the Budapest Opera house. This and other discouragements caused him to give up composing and performing and to concentrate on the collection and editing of folk music. He took heart again only in 1917 when his ballet *The Wooden Prince* (1914–16) was produced at the Budapest Opera house with such success that in the following year *Duke Bluebeard's Castle* was also produced there. The important works of this period, the String Quartet No. 2 (1915–17), Five Songs, Op. 16 (1916; settings of poems by Endre Ady), and the ballet *The Miraculous Mandarin* (1918–19), were characterized by increasing freedom of tonality and identification with the expressionist tendency of the time, which reached their extreme point in Bartók's music in the two sonatas for violin and piano (1921–22).

After World War I, when Universal Edition of Vienna took over the publication of his works, his international reputation grew rapidly. In 1923 he was commissioned to write an orchestral work for a concert celebrating the 50th anniversary of the union of Buda and Pest, and produced the *Dance Suite.* By 1926, after three fallow years again devoted to folklore during which he evidently went through a crisis as a composer, he had abandoned the expressionist style for a neoclassical one, though this was slightly obscured by the percussive dissonance of his language. The works of 1926 were all for piano (a concerto, a sonata and two sets of shorter pieces), and were written for Bartók's own use on his concert tours. Other important works in the next few years were the String Quartets Nos. 3 (1927) and 4 (1928), the *Cantata Profana* (1930) and the Piano Concerto No. 2 (1930–31). In the String Quartet No. 4 he made his most far-reaching application of the principle of symmetry, both in its formal plan and in its harmonic language, but in the cantata and concerto he reverted to a slightly simpler tonal idiom. After another period devoted mainly to folk music, Bartók produced the String Quartet No. 5 (1934), which again prominently exemplifies certain devices of symmetrical construction, but is less concentrated in style than No. 4. It is generally regarded as the first work of his "mellow" final period, in which he achieved a synthesis of his earlier experimental styles. It was followed by the Music for Strings, Percussion and Celesta (1936), the Sonata for Two Pianos and Percussion (1937), Violin Concerto (1938), Divertimento for Strings (1939) and String Quartet No. 6 (1939), all commissioned from abroad. During this period Bartók was released from his duties at the Royal Academy of Music so that he could prepare for publication

his vast collection of Hungarian folk music.

In 1940, Bartók immigrated to the United States, where he had difficulty in settling. His compositions were not often performed and he found few engagements as a pianist. An appointment to prepare for publication a Yugoslav folk song collection at Columbia university gave him modest security till 1942, but shortly after this his health, never strong, gave way completely. There was a turn for the better when in 1943 he composed the Concerto for Orchestra for the Koussevitzky Music foundation. This is even more accessible in style than the late European works. Several further commissions followed, but the only other works Bartók was able to complete were the unaccompanied Violin Sonata for Yehudi Menuhin (1944), the Piano Concerto No. 3 for his second wife, Ditta (1945), and a confused draft of a Viola Concerto for William Primrose, deciphered after his death by Tibor Serly. In addition to the major works mentioned above, Bartók published, among hundreds of small pieces, two important collections of piano pieces for educational use, *For Children* (1908–09) and *Mikrokosmos* (1926–37). He also published definitive works on Hungarian and Rumanian folk music and left behind important Hungarian, Rumanian and Slovak material. He died of leukemia in New York, Sept. 26, 1945.

Immediately after his death Bartók's music won wide acclaim and he is generally acknowledged, with Schönberg and Stravinsky, as one of the three great masters of his time. With Kodály he created the first genuinely Hungarian music of universal and enduring interest, comparable with the national music of Chopin, Dvořák and Smetana or of Borodin and Mussorgsky. In the range and variety of his output he surpasses even Dvořák, while in originality, proximity to the mainstream of music in his time and transcendence of mere "national" charm, his music is nearer to Chopin's. These two comparisons give a clue to what is likely to be the final assessment of his position among his contemporaries and in the history of music.

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BARTOLI, DANIELLO (1608–1685), Italian Jesuit humanist, was born at Ferrara on Feb. 12, 1608, and entered the Society of Jesus in 1623. As author of the well-known and frequently translated *Dell' Huomo di Lettere*, he ranked among classic Italian writers. He also was a historian—biographer of Ignatius Loyola, Francis Xavier, Francis Borgia and other Jesuit saints and author of a history of the missionary works of his order in the orient. He died at Rome on Jan. 12, 1685. (J. F. Bn.)

BARTOLI, MATTEO GIULIO (1873–1946), Italian linguist who deduced a general theory known as neolinguistics, or areal linguistics, was born on Nov. 22, 1873, in Albona (Istria). Having obtained his doctorate at the University of Vienna, Bartoli in 1907 became professor at the University of Turin, where he remained until his retirement. An important early study, *Das Dalmatische* (1906), concerns the now extinct Romance dialect of the island of Veglia (Dalmatia). Bartoli's chief interest was the Romance languages. According to his doctrine of neolinguistics, there exists a direct and causal connection between areal linguistic expansion and distribution on one hand, and linguistic change and its chronology on the other (*see* his *Introduzione alla neolinguistica* [1925], and *Saggi di linguistica spaziale* [1945]). From the well-attested Romance domain, Bartoli transferred his operations to that of reconstructed (Proto-) Indo-European. He also initiated the new *Atlante linguistico italiano*, and from 1926 to 1942 was coeditor of the journal *Archivio glottologico italiano*, in which he published numerous articles. He died on Jan. 23, 1946, at Turin.

See *Belfagor*, vol. 3, pp. 315–325 (1948) for a complete bibliography by Benvenuti Terracini. (E. Pm.)

BARTOLOMMEO, FRA (Baccio della Porta, sometimes called Il Frate) (1472–1517), Italian painter of portraits and religious subjects of the Renaissance Florentine school, was born Bartolommeo di Pagolo de Fattorino in the village of Soffignano, near Florence, on March 28, 1472. A pupil of Cosimo Rosselli, he was a close student of the works of Leonardo da Vinci. Of his early productions, the most important is the fresco of the "Last Judgment," in which he was assisted by his friend Mariotto Albertinelli. He came under the influence of Savonarola, and was so affected by his death that he soon after entered the Dominican convent and for some years gave up his art. He had not long resumed it, in obedience to his superior, when Raphael came to Florence and formed a close friendship with him. Bartolommeo learned from the younger artist the rules of perspective, while Raphael owes to Bartolommeo the improvement in his colouring and handling of drapery. Some years afterward he visited Rome, and was struck with a feeling of his own inferiority when he contemplated the masterpieces of Michelangelo and Raphael. On his return he painted the magnificent figure of St. Mark (his masterpiece, at Florence) and the undraped figure of St. Sebastian. He painted a profile portrait of his friend Savonarola in the character of St. Peter Martyr. He died in Florence on Oct. 31, 1517. The majority of Bartolommeo's compositions are altarpieces. The best collection of his works is in the Pitti palace, Florence. The Louvre possesses an "Annunciation" and a "Virgin in Glory," and there are examples in the National Gallery, at Panshanger, Eng., in Berlin and elsewhere.

BARTOLOMMEO VENETO: *see* Veneto, Bartolommeo.

BARTOLOZZI, FRANCESCO (1727–1815), Italian engraver, and engraver to George III of England, was born at Florence on Sept. 21, 1727. He was originally destined to follow the profession of his father, who was a gold- and silversmith, but he manifested so much skill and taste in designing that he was placed under the superintendence of two Florentine artists, who instructed him in painting. After devoting three years to that art, he went to Venice and studied engraving, being apprenticed to Joseph Wagner. He then moved to Rome, where he engraved works by Il Domenichino and other Italian masters, and completed a set of engravings representing events from the life of St. Nilus. After returning to Venice, he set out for London in 1764 at the invitation of Dalton, librarian to George III. He became engraver to the king. For nearly 40 years he resided in London with his friend Giovanni Cipriani, in Warwick street, Golden square, London, and executed a large number of engravings for George III which are still in the royal collections, including the engravings after Holbein's drawings at Windsor. Among others are those of "Clytie" and "Silence," after Annibale Carracci; of the "Virgin and Child," after Carlo Dolci, and of the "Madonna del Sacco," after Andrea del Sarto. He engraved many works of Cipriani and Angelica Kauffmann. Bartolozzi also contributed a number of plates to Boydell's *Shakespeare Gallery*. In 1802 he was invited to Lisbon as director of the National Academy. He remained in Portugal till his death on March 7, 1815.

In his later years in London Bartolozzi had a studio where many works, signed with his name but to which he only put the finishing touches, were produced. He was not the inventor of the red chalk manner of engraving, which was already practised in France by Gilles Demarteau, but, encouraged by Angelica Kauffmann, Bartolozzi made it the fashion.

Bartolozzi's son, Gaetano Stephano (1757–1821), also an engraver, was the father of Madame Vestris (*q.v.*).

See A. Tuer, *Bartolozzi and His Works* (1882); C. H. S. John, *Bartolozzi, Zoffany, Kauffmann With Other Foreign Members of the Royal Academy, 1768–92* (vol. xvi of *British Artists*, 1924).

BARTOLUS (1313–1357), Italian jurist, the most famous of the post-glossators (or commentators), was born at Sassoferrato, whence his usual name of Bartolus de Saxoferrato. He studied law under Cinus at Perugia and under Oldradus and Jacobus de Belvisio at Bologna. He held the chair of law at Perugia from 1343 onward, and made the law school of Perugia as famous as that of Bologna. He was also a legal practitioner and had been an assessor to the courts at Todi and Pisa.

He and the members of his school used the Corpus Juris of Justinian and the work of the glossators thereon, together with the canon law, as a foundation for a body of legal principles which could be used in practice. These principles became the common law of Italy, but were also recognized as law in other parts of Europe, particularly in Spain, Portugal and Germany.

Some writers have attributed the introduction of the dialectical method to Bartolus; but this had been employed in the 13th century by Odofredus, a pupil of Accursius, whose successors had abused it by burying their subject matter under dialectical forms. Bartolus reformed this abuse and avoided excess; but his great reputation was probably due to his revival of the exegetical system of teaching law. His treatises *On Evidence* and *On Procedure* are his best-known works; his *Commentory on the Code of Justinian* has sometimes been exalted almost to an equal authority with the code itself. (*See* ITALIAN LAW.) (RL. P.)

BARTON, BENJAMIN SMITH (1766–1815), U.S. physician and naturalist, whose *Elements of Botony* (1803) is considered to be the first elementary botany written by an American, was born at Lancaster, Pa., Feb. 10, 1766. When only 24 years old he was appointed to a professorship of natural history and botany at the College of Philadelphia, now the University of Pennsylvania—probably the first position of its kind in any U.S. college. Later he became professor of materia medica (1795) and successor to Benjamin Rush in the chair of practical medicine (1813).

Having an ardent thirst for literary fame as well as wide scientific knowledge, Barton wrote books on such diverse subjects as the natural history of Pennsylvania, goitre, the rattlesnake, the honeybee, the stimulant effects of camphor on vegetables, and numerous other subjects in natural history, botany and materia medica. In 1802 he was chosen president of the American Philosophical society and was a member of honorary scientific societies in Russia, England, Scotland and Denmark. He died in Philadelphia, Dec. 19, 1815.

See W. J. Youmans (ed.), *Pioneers of Science in America* (1896).

BARTON, CLARA (CLARISSA HARLOWE BARTON) (1821–1912), founder of the American Red Cross, was born in Oxford, Mass., Dec. 25, 1821. At the age of 15 she became a schoolteacher and continued in that profession for 18 years, both in Massachusetts and New Jersey. In 1854 she took up residence in Washington, D.C., and became a clerk in the U.S. patent office. At the outbreak of the American Civil War she acted on her own initiative to obtain and distribute supplies for the relief of wounded soldiers. At the end of the war she organized at Washington a bureau of records to aid in the search for missing men. In 1869 Miss Barton went abroad for a rest but upon the outbreak of the Franco-Prussian War the following year she again plunged into the task of aiding the victims of war and associated herself with the International Red Cross. In 1873 she returned to the United States, where she at once began her efforts to establish a United States branch of the Red Cross and to bring her country into the 1864 Geneva convention (*q.v.*). Her efforts were successful in 1881–82. She became the first president of the American Red Cross, holding the position until 1904. She was the author of the so-called American amendment to the constitution of the Red Cross which provides that the society shall distribute relief not only in war but in times of such other calamities as famines, floods, earthquakes, cyclones and pestilence. She conducted the society's relief for sufferers from many disasters during the 1880s and 1890s. She wrote an official *History of the Red Cross* (1882); *The Red Cross in Peace and War* (1898); *A Story of the Red Cross* (1904), and *Story of My Childhood* (1907). She died at Glen Echo, Md., on April 12, 1912.

See P. H. Epler, *Life of Clara Barton*, new ed. (1953); W. E. Barton, *Life of Clara Barton*, 2 vol. (1922); Ishbel Ross, *Angel of the Battlefield: the Life of Clara Barton* (1956).

BARTON, SIR EDMUND (1849–1920), Australian statesman, who helped bring the federal movement to a successful conclusion and became the first prime minister of the Commonwealth of Australia, was born in Sydney on Jan. 18, 1849. He graduated in classics from the University of Sydney, then studied law and entered the New South Wales legislature (1879). Periods as speaker of the house of assembly (1883–87) and as attorney-general (1889 and 1891–93) brought him nearly to the top of colonial politics, and he was acting premier for some months in 1892. Barton had become the leader of the federal movement after the retirement of Sir Henry Parkes in 1891 and had only joined the government that year on the understanding that he should be free to promote this cause. There was strong opposition to the movement throughout New South Wales, which as the oldest and most richly endowed colony had little to gain from federation. In taking up the cause, therefore, Barton risked his career; it was largely because of his tireless efforts, particularly during 1894–97 when he lost his seat in the legislative assembly, that a bare majority in the colony came to accept federation. Barton did much to shape the actual form of the Commonwealth constitution; he was chairman of the committee which drafted (1897) the constitutional bill, and he went to London to see the bill through the English parliament in 1900. He became the first Commonwealth prime minister the following year and for two years successfully led a difficult government composed mainly of colonial statesmen used to being leaders in their respective states. Knighted in 1902, he resigned the premiership and accepted the appointment of senior puisne judge of the high court of Australia in 1903. He died at Medlow, near Sydney, on Jan. 7, 1920.

In neither politics nor religion was Barton deeply committed to any creed. Traditionally he has been charged with indolence, but emphasis should be placed on his urbanity, enjoyment of life and powers of charm and friendship.

See John Reynolds, *Edmund Barton* (1948). (O. M. R.)

BARTON, ELIZABETH (*c.* 1506–1534), the "nun of Kent," English ecstatic whose outspoken prophecies fermented public disquiet over the matrimonial policy of Henry VIII and led to her own execution. Born in the archbishop of Canterbury's manor of Aldington, Kent, she served as a maid in the house of the steward there. She fell ill, showing physical and hysterical symptoms, in 1525, and began to experience trances and to utter prophecies. Archbishop William Warham instituted the customary inquiry through two monks of Christ church, Canterbury, one of whom, Edward Bocking, became Elizabeth Barton's confessor and manager. Her fame spread through the county: her exemplary life and sound counsel gained for her a group of devotees both clerical and lay, among them Warham and Bishop John Fisher. Even Sir Thomas More was for a time impressed by her. Unfortunately for herself, her prophecies grew less mystical and more precise; either spontaneously or, more probably, by Bocking's guidance, she began to threaten Henry VIII with dire consequences if he did not drop his projected divorce from Catherine of Aragon and abandon Anne Boleyn. After Henry's marriage with Anne had been declared valid (May 28, 1533), Elizabeth Barton's utterances approached the treasonable, and the new archbishop of Canterbury, Thomas Cranmer, took steps to investigate her. Arrested and examined, she finally confessed to having feigned her trances and pretended her inspiration, and in the session of Jan.–March 1534 she was condemned, with her chief adherents, by act of attainder, the execution taking place at Tyburn, London, on April 21, 1534. Although the confession was extracted without torture, the proceedings seem utterly to have confused this woman of no education and little intellect; there is no certainty that she confessed the truth. It may at any rate be agreed that she had in her more of the hysteric than of the saint, and that the political tenor of her later prophecies represented an uncalled for exploitation of the faith she had aroused; but it is probable that she was in the main sincere—deluded rather than deluding.

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BARTRAM, JOHN (1699–1777), the first native American botanist, noted for his naturalistic explorations, was born near Philadelphia, Pa., on May 23, 1699. A friend of Benjamin Franklin and an original member of the American Philosophical society, he was largely self-educated and was regarded as a liberal Quaker. Bartram farmed actively, yet followed an impelling scientific curiosity to explore the virgin forests. The seeds and plants that he collected were in great demand abroad and aided in his establishing friendships with European botanists, among them Peter Kalm and Linnaeus.

As early as 1739 he hybridized flowering plants. In 1743 the

British crown commissioned Bartram to visit the Indian tribes of the League of Six Nations and to explore the wilderness north to Lake Ontario in Canada. He reported not only on the negotiations but also on the soil types and the forest formations encountered. On the banks of the Schuylkill river near Philadelphia, he established a botanical garden which became internationally famous for extensive plantings of local and foreign plants. Under George III he held the post of botanist to the king for the American colonies. *Bartramia*, a genus of American mosses, was named for him. He discovered the shrub *Franklinia alatamaha*. During 1765–66 Bartram explored extensively in Florida in company with his son William; the latter also became renowned as a naturalist and nature artist whose *Travels* (1791) greatly influenced English Romanticism. John Bartram died Sept. 22, 1777.

See Ernest Earnest, *John and William Bartram, Botanists and Explorers, 1699–1777, 1739–1823* (1940). (P. D. V.)

BARUCH, BERNARD MANNES (1870–1965), U.S. financier and presidential adviser, was born Aug. 19, 1870, in Camden, S.C. After graduating from the College of the City of New York in 1889 he began his career as an office boy at the age of 19, first in the linen business and then in Wall street brokerage houses. He amassed a fortune as a Wall street speculator and made generous contributions to a variety of charities and to the financing of public causes. Baruch came into public life through his appointment by Pres. Woodrow Wilson in 1916 to the advisory commission of the Council of National Defense. He later became chairman of the War Industries board during World War I. In 1919 he was appointed a member of the Supreme Economic council at the Versailles peace conference, an office which he combined with that of personal economic adviser to the president on the terms of peace. From that time forward his advisory services were sought by the presidents who succeeded Wilson. As an expert in wartime economic mobilization he was much in demand as an adviser during World War II but did not hold any administrative position. After the war he helped to formulate U.S. policy at the United Nations, particularly on the international control of atomic energy. He died on June 20, 1965, in New York city.

See his *Baruch: My Own Story* (1957) and *Baruch: the Public Years* (1960); Margaret L. Coit, *Mr. Baruch* (1957). (Fk. L. K.)

BARUCH, BOOK OF. The name of Baruch, Jeremiah's friend and secretary, is attached to several early writings (*see* Baruch Apocalypses). One of these, the Book of Baruch, is included with the Apocrypha by Protestants and with the deuterocanonical books by Roman Catholics and Orthodox. The book has survived in Greek, from which all ancient versions derive. The sixth and last chapter purports to be a letter by Jeremiah (*see* Jeremy, Epistle of). Bar. i, 1–iii, 8 may have formed part of the Book of Jeremiah, for the text bears the same characteristics as the Greek translation of the second part of Jeremiah.

The Book of Baruch falls into three parts. The first (i, 1–iii, 8) is a liturgical confession and prayer preceded by a historical introduction in which Baruch is said to have read the book before the Jewish exiles. Then a collection of money was made that was sent to Jerusalem for the offering of sacrifices. The second part (iii, 9–iv, 4) is a panegyric on Wisdom, which is here identified with the Law. The Law is the source of life. Israel is now wasting away in a foreign country because she has strayed away from the Law. If Israel will walk in the way of the Law, she will find life and enjoy happiness again. The third part (iv, 5–v, 9) is a moving appeal to Jerusalem together with a reassuring promise of her approaching deliverance. In iv, 5–29 Jerusalem cheers her exiled children, exhorting them to penitence and hope, and in iv, 30–v, 9 God himself consoles Jerusalem, promising her deliverance and threatening her enemies with retaliation. The second and third parts are poetry.

Older critics generally maintained that the whole book originally was written in Greek, while others advocated a Hebrew origin. Modern critics believe that the book originally was written in different languages. That the first part, or at least i, 15–iii, 8, was written in Hebrew is universally recognized, though some scholars believe that i, 1–14 was written in Greek imitative of the Septuagint. A Hebrew original also is assumed, though less confidently, for the second part. The third part is held by some to have been written in Greek, by others in Hebrew. These differences of language and literary forms indicate that Baruch is a composite work of more than one author. But the historical allusions in the book are so uncertain and internal evidence is so slender as to render the determination of the date of composition and final redaction extremely difficult and uncertain. That the book was written by Baruch himself is almost untenable, but it is equally difficult to bring its composition down to Roman times.

The dependence of Bar. i, 15–ii, 17 on Dan. ix, 7–19 and the historical confusion which it shares with Daniel of making Belshazzar the son of Nebuchadrezzar shows the first part to be later than the middle of the 2nd century B.C. Its historical situation is thought by some to fit the period after the destruction of Jerusalem in A.D. 70, but the references to the Roman period are difficult to prove. Indeed the confession is couched in such general terms and bears such striking affinity of ideas and expressions with similar confessions in Neh. ix, 6–37; Dan. iii, 26–45, ix, 4–19 that one doubts whether the writer is alluding to historical events or is using a stereotyped form that is applicable to any time of national calamity.

The date of origin of the second part is more difficult to determine. The historical situation of an age-long dispersion of the Jews among the nations may apply to any time after the exile. The dependence on the wisdom books and on Job is obvious. Protestant critics mostly place the origin of the second part during the Roman period, while Roman Catholics, who do not attribute the work to Baruch, prefer an earlier, though postexilic, date.

It is still more difficult to place the third part in any well-known historical situation. The people are, apparently, in exile, but deliverance is near. This seems to be applicable only to the last days of the exile when Deutero-Isaiah was announcing the impending deliverance. There remains, however, the possibility that a later writer adapted Deutero-Isaiah's literary style and ideas to his own times. The relation between the third part and the Psalms of Solomon is evidence that can be taken either way. While priority is generally given to the Psalms, a dependence in an inverse order is also possible. Those who hold to a Greek original naturally bring down the composition of the third part to the Hellenistic age.

Baruch is never quoted in the New Testament, and is very rarely read in the liturgy. The text "Afterwards he was seen upon earth, and conversed with men" (iii, 37, but 38 in Septuagint) was regarded by some Greek Fathers as a prophecy of the Incarnation.

Bibliography.—For Greek text *see* editions of the Septuagint. Eng. trans. with introduction and notes by O. C. Whitehouse in R. H. Charles (ed.), *Apocrypha and Pseudepigrapha of the Old Testament in English*, vol. i (1913). *See* also W. O. E. Oesterley, *An Introduction to the Books of the Apocrypha* (1935); B. N. Wambacq, "L'Unité littéraire de Baruch 1, 1–3, 8," *Sacra pagina*, vol. i, pp. 455–460 (1959); W. Pesch, "Die Abhängigkeit des 11. Salomonischen Psalms von letzten Kapitel des Buches Baruch," *Zeitschrift für die alttestamentliche Wissenschaft*, vol. lxvii, pp. 251–263 (1955). (P. P. Sa.)

BARUCH APOCALYPSES. Baruch was the amanuensis of the Old Testament prophet Jeremiah (Jer. xxxvi, 4). His close association with the prophet, the fact that he lived at a time of disaster, and an absence of other information about him caused his name to be chosen as a pseudonym by various apocalyptic writers. The list of known writings is as follows:

1. The Book of Baruch as included in the Apocrypha (*see* Baruch, Book of).
2. The Syriac Apocalypse of Baruch (*see* below).
3. The Epistle of Baruch, as in the Syriac Bible.
4. The Greek Apocalypse of Baruch (*see* below).
5. The Rest of the Words of Baruch, as in the Ethiopic Bible and some Greek manuscripts.
6. A Gnostic Book of Baruch, quoted by Hippolytus.
7. A Latin Book of Baruch, quoted by Cyprian.
8. A further Book of Baruch, quoted in *Altercatio Simonis Judaei*, etc.

Possibly the Baruch in the Apocrypha is based on part of the Syriac Apocalypse (which appears to be incomplete), and the Epistle is nine chapters of this work. The Apocalypses appear to be independent works, as does "the Rest."

Syriac Apocalypse.—This work (also called II Baruch) survived only in Syriac, though it is clearly a translation from the Greek, itself a translation from a Semitic language (Hebrew or Aramaic). Fragments of the Greek have been identified among the Oxyrhynchus papyri (a collection of 4th-century, and earlier, papyrus fragments found in Egypt). The book is commonly divided into seven sections: (1) God announces the fall of Jerusalem (i–xii); Baruch is told to remain in the ruined city for revelations of the end of the world. (2) He is given an explanation of the prosperity of the wicked and the suffering of the righteous (xiii–xx). (3) The time of the end has 12 divisions, each with its own tribulation (xxi–xxxiv); then Messiah will inaugurate his reign, which will be followed by a general resurrection either to glory or to perdition. (4) In vision, Baruch sees a vine destroy a mountain and cedar forest, foretelling the overthrow of the gentiles and the triumph of Israel (xxxv–xlvi). (5) He inquires after the nature of the resurrection body, which is explained as the restoration of the physical form which the earth received (xlvii–lii). (6) He sees in vision the history of Israel in the imagery of alternative periods of black rain and bright, but the last period (the messianic) is bright (liii–lxxvi). (7) He sends letters of admonition to the nine and one-half tribes and to the two and one-half tribes, but only the content of the former letter is given (lxxvii–lxxxvii).

Whether the book is the work of one author or a compilation is debated, but in its present form it probably dates between A.D. 100 and 130, and attempts to correct the overpessimistic outlook of IV Ezra.

Greek Apocalypse.—This (also called III Baruch) has survived only in Greek and, as condensed, in Slavonic. Baruch, weeping over the destruction of Jerusalem, is told to restrain his grief for he will be shown the mysteries of heaven. He is conducted through five heavens. In the first two are the men of the tower of Babel, smitten with brute stupidity. In the third he sees a dragon devouring the wicked, and is also shown a vine, the forbidden tree of paradise. (A Christian interpolation defends wine as that which becomes the blood of God). He then sees the chariot of the sun and the phoenix, and the moon and the stars in their motions. In the fourth heaven is the pool from which the souls of the righteous drink, and which is the source of fructifying dew on earth. In the fifth he sees Michael receiving the good deeds of the righteous from their guardian angels and returning them blessings. The angels of the wicked are bidden to go and punish them severely with sword and death and demons. Probably the original continued with a sixth and seventh heaven, but the manuscript comes to an abrupt close at this point.

Teaching.—The Syriac is a serious work, emanating from the same kind of background as IV Ezra, the teaching of which it parallels with interesting divergencies (*see* EZRA, FOURTH BOOK OF). These two books reveal the apocalyptic movement at its best. The Greek, on the other hand, illustrates the puerility into which apocalyptic cosmological speculation often fell. It is chiefly remarkable for its doctrine of guardian angels (*cf.* Matt. xviii, 10).

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BARYATINSKI, ALEKSANDR IVANOVICH, PRINCE (1814–1879), Russian army officer and viceroy of the Caucasus, was born in St. Petersburg on May 14 (new style; May 2, old style), 1814. Entering the army in 1833, he was sent to the Caucasus in 1835 and served with distinction in operations against the Circassians. Ordered again to the Caucasus in 1845, he distinguished himself as a battalion commander in the expedition against Dargo, especially in the routing of Shamil's warriors near Gogatl and Andi. In 1846, in Warsaw, he assisted I. F. Paskevich to destroy the Polish insurgents in Cracow. From 1847 he took a leading part in all the military operations in Chechenia. His energetic and systematic tactics inaugurated a new era of mountain warfare. In 1853 he was made general and appointed chief of staff. In 1854 he took part in the brilliant Kürük-dere campaign against the Turks. He became commander in chief of the Caucasian corps (later the Caucasian army) in July 1856 and viceroy of the Caucasus in the following August. Baryatinski was an advocate of a firm establishment of Russian rule in the occupied territories. Incessant offensive operations finally broke Shamil's resistance and his capture in 1859 brought to an end the war for the possession of Chechenia and Daghestan. Baryatinski was made a general field marshal, but was relieved of his post at his own request in 1862. He spent his last years abroad, dying in Geneva on March 9 (N.S.; Feb. 25, O.S.), 1879. (A. GU.)

BARYCENTRIC CALCULUS, a method of geometric analysis developed by August Ferdinand Möbius (*q.v.*) and founded on the notion of centre of gravity (or centre of mass) of a system of mass particles. The prefix "bary" is from the Gr. *barys*, heavy. The method was known to Möbius in 1823 and he published a detailed account in 1827.

If two particles of weights α and β are located at the respective ends A and B of a weightless rod AB, then there is a unique point P on AB such that the rod may be balanced, under the force of gravity, on a support at P. The respective distances of P from A and B are in the ratio $\beta:\alpha$, and the pressure of the rod on the support at P is equal to that produced by a weight of $\alpha + \beta$. The point P is called the centre of gravity of the two particles. Similarly, there is a centre of gravity or balancing point P for any finite system of particles, situated either in a plane or in space, and we may attach to P a weight equal to the sum of the weights of the given particles.

In the barycentric calculus, the notion of centre of gravity is generalized and its algebraic properties are studied. With a given point A there may be associated any real number α (positive, negative, or zero), called its weight, the weighted point being denoted by α A. The barycentre or sum α A + βB of two weighted points α A and βB is defined to be the weighted point $(\alpha + \beta)$G, where G is the point of the directed line AB for which $AG:GB = \beta:\alpha$. Geometric considerations show that $(\alpha A + \beta B) + \lambda C = \alpha\ A + (\beta B + \gamma C) = (\alpha + \beta + \gamma)P$ for a unique point P, and the weighted point $(\alpha + \beta + \gamma)$P is defined to be the barycentre of the system consisting of αA, βB, and γC. The notion can be extended to any finite system of points, and obeys simple algebraic rules. When the sum of the weights is zero, the corresponding barycentre may in some cases be regarded as a weighted point at infinity; in other cases, it is indeterminate.

With respect to a given tetrahedron of reference ABCD, the barycentric co-ordinates of a point P in space are numbers α, B, γ, and δ such that $\alpha A + \beta B + \gamma C + \delta D = (\alpha + \beta + \gamma + \delta)P$. For $k \neq 0$, the numbers $k\alpha$, $k\beta$, $k\gamma$, and $k\delta$ form another set of barycentric co-ordinates of P. Thus the barycentric calculus gives rise to a useful homogeneous coordinate system for representing the points of space; this has been an important tool in projective geometry.

A set of points in space is said to be convex provided it includes, with each two of its points A and B, the entire line segment AB joining them. The points on AB are exactly those which have the form $\alpha A + \beta B$ for some nonnegative weights α and β with $\alpha + \beta = 1$. More generally, consider any set S of points and let C denote the set of all points having the form $\alpha A + \beta B + \ldots + \lambda L$, where A,B, . . . ,L are points of S and α, β, . . . ,λ are nonnegative weights of sum one. It can be seen that C is merely the smallest convex set containing S. Thus the barycentric calculus is closely connected with the theory of convexity. A further generalization of the notion of barycentre is important in some infinite-dimensional aspects of the theory.

BIBLIOGRAPHY.—A. F. Möbius, *Der barycentrische Calcul* (1827), reprinted in his *Gesammelte Werke*, vol. i, pp. 1–388; and *Encyklopädie der mathematischen Wissenschaften*, vol. iii, pp. 1289–93 (1885–87). The former contains the original development of the barycentric calculus by Möbius; the latter gives a brief summary and a history, with references to the literature. For barycentric co-ordinates in the theory of convexity, *see* H. G. Eggleston, *Convexity*, pp. 14–16 (1958). (V. K.)

BARYE, ANTOINE LOUIS (1796–1875), French sculptor and painter, was born in Paris on Sept. 15, 1796, and died there on June 25, 1875. He studied under the neoclassical sculptor F. J. Bosio and at the École des Beaux-Arts, but his artistic tempera-

ment was chiefly formed by three painters: Baron Gros, whose pupil he also was; Delacroix, who admired his work and with whom he studied the animals at the Jardin des Plantes zoo; and Géricault. From these he caught the romantics' predilection for the exotic and the violent, and many of his best-known bronzes depict, with great skill, wild beasts locked in combat. Nevertheless his sculptures, and even more his animal paintings and drawings, lack the full flourish and verve of Delacroix and Géricault; Barye was indeed a close friend of Corot, Millet and other members of the more placid Barbizon group, and his few rather arid Fontainebleau landscape paintings show the influence of Théodore Rousseau. Among Barye's large sculptures are the stone groups for the Louvre (1855)—"La Guerre" and "La Paix" (Pavillon Richelieu), "La Force" and "L'Ordre" (Pavillon Denon); his smaller bronzes include "Tigre dévorant un gavial" (1831, Louvre), the table centrepiece "Lion Hunt" (1833) for the duke of Orleans (Walters museum, Baltimore) and "Thésée combattant le minotaure" (1847).

The son of a goldsmith, Barye at first earned his living at that craft and later often turned to decorative metalwork for a livelihood when his major sculpture failed to gain recognition; he was elected to the Academy only in 1868.

BARYTES: *see* BARITE.

BASALT, in petrology, one of the oldest rock names, is believed to be derived from the Ethiopian word *basal,* signifying a stone which yields iron. According to Pliny, the first basalts were obtained in Ethiopia. In current usage the term includes a large variety of types of igneous rock belonging to the basic (or low silica) subdivision, dark in colour, weathering to brown and comparatively rich in magnesia and iron. Some basalts are in large measure glassy (tachylytes), and many are very fine grained and compact; but it is more usual for them to exhibit porphyritic structure, showing larger crystals of olivine, augite or feldspar in a finely crystalline groundmass. Olivine and augite are the commonest porphyritic minerals in basalts, the former green or yellowish (and weathering to green or brown serpentine), the latter pitch-black. Porphyritic plagioclase feldspars, however, are also very common, and may be one or two inches in length, though usually not exceeding a quarter of an inch. Basaltic lavas are frequently spongy or pumiceous, especially near their surfaces; and the steam cavities become filled with secondary minerals such as calcite, chlorite and zeolites.

Basalts may be broadly divided on a chemical and petrographical basis into two main groups—the calc-alkali and the alkali basalts. The lavas of the first group are characterized by essential basic plagioclase with augite, pigeonite or hypersthene and olivine as dominant mafic (basic) minerals, but basalts without olivine are also well represented. Basalts of this group show a range of silica content from 45% to 52%. They range from picritic (olivine-rich) basalts to higher silica varieties such as the andesitic basalts. Calc-alkali basalts, which include the tholeiites (basalts with lime-poor pyroxene), predominate among the lavas of orogenic belts and their flows may build enormous plateaus as in Washington and Oregon of the United States, in the Paraná basin of South America and in the Deccan of India. The active volcanoes of Mauna Loa and Kilauea in Hawaii erupt tholeiitic lavas, and similar basalts are found in the lower portions of the volcanic pile of other extinct volcanoes of the Hawaiian group.

VINCENT SERVENTY

HEXAGONAL COLUMNS OF BASALT OF THE GIANT'S CAUSEWAY, ANTRIM, N. IRE.

The normal alkali type of basalt carries among its mafic minerals olivine and commonly a diopsidic or titaniferous augite. Pigeonite and hypersthenic pyroxenes are typically absent. Among special types of alkali basalts of this group are the mugearites (oligoclase-basalts) and trachybasalts with a conspicuous content of alkali feldspar. Spilites which carry albite feldspar often of metasomatic origin may be more closely related to the calc-alkali group of basalts. Alkali types of basalt predominate among the lavas of the ocean basins and are common among the basic lavas of the forelands and backlands of the orogenic belts. In the Brito-Icelandic province the Tertiary lava flows of the Inner Hebrides, Antrim and the Faeroe Islands include great successions of both calc-alkali and alkali basalts.

Minerals of the feldspathoid group occur in a large number of basaltic rocks belonging to the alkali group; nephelite, analcime and leucite are the most common, but hauynite is occasionally present. If nephelite entirely replaces feldspar, the rock is known as nephelite-basalt; if the replacement is only partial the term nephelite-basanite is used. Similarly there are analcime- and leucite-basalts and leucite-basanites. The nephelite is in small six-sided prisms and usually cannot be detected with the unaided eye. Even with the help of the microscope nephelite-basalts are not always easy to determine, as the crystals may be exceedingly small and imperfect, and they readily decompose into analcime and zeolites. Most nephelite-basalts are fine-grained, very dark-coloured rocks and belong to the Tertiary period. They are fairly common in some parts of Germany and occur also in the United States, as in New Mexico, and in Tripoli, Asia Minor, Cape Verde Islands, etc. Leucite-basalts contain small rounded crystals of leucite in place of plagioclase feldspar. Rocks of this group are well known in the Eifel and other volcanic districts in Germany, also in Bohemia, Italy, Montana, Java, Celebes, etc. The young volcanic fields of the western rift of Equatorial Africa in south-western Uganda and the Republic of the Congo exhibit a series of undersaturated alkali basalts ranging from extremely potassic to comparatively sodic. They include types rich in melilite, leucite, potassic nephelite and kalsilite the potassic analogue of nephelite. *See* PETROLOGY; VOLCANISM; *see* also Index references under "Basalt" in the Index volume. (C. E. T.)

BASANAVICIUS, JONAS (1851–1927), "the patriarch of the Lithuanian renaissance," medical doctor and folklorist, was born in Ozkabaliai in the district of Vilkaviskis, Lithuania (then part of Russia), on Nov. 11, 1851. Leaving the secondary school in Marijampole in 1873, he studied history and archaeology in Moscow and, from 1874, medicine in Warsaw. He graduated in 1879 and for 25 years practised medicine in Bulgaria. His inspiring Lithuanian cultural and political magazine *Ausra* ("Dawn"), which began to appear in 1883, was produced in Tilsit and Ragnit (in East Prussia) and smuggled into Lithuania. From 1905 onward Basanavicius lived in Vilnius and engaged in many activities. Considered as the "moral president" of the nation, he presided over the diet of Vilnius which in 1905 demanded autonomy for Lithuania and was president of the congress that on Feb. 16, 1918, proclaimed the independence of Lithuania.

One of Basanavicius' outstanding contributions to the field of Lithuanian science was the founding of the Lithuanian Scientific society in 1907. For 20 years he was its president, the editor of its organ and the organizer of research in archaeology and folklore. His many publications include two volumes of Lithuanian songs (1902); four volumes of Lithuanian tales (1903–05); a work on ancient Lithuanian beliefs about souls and devils (1903—an outstanding collection on Lithuanian mythology); a study on Lithuanian crosses (1912); and a work on the Thraco-Phrygians and their migration to Lithuania (1921). Basanavicius died in Vilnius on Feb. 16, 1927. (MA. G.)

BASARAB (BASSARAB or BESSARABA), the name of a Rumanian dynasty, members of which, as voivodes, ruled Walachia from

(LEFT) COURTESY OF TURKISH PRESS BROADCASTING AND TOURIST DEPT.; (RIGHT) THAMES AND HUDSON, LONDON

(LEFT) HITTITE BASE WITH SPHINXES FROM PALACE OF BAR RAKAB, ZINCIRLI, TURKEY, 8TH CENTURY B.C., IN ANTAKYA MUSEUM; (RIGHT) ITALIAN ROMANESQUE BASE FROM DUOMO SAN GEMINIANO, MODENA, 12TH CENTURY A.D.

the beginning of its independent history until 1658. The origin of the family is obscure, but it has been suggested the name may be connected with the Kuman word *aba*, "father."

BASARAB I (1310–52), who founded the independent feudal state of Walachia, came from the valley of the Olt in southern Transylvania (on which the Hungarians were progressively encroaching) and settled in Cîmpulung. He collaborated with the Bulgars against the Byzantines and the Serbs and defended Walachia against the attempts of Charles Robert of Hungary to conquer it, defeating him at Posada, in the Prahova valley, in 1330.

During the reign of MIRCEA THE OLD (1386–1418) the struggle against the Turks began. His forces and their allies were defeated in 1396 at the battle of Nicopolis (Nikopol on the Danube) and by the end of his reign Walachia was forced to acknowledge Turkish suzerainty (*see* RUMANIA: *History*).

During the 15th century the throne was usurped by a rival branch of the family, and the dispossessed members fled to Transylvania. The usurpers, VLAD DRAKUL or the Devil (1433–46) and VLAD ŢEPEŞ or the Impaler (1456–62 and 1476–77), were notorious for their cruelties.

The reign of NEAGOE BASARAB (1512–21) was peaceful, the prince being concerned chiefly with cultural activities and with building. Among the buildings erected during his reign, the most beautiful is the cathedral of Curtea de Argeş (1517), which is one of the finest monuments of Rumanian art.

MICHAEL THE BRAVE (Mihai Viteazul), who ruled from 1593 to 1601, is probably the most famous member of the family. He withstood the Turks and for a short time succeeded in uniting all Rumanians under one rule.

The most outstanding ruler of the 17th century was MATEI (Matthias) BASARAB, who took the throne in 1632 as a result of action against the Greek aristocracy. During his reign he carried out constructive economic, cultural and legislative reforms: he started replacing Slavonic with Rumanian as the official language and brought printing presses from Kiev; he had the first written code of law printed and built many churches and monasteries. He followed Michael the Brave's policy of allying himself with the Transylvanian princes against the Turks. He was succeeded in 1654 by CONSTANTIN ŞERBAN, on whose death in 1658 the male line of the ruling Basarab dynasty became extinct.

See N. Iorga, *Histoire des Roumains*, vol. 3 and 4 (1937).

BASCOM, JOHN (1827–1911), U.S. educator and philosopher, was born at Genoa, N.Y., on May 1, 1827. After graduation from Williams college, Williamstown, Mass. (1849), and the Andover Theological seminary (1855), Bascom became professor of rhetoric and English literature at Williams. He left Williams in 1874 to accept the presidency of the University of Wisconsin, Madison, and resigned 13 years later because of increasing interference by the university's governing board. Under his administration the institution substantially improved the quality and increased the variety of its instruction. His favourable disposition toward coeducation helped to resolve that issue at the university. He returned east in 1887 to lecture occasionally on sociology at Williams and at neighbouring colleges, and in 1891 he again attained full status at Williams as professor of political science. Bascom retired from teaching in 1903, ending 48 years of service as college teacher and administrator. He died on Oct. 2, 1911, at Williamstown. Bascom published 20 books and over 100 journal articles. Of his books, the seven on religion and theology reflect his liberal religious beliefs. The remaining 13 were products of his courses in economics, philosophy, sociology and literature. Bascom summarized his personal and social views in his autobiography, *Things Learned By Living* (1913), which includes a bibliography of his work. (J. M. BK.)

BASE. In architecture, a base is the lowest visible element on which rests a wall, column or pier. In the Greek Doric order, and in some Egyptian examples, the individual base was lacking. Individual stone bases were used originally to protect the foot of a wooden support from ground moisture, and to spread the load over a wider area. In the latter function it has also served in masonry construction, but in general the base became an aesthetic rather than a utilitarian feature. From the days of classical antiquity the base, as used in the Greek Ionic and later in Greek and Roman Corinthian orders, consisted of a series of moldings (*q.v.*) that combined the convex, half-round torus (*astragalos*) and the concave scotia (*trochilos*). These were separated by narrow, flat fillets, sometimes combined with small reed moldings as well. Two main types were the Attic Ionic (scotia between two tori) and Asiatic (torus above two scotias). From these were derived the greater number of base types of later ages in Europe and America. The base (or socle) has also been used at the foot of walls, either as a simple offset or in molded forms that resemble the profile of the column bases. Early bases in Asia Minor (Hittite period) frequently rested on the backs of guardian lions, a feature that reappeared in Europe, especially in northern Italy, during the middle ages. Square or polygonal plinths below round bases rarely appear until Roman times. (*See* also ORDER; CAPITAL; COLUMN.)

The word base has many uses other than architectural. For its sense in chemistry, *see* ACIDS AND BASES. (R. SL.)

BASEBALL (originally written "base ball"), usually called

the national game of the United States, is a contest between two teams of nine players each, involving the throwing, batting and catching (fielding) of a ball on a field on which are placed four bases at fixed points at the angles of a 90-ft. square. Competitors run from base to base, counterclockwise, a complete circuit scoring a run, and victory goes to the team tallying the most runs. Following are the main sections and subsections of this article:

I. Teams and Players
II. How Baseball Is Played
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2. The Umpires
3. Put-Outs
4. The Attack
III. Special Skills
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2. Defensive
3. Outfielders
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6. Pitching
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1. Uniforms
2. The Bat and Ball
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4. Protective Equipment
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2. The Averages
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4. The Baseball Season
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VI. History of Baseball
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I. TEAMS AND PLAYERS

The pastime's most skilled players usually are professionals who make the sport their full-time vocation from late February until late September or early October. Professionals in the United States belong to clubs representing various cities, and outstanding players attain the status of local, or even national, heroes in the eyes of both adults and youths. The professional clubs compete as members of leagues and during the course of a championship season each team plays an equal number of games with each other league member, half in its own park and half in the park of its opponent. The ranking (or standing) of the teams is determined on percentages, based on games won and lost.

Operation of a professional league club is a highly organized commercial enterprise usually conducted by an incorporated business company (see *Organized Baseball* below for U.S. supreme court decision in 1953 on status of baseball). It involves an extensive investment in real estate and accommodations for spectators; the purchase and training of players; maintenance crews for upkeep of the field, stands and clubhouse; and refreshment-purveying personnel in proportion to the size of its home city and park. There must also be an administrative staff that includes scouts, the experts whose duty it is to travel about the country in quest of new players who have, or show possibilities of attaining, the skill necessary in league play.

The method established for the founding of a professional baseball team is by the purchase of a franchise from the central authoritative body of the area, league or association concerned. A franchise is an official permit establishing the legality of a team and ensuring that it is entered on the roster of the league and thus permitting it to play competitively. It is normally owned by one person or by several acting in concert. The team will generally take its name from its home town or city with the addition of a particular nickname to identify it, as the Chicago White Sox or the New York Yankees.

Although nine players comprise a team at any point in a major league contest, the manager usually has more than twice that number in uniform and ready for duty during the course of the game. The two major leagues in the United States, the American and National, often have as many as 40 eligible men in uniform early in the season, although 25 is the usual limit enforced through most of the campaign. Similarly, though only one ball and one bat can be in play at any given moment, about three dozen balls are used in the course of the average game, and each team is equipped with several dozen bats.

The constant influx of new talent to the professional leagues comes from schools and colleges, and the independent teams representing factories, business houses and club teams of both city and rural districts throughout the country. In the United States almost every boy plays baseball and its variant, softball (*q.v.*), during his elementary school years, and those with skill often set the major leagues as their goals. Many amateur baseball leagues, organized for the purpose of training boys and helping curb juvenile delinquency, exist in the U.S. The American Legion junior league, formed in 1926 for boys up to 17 years of age, had more than 19,000 teams playing during the 1960s, and more than 300 former American Legion players were listed on the annual rosters of American and National league clubs. Since the inception of this program, more than 1,600 Legion graduates had appeared in the major leagues.

The Little league, for boys 8–12, had a phenomenal growth, starting in 1939 with only 3 Pennsylvania teams and expanding after World War II to include more than 15,000 teams by the 1960s. The Little-Bigger league, for boys 13–15, was organized on a national basis in 1952 and at the end of the 1953 season changed its name to the Babe Ruth league. Competition supervised by the Police Athletic leagues in various cities and the P.O.N.Y. (Protect Our Nation's Youth) league are among the many other organizations formed for promotion of the game among boys.

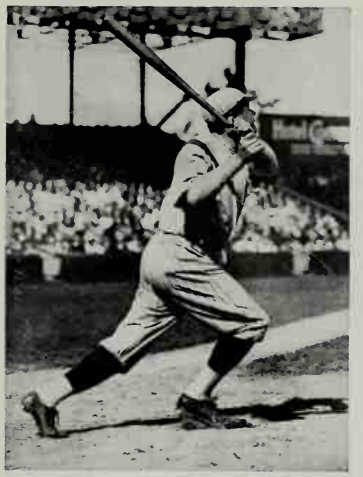
Outside the U.S., baseball is played widely in Cuba, Puerto Rico, Mexico, Canada, Venezuela, Australia and Japan. Extensive tours by U.S. major league players after the close of their seasons at home and the introduction of the sport in many countries where servicemen were stationed in the first half of the 20th century did much to interest peoples of other lands in baseball. A number of Latin-American players became stars in the U.S. major leagues. Italy adopted the sport after World War II, and several other European countries, including the Netherlands, Belgium, Spain and Germany, have started baseball leagues. An all-European championship is conducted annually and many servicemen and U.S. embassy personnel have served as coaches. In Panama and Tunisia leagues conduct regular schedules and round-robin championship play-offs at the season's end have been in operation.

II. HOW BASEBALL IS PLAYED

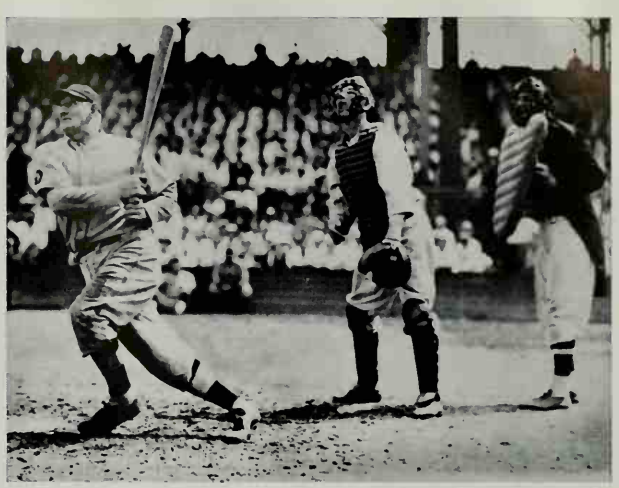
Baseball belongs to the extensive genus of civilized athletic competitions stemming from the primitive play urge to hit a fragment of rock with a club. Two boys with one stick of wood and a rubber ball portray baseball in its essence when they mark two fixed points on their playground with a couple of flat stones as bases and take turns whacking the ball with the bat. One, armed with the bat, stands at one of the bases. The other stands an agreed distance away and tosses the ball to the batter, who drives it as far as he can. Just how many times the batter must run between bases before he is credited with a run, or a score, is usually agreed upon between the two contestants. Each keeps count of his runs and, after each has had the same number of turns at batting, the one who has scored the most runs is the winner.

Baseball in all the leagues, in the big city stadiums with attendances of 50,000 or more, is a refined and more intensified form of this same competition. There are nine-man teams opposing each other instead of just two individuals. There are four bases instead of two. In scoring a run a batter must go to each of the other three bases before returning to his starting point to complete his run, but he may perch temporarily on a base on his way around until the opportunity is offered to continue his course.

Just as each batter has eight teammates to help him, there are nine players to pursue the batted ball instead of just the one boy who in the playground miniature game had to be both thrower and retriever.



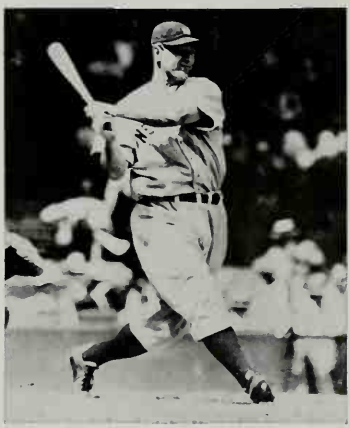
George Herman (Babe) Ruth, pitcher and outfielder, Boston and New York, American league, in a 1921 game. Ruth hit a total of 714 home runs in 22 seasons of play



John Peter (Honus) Wagner, left, shortstop, Pittsburgh, National league, swings in a 1931 game between former stars and the Baltimore Orioles. Catcher is Ike Denning and the umpire is Al Schacht

The National Baseball Hall of Fame, Cooperstown, N.Y., houses mementos of famous players and has plaques for each player elected. The first five players enshrined, elected in 1936, were Ruth, Wagner, Cobb, Walter Johnson and Christy Mathewson

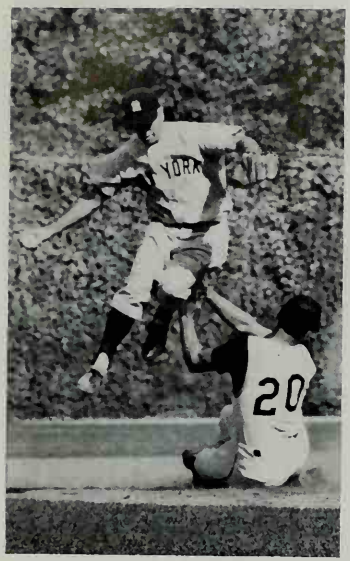
Tyrus Raymond (Ty) Cobb, outfielder and manager, Detroit and Philadelphia, American league, shown stealing third base when he was with Detroit in 1909



Henry Louis (Lou) Gehrig, infielder, New York, American league, elected to the Hall of Fame in 1939, bats in a 1934 game

BASEBALL'S HALL OF FAME AND SOME PLAYERS ENSHRINED THERE

BASEBALL



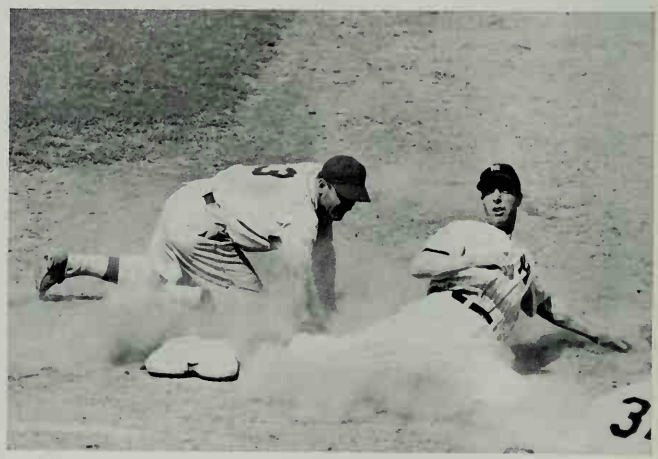
Gino Cimoli, outfielder, Pittsburgh Pirates, was out at second base in this play during the 1960 World Series with the New York Yankees at Pittsburgh. Bobby Richardson, Yankee second baseman, made the force out

ACTION ON THE BASE PATHS

PHOTOGRAPHS, (TOP LEFT) MARVIN E. NEWMAN, (ALL OTHERS) UNITED PRESS INTERNATIONAL

Red Schoendienst, New York Giants, was tagged by Milwaukee's catcher Del Crandall in this rundown between third and home in 1957 game. Watching the action are umpires Stan Landes, at third, and Bill Baker, foreground; Braves' shortstop Johnny Logan, at third, and third baseman Eddie Mathews, right; Giant player Willie Mays went to third on the play

Pee Wee Reese, Brooklyn Dodgers, beats the throw from New York Yankee pitcher Duane Pillette to first baseman Joe Collins with a headon slide during an attempted pickoff play in spring exhibition game at Miami, Fla., in 1950



Joe DiMaggio, New York Yankees, used his famous hook slide to beat the throw to Tony Lupien, Chicago White Sox first baseman. A fast relay forced DiMaggio to return to first after he had tried for second base during 1948 game

Phil Rizzuto, New York Yankees, laid down this bunt during a 1950 game with the Detroit Tigers. Rizzuto has started to run to first before either the bat or ball have touched the ground, and while Tiger catcher Aaron Robinson is still in his crouch

The official baseball rules, uniformly in force internationally and unchanged in any conspicuous feature after 1920, prescribe the dimensions and markings of the playing field, the conditions under which the teams function when at bat and when in the field and the law of the game as it has evolved to cover every conceivable eventuality of the sport; variations in playing conditions in individual parks are provided for by local ground rules.

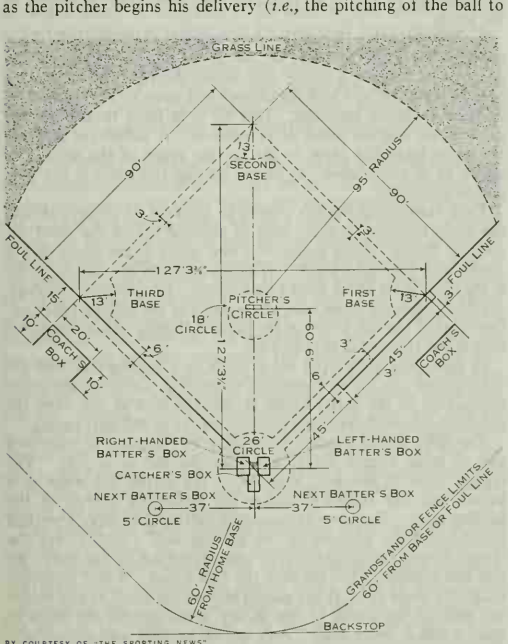
The rules give each team collectively nine turns at bat, or innings, and at the end of nine innings, the one with the most runs is the winner. When the home team, which bats second, has more runs after the first half of the ninth inning, it does not bat. If both teams have an equal number of runs at the end of nine innings, the game continues until one side or the other, in equal innings played, can show a plurality of runs.

1. Positions.—The bases are called first, second and third base and home base or plate. All batting is done at home plate. The base running proceeds from home plate along the base lines (the boundaries of the square). A run is scored when a player, having successively touched first, second and third, reaches home plate.

Seven of the nine players on the fielding team take their stations prepared to capture (field) the ball as soon as possible after it is hit by the batter. The other two, the pitcher and the catcher, form the battery. The catcher stands behind and within stepping distance of home plate, but not close enough to impede the batter's activities.

The pitcher stands near the centre of that portion of the playing field known as the infield. He puts the ball in play by throwing it to the catcher. The batter stands on one side of home plate, within a prescribed area marked on the ground (the batter's box). He gets his chance to hit the ball as it passes him on its way to the catcher. He therefore stands facing the plate, swinging the bat with both hands, and in such a position as to be able to put the full force of his shoulders and arms into his swing at the ball.

Players are termed right-handed batters or left-handed batters according to whether they swing the bat from their right side or their left. A right-handed batter stands on the side of the plate nearer third base and looks at the pitcher over his left shoulder as the pitcher begins his delivery (*i.e.*, the pitching of the ball to the catcher). A left-handed hitter's stance is the reverse.



BY COURTESY OF "THE SPORTING NEWS"

FIG. 1.—OFFICIAL MEASUREMENTS FOR LAYING OUT BASEBALL FIELD

When the batter hits the ball inside fair territory, he is entitled to start running round the bases. Fair territory includes the area of the playing field between the foul lines. These are straight white lines along the ground marking two sides of the square (from home to first base and home to third), and prolonged beyond first and third to the limits of the playing field. Since it is only a fair ball that entitles the batter to run, the fielding team's defensive arrangement places its seven movable men within the fair territory. Four of them (the infielders) patrol the ground between first and second and second and third. The other three (the outfielders) are stationed in the wide sweep of the playing field from foul line to foul line beyond the two base lines. This area is called the outfield.

The outfielders are called right fielder, centre fielder and left fielder with relation to a man standing on home plate and facing out across the playing field toward second base, but there are no visible boundaries separating right field, centre field and left field. With the exception of the pitcher and catcher (and in their case only at the moment of putting the ball in play), there is no restriction on the movements of the members of the fielding team. The four infielders are named first baseman, second baseman, shortstop and third baseman, stationed in that order from first base around the rim of the infield to third. Their fields of operation are nearly as flexible as those of the outfielders. The arrangement of the fielding team at any given point in a game is changed to meet the needs of the existing situation.

2. The Umpires.—Play is under supervision and control of one or more umpires, acting as impartial judges and announcing decisions on whether the pitched balls pass over the plate within or outside of the strike zone, whether batted balls are fair or foul, whether a base runner has been put out by a throw or by tagging, or is safe (*i.e.*, entitled to hold the base he has reached by running).

Four umpires are usually on duty in major league games, one stationed behind the catcher, the other three covering the plays that occur at first, second and third bases. The home plate umpire starts the game by calling play for the first inning. The ball goes into play when the pitcher pitches it to the catcher. It remains in play except when an umpire calls "time," which is done on all foul balls except flies that are caught before touching the ground, also upon the request of either team at a time when the ball is being held by a player of the fielding team and no base runner is attempting to advance.

The request for "time" most frequently is made by a batter when he wishes to step out of the batter's box between pitches. Time is also called on the rare occasions when a batted ball strikes a base runner, and in other circumstances when the umpire's discretion so dictates.

3. Put-Outs.—The main offensive force at work in a baseball game at any given point is the batting team's ability to hit fair balls out of the reach of the defending fielders. Along with this batting power goes the running speed of the batting team in its efforts to traverse the bases.

To meet this force, the rules provide the fielding team with ways of making put-outs. A put-out removes the player from further offensive play until his next turn at bat. The batting team's inning continues until three put-outs are made; then it goes into the field and the rival team comes in for its turn at bat.

Most put-outs are made by (1) striking out the batter; (2) catching a fly; (3) throwing him out; or (4) tagging out a base runner. The batter is struck out when the pitcher succeeds in preventing him from hitting the ball into fair territory within the limit of three strikes. Strikes are counted on the batter whenever he swings at a pitched ball and misses, or when he does not swing at a pitched ball that passes him inside the strike zone, which is an imaginary rectangular plane in front of the batter. Its top and bottom are in line with his shoulders and knees respectively. Its long sides are perpendiculars extending upward from both ends of the front rim of home plate, which is a rubber slab, pentagonal in shape, level with the ground, two sides fitting exactly into the home plate angle formed by the third and first

base lines, and presenting to the pitcher a straight front margin 17 in. wide (*see* fig. 3).

The strike zone is thus a rectangle 17 in. wide, facing toward the pitcher, the length of its vertical sides depending on the height of the batter. When the ball passes through this rectangle at any point and the batter does not swing, it is a called strike, counting exactly as if he had swung and missed.

A strike is counted when the batter fouls the ball to the ground or out of the field of play. Fouling the ball means striking it with the bat but not driving it inside fair territory. This foul strike is not counted if the batter already has two strikes against him, provided he swings at the ball in fouling it. If, with two strikes, he fouls in an attempt to bunt, that is, merely blocks the ball with his bat instead of swinging, his foul counts as his third strike and he is out.

A batter is put out if a member of the fielding team catches and holds a batted ball before it touches the ground, whether it is fair ball or foul. There is the exception that a foul tip, a pitched ball that the batter merely flicks slightly with his bat, counts as a strike if caught and held by the catcher. It does not count as a put-out unless it occurs on the third strike.

A member of the offensive team is tagged out when he is running bases and is touched by the ball in the hand of a member of the fielding team at a time when the runner is not in contact with a base. A member of the batting team is thrown, or forced, out when he bats a ball that touches the ground before being caught but that comes within reach of a fielder (usually an infielder or the pitcher) in time for him to throw the ball to the first baseman so that the latter catches it and touches first base with his foot or some other part of his person while holding the ball securely before the batter can reach first base.

Only one runner may have title to a base at any given moment. It is therefore possible for a runner to be thrown out at second base, third, or even at home plate without being tagged. The batter becomes a runner entitled to try to reach first base safely the instant he hits a fair ball that strikes the ground. At that same instant, if there was a teammate on first when the ball was hit, that base runner is no longer entitled to first base and must run to second. If runners are on both first and second, or runners are on all three bases, they are all forced to run when the batter hits a fair ball that strikes the ground. Any base runner thus forced to run can be put out, or retired, without tagging, by the throw of the ball to a fielder who can touch the base to which the base runner is forced before the runner reaches it.

This method of retiring base runners is called the force play. With first base occupied and the ball driven along the ground to the pitcher or an infielder, the ball can often be first thrown to second base for a force-out of the man from first base, then relayed to the first baseman to retire the batter—two outs on one play. This is the usual form of the double play in baseball, one of the most effective and spectacular defensive tactics.

A runner can also be thrown out without being tagged if he has left a base to which he was entitled before the ball was hit and the batting of the ball results in a fly that is caught. With the catching of the fly, the runner must return to the base he just left before being eligible to advance. If the catcher of the fly can throw the ball to that base before the runner succeeds in returning to it and touching it, it counts as an out, retiring the runner as well as the batter by a double play of a different type than the force play "double up" described above.

In very rare cases a runner can be tagged out while standing on a base if, through confusion of mind or misjudgment of the play in progress, he remains standing on a base to which he is no longer entitled. In almost all situations of baseball, however, the bases form anchoring posts (isles of safety) for the players of the side at bat in their progress toward scoring runs.

Intentional Pass.—Frequently (sometimes as many as three or four times in a single game) there is a base on balls not due to the pitcher's inaccuracy (see *Base on Balls*, below) but performed by him for tactical reasons. The team at bat, for instance, has a runner in scoring position (*i.e.*, on second or third base, or both) but none on first. If, in the collective judgment of the pitcher, his catcher and his manager, the man at bat is more likely to make a safe hit than the man who will follow the man at bat in the opposing team's batting order, it is considered sound tactics to give the batter an intentional pass, or base on balls, to first base. The catcher moves from behind the plate to one side after the pitcher delivers the ball, and the pitcher delivers four pitches that the batter cannot reach while standing in the batter's box. The batter thus receives a base on balls and must go to first base, bringing to bat the man considered a weaker hitter.

The intentional pass has the additional merit of setting up a possible force play at second base which can materialize if the weaker hitter drives the ball along the ground within reach of an infielder or the pitcher or catcher. With runners on first and second a force play is also set up at third, and if both second and third are occupied when the intentional pass is given, there is made possible also a force play at home plate. The defensive side's advantage is in being enabled to make a put-out without tagging the runner trying for the base. Contact need merely be made with the base by a defensive player with the ball in his possession before the runner reaches the base. This advantage is of greater potency when there are fewer than two out, in which situation the batter's grounder can be converted into a double play, rescuing the pitcher and the defensive team from a scoring threat.

So valuable is this double play opportunity that often, when there is no disparity between the batting abilities of the two batters under consideration, the intentional pass will be ordered by the manager, solely to create the double play opportunity.

As countertactic when an intentional pass is given, the team at bat frequently replies by sending in a pinch hitter, that is, taking the weaker hitter out of the line-up and substituting another player whose likelihood for driving the ball for a hit or a fly to the deep outfield is greater than that of the player brought to bat by the intentional base on balls. Such a pinch hitter must be a player not already in the line-up, nor in the batting order at any previous time in the game. Pinch hitters are sent into action in other situations than as a rebuttal to an intentional pass. In fact, in nearly every baseball game, the late innings are marked by one or more substitutions of this type, made by whichever team is behind in the score.

4. The Attack.—When the plate umpire calls "Play ball," thus ordering the game to start, he has in his possession the batting order of each team, a list of nine names delivered by each manager as the order in which his players will come to bat, regardless of their defensive positions. This list is in force throughout the game in its original order of precedence. A substitute entering the game takes the place in the batting order of the player for whom he is substituted. A player leaving the game is not permitted to return.

Each team in its innings strives to advance its players around the bases to score as many runs as possible before the third out ends its inning. Each inning is a new game in the sense that it starts with the bases empty. The first man in the batting order is the first batter in his team's first inning. In subsequent innings, the first batter up is the man whose name in the batting order follows that of the last batter in the previous inning whose completed turn at bat resulted in the third out.

In cases where the third out is made on a fielding play that did not involve any hit or strike out or base on balls, or any other completion of the batter's turn at bat, the man at bat when the third out was made becomes the first batter of the next inning.

The rules permit runners to advance on the bases at their own risk of being tagged out at any time the ball is in play. The regular basis of advance, however, is the batted ball when it is batted into fair territory outside the immediate control of the fielding team. The acme of successful batting is to drive a pitched ball beyond the confines of the playing field (usually into the stands among the spectators, or completely out of the park) inside fair territory (*i.e.*, between the foul lines). A ball so driven is called a home run. It has passed beyond the reach of any fielder and entitles the batter to run at any speed around the bases to score a run at home plate. Any and all runners who are on base when the home run is hit likewise make their way to the plate in

the order in which they reached base and register a run each.

Failing a home run, the batter aims to drive the ball in such a way that it cannot be caught before touching the ground in fair territory nor caught after touching ground soon enough to be thrown to first or any other base before the batter or other runners get there. If he succeeds in this, he has made a hit. If he reaches first base, it is called a one-base hit or a single. If he drives it far enough so that he can reach second base safely, it is a two-base hit, two-bagger or double. A hit long enough for the batter to reach third base is a three-base hit, three-bagger or triple.

With the ball thus hit by the batter into fair territory, any members of his team who are already occupying bases advance as close to home plate as possible before the ball is returned to the infield. They must reach their objectives without being tagged out; thus their judgment of how far they can go when the ball is hit safely is a major element in successful attack.

A batter hitting the ball inside fair ground and reaching first safely because of a fielding lapse (*i.e.*, failure to catch the ball or inaccurate throwing) is not credited with a hit. The failure of the fielder appears in the record of the game as an error committed by him. Failure to tag a runner with the ball when a chance offers to make a put-out by this method also counts as an error.

Base on Balls.—A batter may reach first base without having hit the ball. This is nearly always the result of inaccuracy by the pitcher in his efforts to make the batter hit a bad ball (*i.e.*, a ball passing the batter at a point where the batter cannot hit the ball with his full power). Whenever the batter does not swing at a pitched ball, and the ball does not cross the plate inside the strike zone, the umpire standing behind the catcher announces "one ball." If four balls are thus declared in a single turn at bat, that is, before the pitcher has thrown three strikes, the batter is entitled to go to first base without a play being made on him, the recipient of a base on balls. A game without a base on balls for any batter of either side is unusual. In an average game there are from four to a dozen bases on balls.

Hit by Pitched Ball.—The batter reaches first base without hitting the ball if a pitched ball at which he does not swing strikes any part of his person. The umpire then awards him the right to go to first base. A team may go for days, or even weeks, without any of its batters reaching first by being hit by a pitched ball.

Interference.—The batter also reaches first base if the catcher interferes with him by touching any part of his body or interferes with the swing of his bat as the pitched ball is on its way to home plate. If, in the umpire's judgment, this has happened, the batter is awarded first base and the catcher is charged with an error.

Missed Third Strike.—If with two out, or with the first base unoccupied regardless of how many are out, the batter swings and misses the ball for his third strike, and the catcher does not catch the pitched ball before it touches the ground, the batter is entitled to run for first just as if he had hit the ball along the ground in fair territory. The batter is also entitled to run to first base if the catcher misses a third strike that the batter does not swing at. The catcher must then get the ball and throw to first ahead of the batter in order to put him out. In instances when such a pitched ball rebounds off the catcher out into the infield, the pitcher or any infielder may make the pickup and throw to first just as if it were an infield grounder. This right to try for first base does not exist when first is occupied and there are fewer than two out, because, if it did, the catcher might drop the ball directly in front of him and thereby create the opportunity for a double play, throwing to second to force out the man on first, the double play then to be completed by a throw from second to first before the batter arrived at first. Missed third strikes are uncommon in the professional leagues.

The Infield Fly Rule.—Similar protection is afforded the batting side by the infield fly rule, in instances where, with both first and second occupied, or with first, second and third bases occupied, and fewer than two out, the batter hits a high fly that in the judgment of the umpire can readily be caught by an infielder or the pitcher or catcher, inside fair territory. When such a fly is hit in such circumstances, the umpire immediately declares the batter out, whether or not any member of the fielding team subsequently catches or misses the ball. This law was enacted in 1895 because clever infield players would pretend to catch the fly, but at the last moment would let it strike the ground, thus setting up a force play at both third base and second base, which could be made a double play by quick and accurate throwing. An attempt to bunt, however, under the conditions noted above, which results in a fair fly shall not be regarded as an infield fly.

Stolen Bases.—The base runner can wait on a base until a teammate drives the ball out of reach of fielders, enabling him to travel further on his road to home plate to score a run. The rules do not compel him, however, to wait for the ball to be batted. His only restraint is the threat of being tagged out, that is, of being touched with the ball in the hand of a member of the fielding team at a time when he is not on a base. Obviously, a dash for the next base when the ball is being held by the pitcher, the catcher or an infielder, makes the runner almost a certain out. When the pitcher delivers the ball to the batter, however, the runner can match his speed with the strength and accuracy of the catcher's arm. If the runner makes such an attempt and succeeds in reaching the next base without being tagged out, he is said to have stolen a base.

In 19th-century baseball and the first 25 years of the 20th century, the stolen base was a prominent and spectacular feature of baseball. In the years immediately following World War I, better materials and improved machinery in the making of baseballs brought on the era of the "lively ball." It became more advantageous to wait for the batter to hit the ball than to risk the matching of speed against fast and accurate play by the catcher and the infielder guarding the base to be stolen.

Except in cases of speedy players with a flair for getting the jump on the pitcher and in avoiding the tagging stab of an infielder's hands, stolen bases as individual exploits ceased to be a usual procedure.

The Hit-and-Run.—Attempts at stealing bases in modern baseball usually take the form of the hit-and-run play, in which the batter co-operates with the runner. It requires a fast base runner and a coolheaded, keen-eyed and quick-thinking batter and is rated as a risk play, a gamble not highly favoured by most managers except in emergencies.

When it is used, the setup almost always calls for a runner on first, but on no other base. The runner starts for second as the pitcher begins his pitch. If the second baseman shifts to be in position to receive a throw from the catcher, the batter tries to drive the ball along the ground through the area ordinarily guarded by the second baseman. If it is the shortstop who has thus covered second, the batter tries to drive the ball through the shortstop's just-vacated sector.

When the batter succeeds in his effort, the ball goes to the outfield as a hit and the runner usually reaches third base easily. There are lesser degrees of success. The batter may hit the ball along the ground but not through the open sector. This results usually in an out at first base on the batter, with the runner reaching second safely, moderately advantageous, since it has placed the runner on second, in position to score on an ordinary one-base hit to the outfield by a subsequent batter and has removed the double play menace that always exists when a runner is on first base with fewer than two out.

If the batter hits a fly, the runner must quickly retrace his path and regain first base, which is usually done easily. If the batter misses the ball entirely, the most he has accomplished is to offer a visual hazard to the catcher's throw to second base. The play in this instance takes the pattern of a plain attempt to steal second. In every major league season a large percentage of the stolen bases credited to players are the result of hit-and-run plays in which the batter fails to hit the ball.

Since the hit-and-run play involves two players, there is usually the exchange of a secret signal between them, preceded by a signal to both of them by the manager or one of the coaches.

The coaches, two in number, are stationed outside the base lines, one near first base and the other near third. They are advisers to the base runners and liaison operatives between the manager,

batter and runner. Coaches are usually experienced men whose days as players have ended. Besides their duties during the game, they act as all-around assistants to the team's manager. In the major leagues the manager has at least two, often three, of these assistants.

The manager himself may elect to serve as a coach in the play of the game, usually choosing the position at third base, since it is there that the most vital decisions of base running must be made, namely, whether to stop the runner at third or to let him keep on running and try for home plate.

When the manager is directing play from the coach's box, the hit-and-run signal travels directly from him to the batter and runner. If he is a bench manager, he signals to one coach or the other. If the defensive team detects the signal or suspects from some action or attitude of either player that the hit-and-run play is about to be used, their defense calls for a pitch-out. As the runner starts his dash, the pitcher pitches the ball to the catcher at a point outside the reach of the batter's bat, thus putting the catcher in position to make a clear throw to second.

The most disadvantageous outcome of the hit-and-run play occurs when the batter hits a line drive that is caught by the pitcher or an infielder. Such a drive, traveling low and fast and caught within a fraction of a second of its leaving the bat, retires the batter instantly and makes a double play virtually inevitable, since the ball is caught within easy throwing distance of first and the runner, at the moment of the catch, has gone more than halfway to second. The fly catch rule requires him to return to his base, under penalty of being put out, before the ball is held on that base by a defensive player.

The Bunt.—Nearly every time a batter tries to hit a ball he takes a full swing, aiming to drive it as fast and as far as he can. He puts every ounce of muscle into his swing, stepping "into" the ball as it approaches him and lashing at it with the bat held in both hands and powered by wrists, arms, shoulders, back and hips. There are times, however, when he bunts the ball, tries to tap it lightly with the bat to make it spill along the ground 12 or 15 ft. into a zone about halfway between pitcher and catcher and off to one side or the other of a straight line from catcher to pitcher. In bunting, the batter usually relaxes his grip on the bat and, instead of swinging, merely holds out his bat so that the ball strikes it and plops to the ground with only enough force to send it out at a point in the infield. The bunt is always a strategic action. The batter therefore tries to conceal his intent as long as possible so that neither the pitcher and catcher nor the infielders can get the jump on the play. The bunt is usually intended to be a sacrifice, that is, the batter expects to be thrown out at first base. His purpose is to enable one or more runners to proceed to their next base while the play is being made on his bunt, retiring him at first base. He thus sacrifices himself in the interests of advancing a potential run or two.

At most stages of any game, most managers will order a bunt whenever both first and second bases are occupied with none out. So faithfully is this done that sometimes the defensive team shifts its infield arrangement so that the first baseman and third baseman are stationed 10 or 20 ft. closer to home plate than ordinarily. This invites a tactical change by the batter to cross them up by swinging instead of bunting, but the sacrifice bunt is rated so sound a procedure that only rarely does the attacking team discard it, no matter how close the infielders play.

When a bunt is the expected tactic, the defensive team exerts every effort to defeat it. The pitcher resorts to high fast pitches because it is harder for the batter to dump the ball along the ground if he has to reach high and the greater the speed of the pitch the less likely the batter will be to hit the ball at all or, hitting it, to control its course. A bunted ball going foul counts as a strike even after two strikes; therefore, a pitcher having succeeded in getting two strikes on a bunting batter can usually count on the batter not risking a third strike on a foul bunt.

When the ball is successfully bunted, the defensive team is quick to seize any chance there may be to defeat it by fielding the ball to second or third base for a force play. Exact judgment is required for this play, for the runner, expecting the bunt, is off at top speed the moment the ball and bat are in contact. Catcher, pitcher and either the third baseman or the first baseman are usually rushing toward the ball. The one who reaches it usually gets shouted advice from the others as to where to throw the ball, whether to try for the force play or merely to throw to first to retire the batter.

When the ball is bunted toward first, drawing the first baseman toward home plate, it is the task of the second baseman to run over to first base to receive the throw for the put-out. In this situation the shortstop covers second base and the third baseman covers his own base.

When the ball is bunted on the third-base side of the diamond with first the only base occupied by a runner, the third baseman joins the pitcher and catcher in trying for the ball, the first baseman or the second baseman covers first and the shortstop moves over to defend second. The third baseman then drops back to protect third base in case of an error.

If there are runners on first and second when the ball is bunted toward third, it is the pitcher's play to field the ball, unless the bunt is so short that the catcher can overtake the ball. If the bunt is deep and directly down the third-base line, then the third baseman must come in to play it and throw to first base in an attempt to retire the batter. This is the "perfect" sacrifice, since the batter has bunted adeptly enough to make the third baseman leave his station, thus advancing the two base runners. The catcher is the man with the entire picture of the play in front of him. On any bunt, unless he can field the ball himself, it is usually the catcher who calls out instructions as to where the ball is to be thrown.

The Squeeze Play.—The bunt is also used to sacrifice a runner home from third base, but the technique is somewhat different. On a prearranged signal, as the pitcher starts delivering his pitch the man on third must start running toward home plate. This is an all-or-nothing play. If the batter misses entirely, the catcher, by catching the ball, has the runner trapped between third and home, a certain out, unless the runner resorts to dodging back and forth and some error of throwing or catching allows him to escape. The bunt with a runner rushing home from third is called the squeeze play. If the batter can bunt the ball into fair territory, it means a certain run scoring for his side, because of the runner's flying start. The best the defensive side can do is to throw out the batter at first base. The squeeze play is the most spectacular and most dangerous sacrifice bunt.

An expert batter, gifted with exceptional running ability, will sometimes bunt the ball when there are no teammates on the bases. The unexpectedness of his action and his speed sometimes enable him to reach first before the ball can be thrown there. This is known as beating out a bunt and counts as a one-base hit, just as if he had swung and driven the ball far enough to reach first safely.

A batter assigned to sacrifice sometimes beats out his bunt, but only rarely, because when the sacrifice is in order, he takes particular care to meet the ball fairly. The batter who aims solely to beat out a bunt for the purpose of getting on base himself takes a quick stab at the ball. In fact, such a batter starts to run for first base an instant before his bat touches the ball, whereas the sacrificing batter loses this flying start in his effort to assure himself and his team of a squarely bunted ball.

III. SPECIAL SKILLS

1. Offensive.—Each of the nine players on a team must take his turn at bat. The strongest hitters are grouped one after the other, starting with the third position in the batting order. The first two positions, lead-off and no. 2, are assigned to players with keen eyes and brains, those fast afoot, usually not so powerful in driving the ball for distance as the no. 3 and the cleanup man, no. 4.

The best lead-off man is one who can know whether the pitch will be a strike or a ball if he lets it pass him without swinging. Such a player is called a "waiter." By waiting out the pitcher, letting the bad ones pass, he draws many a base on balls which a less accurately judging batter would not receive. In his strategic

position, first batter up in the first inning, and following the weak-hitting pitcher in the other innings in which he bats, a base on balls for him is usually just as advantageous to his team as making a one-base hit. Getting on base is the lead-off man's main offensive function, since over a stretch of games his run-driving opportunities are relatively few.

For no. 2 the manager selects his best hit-and-run man, the batter who is most skilled in driving the ball toward the right side of the field. When there is a runner on first, the first baseman is "tied to the bag," that is, he takes his position on or close to first, thus opening a wider sector through which the ball may safely be driven along the ground into right field. The ability to hit the ball in this direction is important, especially on a hit-and-run play with the runner rushing for second as the pitcher pitches. The no. 2 man must also be a capable bunter.

No. 3 is usually the best all-around offensive player on the team, with speed afoot combined with batting power and skill. The greatest hitters of all time have been in the main no. 3 in their team's batting order—Tyrus R. ("Ty") Cobb, George Herman ("Babe") Ruth, Rogers Hornsby, Edward T. ("Eddie") Collins and George Sisler, for example. No. 4 and no. 5 are the long-distance hitters, not likely to hit the ball safely as large a percentage of times as no. 3, but often with greater distance. The remaining positions in the batting order scale downward, and it is there one finds the highly skilled defensive stars, players whose value to the team is their mastery of their fielding positions. No. 9 is invariably the pitcher, the most specialized of all players, whose hitting ability is usually negligible. There are rarely pitchers with batting ability, but because a pitcher is called on for duty only about once in four or five days, even pitchers so gifted do not have the chance to continue tuned up. Their batting ability is rarely considered; whereas in the other positions a man's worth always represents his combined batting and fielding skills.

2. Defensive.—There is no rule relating a man's position in the batting order with his position on defense; fielding positions may be rearranged at any point in the play. In the scale of defensive skills, pitcher is no. 1, shortstop is no. 2, second baseman is no. 3, then catcher, centre fielder, first baseman, third baseman, then the two flanking outfielders, whose degree of fielding importance relative to each other depends on the comparative areas and other physical hazards of their respective fields, determined usually by the contour of their home playing field's outfield boundaries.

This scale of skills is the basis of the baseball expert's argument in rating one team superior to the other defensively because it is stronger "down the middle." An outstanding team usually has a star player at each "middle position": catcher, "the keystone combination," meaning the second baseman and shortstop, and centre fielder.

It is obvious that when two aspirants for one fielding position are equal in batting ability, the better fielder is chosen to play that position in the game; likewise, when the two are of equal defensive skill, the better batter gets his name in the batting order. The lower the position stands in the scale of skills the less there will be to choose among aspirants on the ground of fielding skill. It follows that batting ability will overshadow fielding considerations in positions such as right field or left field, third base and even first base, whereas in the middle positions the manager will weigh very carefully the fielding merits in making his selections. He must have for his shortstop the best possible fielder of the position he can find, regardless of batting, and whatever such a star fielder can furnish in hitting power is sheer profit. But his right fielder and his left fielder must be hitters, and their ability to run faster, to judge a fly ball more accurately or to throw a ball straighter is a secondary consideration.

3. Outfielders.—Of the three outfielders collectively, less is required in the way of special skill than in any of the other six positions. All the catching of thrown balls, all tagging of base runners and all plays on ground balls to retire runners at bases take place in the infield and the immediately adjacent terrain. The outfielders are stationed in order to be able to catch batted balls driven reasonably high in the air beyond the infield. They must be able to judge the trajectory of such flies and have speed of foot to run to the point where the ball will come down.

Batted or thrown balls that pass beyond the infielders along the ground must be run to earth and picked up by the outfielders. Strong throwing arms are essential, and the more accurately an outfielder can throw the ball to the right point in the infield, the more valuable his defensive services. An alert outfielder can also add to his value by moving in as a backer-up of the infield when the ball has been batted to some point other than his own area and is being thrown about by his teammates in an effort to retire runners.

The centre fielder rates high in the fielding scale because of his central position in the outfield. He must be a "ball hawk," possessing great speed and expert judgment of a batted ball's trajectory. The accomplished centre fielder makes a study of all the important batters of rival teams. He keeps a mental chart of each batter's power (*i.e.*, toward which point in the rim of the outfield the batter's longest drives usually are directed). The centre fielder will not only station himself at a strategic point to meet each threat but will direct the playing positions of his outfield teammates on either side. The difference between a three-base hit and a put-out is often such a strategic shift of position. Almost invariably the great defensive outfielders of baseball history have been centre fielders (Tristram E. ["Tris"] Speaker, Max Carey, Terry Moore, Joseph P. ["Joe"] DiMaggio, to name a few). Not as much skill is demanded in right field or left field as in centre, but a right fielder or left fielder can employ all the talent he has in the way of speed, judgment, throwing, etc., to enhance his own value and further his team's defensive solidarity. It is a thrilling play when an outfielder aids in a double play. Such rare feats occur when a base runner misjudges the fielder's ability to overtake and catch a well-hit fly ball that is returned to a base before the runner can scramble back to the base and tag up as the rule requires.

4. Infielders.—The outfielders form the outer ring of defense against the batting of the opposing team; the infielders form an inner ring, four strong, their function to field the ball at close range. They capture on the fly line drives when such drives come within reach, but mainly their work on batted balls is the picking up of grounders, when the ball is batted so that it skips along the ground toward the outfield or shoots swiftly across the grass on one or more bounces. The fielding of a grounder is baseball's most characteristic play, setting it apart from most other sports. When a batted ball strikes the ground, the game becomes a race between the batter's speed in running from home plate to first and an infielder's agility and adroitness in gaining control of the ball and throwing it.

The four infielders shift positions to guard against each batter's individual power, as do the outfielders. They have the additional responsibility of guarding the bases when any or all of them are occupied. When a ball is batted along the ground, only one of them is called on for the effort to gain control of it, but at least one of the others is almost always involved in covering a base to take the throw; sometimes two bases must be covered for a possible throw, sometimes all three.

In the many situations arising in the course of one game, the infielders must adjust themselves correctly, rapidly and in co-operation in order to be efficient. The fielding of grounders—pickup and throw—is the common skill of all four infielders. Each position has its special modifications of fielding requirements.

At shortstop the throw is the longest and/or most difficult, whether the batted ball is a swift one shooting toward the outfield to the shortstop's right or left or straight at him, or is a tantalizing slow "skipper" for which he must rush toward the plate in order to field it quickly and have a chance to retire the batter.

The second baseman's function on grounders is the same, except that his throw has a shorter distance to travel to reach first, giving him an extra instant of time. Offsetting this advantage somewhat is the fact that the shortstop faces first in all instances except when a ball is off to his right, while the second baseman, on most of his grounders, must throw "around the corner." It is a baseball saying that a good shortstop can always move over and become a good second baseman, but even a very good second baseman can rarely

become an even adequate shortstop, mainly because of the extra throwing skill and power demanded by the shortstop's location in the fielding strategy.

On a force play at second, whether part of a double play or not, either the second baseman or the shortstop must cover second to catch the throw with his foot on the base, just as the first baseman does on an out at first. The force play is always a potential double play. The second baseman, coming to the base to take the throw, has first base over his left shoulder, so that he must throw around the corner to complete the double play. Thus, skill in pivoting is an important part of a second baseman's category of talent.

The third baseman, playing nearer the batter than the shortstop or second baseman, must be agile and nimble but is not called on to scurry over as wide a zone as they. The grounder aimed his way reaches him or is past him into the outfield sooner than is the case at second or short. On his most difficult play, the fielding of a bunt or a dribbling roller halfway between home plate and his position, the third baseman finds himself with a throw to first which is shorter than any the second baseman or shortstop is ordinarily called on to make and often has more time in which to make it.

The first baseman's fielding of grounders is made easier because of his proximity to the goal for which the batter is striving. Often he is able to touch base with his foot, with ample time to spare, after picking up the grounder. When there is not time for that, his throw is a mere underhand toss to the pitcher as the pitcher moves over to cover first.

The first baseman's most difficult play develops when there are runners on one or more of the bases and the fielding of a grounder involves a throw to second, third or home. Such plays are rare by comparison with the number of throws made by the other infielders. Because they are often important, it is considered an advantage for the first baseman to be a left-handed thrower, making it a more natural movement for him than for a right-handed thrower.

Second basemen, shortstops and third basemen in modern baseball are invariably right-handed throwers. Catchers in modern baseball are always right-handed. Pitchers and outfielders may throw with either hand.

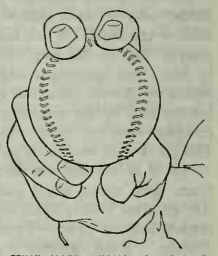
5. The Battery.—The pitcher and catcher together are known as the battery or as batterymen. The pitcher functions as an emergency first baseman when a grounder is driven toward the first baseman at a point so far from first that the first baseman has not time to field the ball and run to the base before the batter will reach it. This is not a difficult fielding play for the pitcher, provided he starts running promptly. The distance from the pitcher's box to first is roughly two-thirds as far as the distance the batter must run. The pitcher can easily get there ahead of the batter. All that remains is to catch the ball tossed to him by the first baseman and touch first base with his foot. It is a fairly common play, though sometimes throughout an entire game the pitcher may not be called on to make it.

Otherwise the pitcher's fielding functions consist of trying to field any ball batted in his direction, to catch it and hold it for the out if it is a line drive or a fly that does not go high enough into the air for the catcher or one of the infielders to reach it before it will strike the ground, to pick it up and field it to some base if it has struck the ground.

On bunts the pitcher functions as an infielder, covering his share of the zone between the foul lines and between the pitcher's box and home plate. Fielding skill is an important asset to a pitcher. It can save him many a game and make up for a moderate degree of deficiency in pitching skill. Without fielding talent a pitcher can be successful only by the possession of exceptional pitching ability.

The catcher, as a fielder, is mainly a catcher of high flies, a thrower and a guard at home plate. The flies he is called on to catch are "skyscrapers," batted balls that soar almost straight upward from the bat and come down somewhere between the base lines and the grandstand or else directly in front of home plate. Keenness of vision to perceive the angle at which the ball leaves the bat is the indispensable attribute necessary to get a quick start in the right direction from home plate. Unerring catching of such flies develops a special sense in catchers not required in any other position. The ball is high in the air directly overhead and coming down at him almost perpendicularly.

The "good hands" essential to every player are especially important for the catcher. Throughout the game he must catch the pitched balls not hit by the batter, sometimes pitches that strike the ground near the plate. Sometimes he must jump for high ones or wide ones. The bat swinging directly in his visual line as he reaches for the pitch is no hazard to him. From long use he has become accustomed to it. It is when the bat flicks the ball slightly in passing that the catcher's good-handedness pays off. If the batter has two strikes, the ability of the catcher to catch the ball and hold it makes the difference between a strike out, ending the batter's turn at bat with a put-out, and potential trouble. Such a foul tip, eluding the catcher's grasp, becomes a mere foul ball, counting nothing against the batter and, in fact, granting him one more chance to hit safely.



FROM ETHAN ALLEN, "MAJOR LEAGUE BASEBALL," THE MACMILLAN COMPANY

FIG. 2.—HOW THE PITCHER "GRIPS" THE BALL IN THE ACT OF DELIVERING IT TO THE BATTER

The catcher sometimes fields a bunt or a half-hit ball spilling just in front of the plate. Agility in pouncing upon the ball and accuracy in throwing to the proper base are then required. The catcher's throwing arm is a valuable item in his team's defense. Base runners will be chary of straying too far from their bases when the catcher has a quick and strong arm ready to shoot the ball to the baseman for a tag-out before the runner can scramble to safety. When a runner attempts to steal a base, the attempt usually begins as the pitcher starts pitching the ball to home. Unless the batter hits the ball, the play then becomes a match between the catcher's throwing arm and the runner's speed.

6. Pitching.—Important as is his fielding, the catcher functions even more importantly as the counselor of the pitcher. The catcher is, besides, the only player in the defensive line-up who has the whole game in front of him at all times. He is the man best placed for directing advice to teammates when necessary.

When a batter comes to bat, the pitcher and catcher operate against him as a unit, the battery. Up to the moment the batter hits the ball, the whole game is this duel between batter and battery. The pitcher is equipped with a strong arm, able to fire the ball across home plate so rapidly as to offer the batter only a flicker of time to decide whether or not to swing at it.

Besides sheer speed, the pitcher has other resources in the way of curves, change of pace, screwballs, sliders, etc. These represent ways of throwing the ball so that its course through the air diverts from the usual line of a fast ball, causing the batter to go off his stride, swing too early or too late at the ball, strike it merely a glancing blow or miss it entirely.

Before each pitch, the catcher, squatting behind the plate with his hands together between his knees, gives signs to the pitcher. With the fingers of his bare hand he transmits to the pitcher instructions for the next pitch. The catcher's knowledge of his pitcher's abilities shapes his decisions on each pitch, and his knowledge of the batter's abilities and peculiarities guide him in his choice.

Most batters get their greatest power into a drive when the ball comes to them a little above waist level. A minority are low-ball hitters, preferring a pitch between the belt line and the knees. With most batters it makes a difference whether the ball is inside or outside, that is, across the plate near the edge that is closer to the batter or the rim of the plate farther from him. Most batters can more readily hit a fast ball, that is, a straight one, than a curve or any of the breaking balls. Some gifted batters have more success when the ball breaks, a factor in this phenomenon being that the breaking ball is always less swift in its course than

the fast one. Nearly all batters have a blind spot, or hole, of greater or less extent, somewhere in the strike zone. If the pitcher has good control, he can pitch the ball across the plate through this hole, and the batter is virtually helpless, either missing the ball or striking it an ineffectual glancing blow.

The mental capacities and experience of each pitcher determine how much of the battery's collective thinking is done by the catcher. In general, the catcher is the boss. Veteran pitchers, learned in the ways of batters in general and with their own special systems of pitching to each, need little assistance from the catcher. But for most pitchers, particularly young ones or new ones, it is the physical skills that occupy their attention, while the catcher does the thinking, makes the decisions of what to pitch and where.

Even in the case of a veteran pitcher, the catcher keeps his partner under constant study, alert to detect signs of weakening. In the major leagues for most clubs in the course of a season, only about half of their games, usually less than half, are transacted with a single pitcher playing the entire game. Sometimes three or four pitchers divide the work. It is often the catcher's verdict, upon consultation with the manager, that brings about the removal of one pitcher and the substitution of another.

In 19th-century baseball, up until about 1870, the pitcher was merely a player assigned to put the ball in play by pitching it to the batter to hit. One man usually did nearly all the pitching for a club all season, with a change pitcher to relieve him of some of the load at times. This change pitcher was usually an outfielder. The two would often merely exchange fielding positions without leaving the game.

With the start of league baseball in the 1870s, the pitcher became a stronger factor in defensive play. His use of speed and curves became a deciding element in championship contests.

A major league club has 25 players on its roster normally. Usually nine or ten of these are pitchers. A team's infield and outfield line-up may remain intact for weeks on end, barring injuries and illnesses. Its regular catcher occupies that position in about two-thirds of the season's games. Each regular pitcher, however, requires about three or four days' rest between assignments, spending his time during his rest days at light exercise, running about the outfield during practice, seeing to it that his pitching arm is moderately exerted each day but in general merely keeping in shape until his next turn to pitch.

In a staff of ten pitchers, the manager earmarks his best four or five at any given time as starting pitchers. These are the regulars. They take their turns every four or five days, resting in-between. The remainder of the staff constitutes the bull-pen squad or the relief pitchers. When the catcher detects signs of weakening on the part of the pitcher in the game, these bull-pen pitchers begin warming up. Near their bench regulation-size home plates are embedded in the ground. At the correct distance from each of these plates is a pitcher's box. They warm up by throwing practice pitches to substitute catchers. The bench, together with the practice ground, is known as the bull pen. An effective relief pitcher is one who can depend upon his ability to control the placement of his pitches, as he often enters the game at a stage in which the offensive team poses a scoring threat with one or more base runners and a dangerous hitter at bat. Two or three relief pitchers each day are assigned to be ready for the call to substitute for the starting pitcher.

Control.—The catcher is quick to perceive signs of tiring on the part of the pitcher, a slowing up of his fast pitches, a dulling of the break in his curve. From other points of vantage, the pitcher's tiring becomes evident in loss of control.

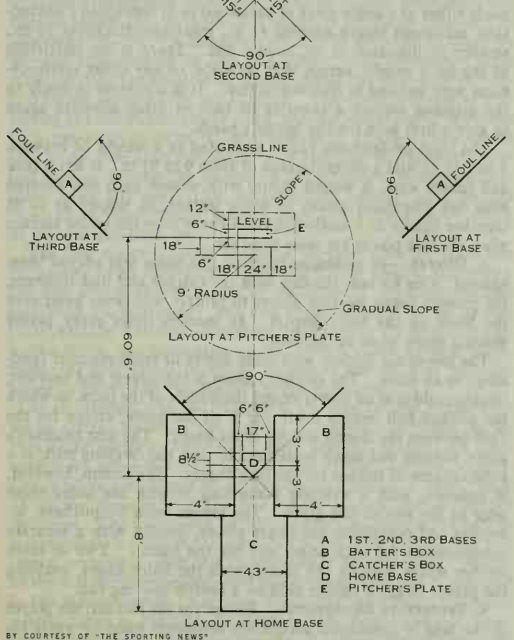
Pitching demands more of a man in the way of exact co-ordination of mental and muscular faculties than any other activity in the game. He is aiming at the strike zone, an area the width of the front rim of home plate (17 in.) and the height from the batter's shoulders to his knees (about $3\frac{1}{2}$ ft.).

The pitcher's "target" above home plate is at a point 60 ft. 6 in. from the plate against which the pitcher's pivoting foot must push in the act of pitching the ball. This plate is of composition, 24 in. long, 6 in. wide, placed with its long sides facing home plate and second base.

The term "pitcher's box" is a holdover from 19th-century baseball when an oblong area was marked out by white lines on the ground for the pitcher to occupy in the act of delivering the ball. In 1894 the actual drawing of a box on the ground was discarded in favour of a slab of rubber, 12 in. by 4 in., for the pitcher to step on when delivering the ball. The term "box" has continued in use, however, referring loosely to both the pitching plate and the immediate area surrounding it for nine feet in every direction. This circular area is kept free of grass and rises in a gentle slope to the point where the pitching plate is imbedded. The plate is level with the ground at the summit of the slope. The rules specify that the summit shall be not more than 15 in. above the level of the base lines.

Lapses of control apparent to spectators take the form of bases on balls or numerous safe hits. Less often as a pitcher begins to tire, the loss of control results in hit batsmen. Each base on balls puts a potential run on first base, as does each hitting of a batter with a pitched ball. Sometimes a weakening pitcher's flustered nerves result in what is known as a balk, which can prove costly if occurring at a critical point in a close contest.

The Balk.—A balk is a departure from the restrictions imposed upon the pitcher by the rules and can only be committed with a runner or runners on base. In pitching the ball to the batter the pitcher must have his pivoting foot in contact with the pitching plate. If he does not, a balk is declared by the umpire. The pitcher must hold the ball in both hands in front of him at chest level before starting his delivery. Once started, he must continue his motion so that the ball is delivered to home plate. If he starts to make a throw to a base when a runner is occupying that base he may not stop, but must go through with the throw, otherwise a balk is called and all runners on bases at the time advance one base each. With a runner on third, a balk thus results in the gift



BY COURTESY OF "THE SPORTING NEWS"

FIG. 3.—OFFICIAL MEASUREMENTS OF HOME BASE, THE PITCHER'S PLATE AND THE THREE BASES

of one run for the offensive team. The balk rule was clarified at a meeting of major and minor league officials in Nov. 1953. Under the old regulations the ball was declared dead as soon as a balk was called. The runners, if there were any at the time, automatically moved ahead one base each as a penalty for the infraction, but the batter was not involved and anything he might have done on the pitch was nullified by the balk. Under the 1953 ruling the batter became definitely involved. If he hits a balk pitch for a home run or for a shorter safety, if he drives the ball through a fielder's position for an error, or if it is a fourth ball or a wild pitch, the batter's team has the privilege of accepting the result more favourable to its interest. Thus, the balk is declined in most cases where the runners advance or in cases where the batter reaches base safely on the results of the balk pitch.

The Pitching Repertoire.—A pitcher's speed is usually the index of his general ability. A diminution in the speed of successive pitches is the symptom the catcher sees most often as a forecast of disaster. Originally, speed was the pitcher's sole reliance in his effort to thwart the batter. The curve was developed in the late 1860s. Other variations from the straight line of fast ball pitching have developed in succeeding epochs, but fundamentally the fast ball continues to be the basis of pitching skill.

The fundamental or regulation curve is a swerving pitch which breaks away from the straight line downward and across home plate in the direction of the catcher's right knee if the pitcher is right-handed; toward the catcher's left knee if the pitcher throws left-handed.

Many pitchers employ a curving ball whose break slants the opposite way from the regulation curve, a pitch known variously as the fadeaway (Christopher ["Christy"] Mathewson) or the screwball (Carl Hubbell), or some pet name applied by the pitcher himself who has mastered its secrets. The effect is to endow the pitcher with a reverse curve; thus Mathewson, a right-handed pitcher, used the conventional curve to break the ball away from right-handed batters, and his fadeaway to break it away from left-handed hitters. Hubbell, a left-hander, used his screwball to slant the pitched ball out and beyond the reach of right-handed hitters, using the regulation curve when facing a left-handed hitter.

In the case of both curves and reverse curves, the ball reaches the batter at a slower rate of speed than the fast ball, and the deception is almost as much due to the slower ball's falling away from the bat as to its swerving from the straight trajectory from the pitcher's hand to catcher's glove. Comparatively few pitchers use the "knuckle" ball, whose power lies in its almost entire lack of axial rotation as it sails toward home plate. This absence of spin makes it the plaything of air currents, so that, when the knuckles are expertly employed, the ball is wobbly as it approaches the batter, making it harder to hit solidly than a spinning ball sailing along "on the beam."

IV. UNIFORMS AND EQUIPMENT

1. Uniforms.—The uniform consists of a cap, a blouse, pants, stockings and shoes. In league baseball the home team usually wears white blouses and pants. Gray is the prevailing solid colour of the blouses and pants of the visiting team. All the players of the same team must wear uniforms of exactly the same design and trimming in league games. An identification number is worn by each player on his blouse so that by referring to the printed scorecard the spectator can identify the player. On some teams each player wears his name on his blouse.

The cap has a visor as a shield from the sun. Sun fielders, outfielders whose location makes it necessary for them frequently to stare into the sun when judging the flight of the ball, have the peaks of their caps equipped with sunglasses. These are usually fastened on the underside of the cap's visor, snugly out of the way most of the time, but with a device that enables the outfielder to snap them into position when the ball is batted in his direction high in the air.

The blouse is collarless, without sleeves or with abbreviated sleeves usually ending halfway from shoulder to elbow. Under the blouse the player may wear a flannel undershirt.

The pants cover the player's knees, the elastic at the bottom pinching in just below the knee joint, with ample material to allow freedom of knee motion in running and to afford a degree of protection from abrasion by sudden, forceful contact with the ground. Most players wear, along the outside of each thigh, under the pants, sliding pads, two pieces of padded felt reinforced with leather and suspended from the waist. These pads protect the sides of the player's legs when he flings himself feet first along the ground (sliding to a base), as well as from abrasions that might be suffered in unintentional tumbles.

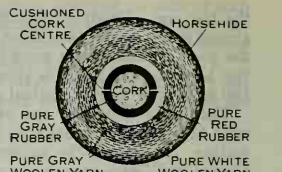


FIG. 4.—CROSS SECTION OF A BASEBALL

About nine inches in circumference, the ball weighs about five ounces

Players wear white cotton stockings underneath woolen coloured stockings. The woolen stocking usually is footless, its bottom consisting of an elastic band which passes beneath the player's instep.

The shoes are Oxford style, very light in weight, with flexible soles and heels. Each shoe has three prongs (spikes) on the sole and three more on the heel. These spikes, whether attached to the shoe individually or to triangular metal "spike plates," give the player a good grip on the ground, whether it be turf or the grassless dirt surface of the base lines. The pitcher also wears on his pitching foot (right foot for a right-hand pitcher; left foot for a southpaw) an additional pitcher's plate, a metal reinforcement at the inside of the toe, to give him a better foothold in the act of pivoting to deliver the ball. Umpires wear spiked shoes similar to those of the players.

It is in the lettering and the trimming of the caps, blouses and pants and in the colour and design of the stockings that the teams are easily distinguished from each other. A club's traveling uniform usually is lettered with the name of its city.

2. The Bat and Ball.—The bat used is a smooth, rounded stick, made either of a single piece of hardwood or of laminated construction, maximum length allowed 42 in., maximum thickness $2\frac{3}{4}$ in., smaller in diameter at its handle end. There is no restriction of the bat's weight, except that no metal or any other reinforcement may be used in its construction. It is allowable to apply to the gripping surface a covering of tape or other abrasive agent to give a firm hold for the batter's hands.

The legal professional ball is restricted to a weight of between 5 and $5\frac{1}{4}$ oz. and a circumference of from 9 to $9\frac{1}{4}$ in. It has a cork and rubber core, is wound tightly with woolen yarn and covered with two bispatular pieces of white leather, so shaped as to fit together tightly as a single-thickness cover over the entire surface when the two pieces are sewn together.

3. Gloves.—In preleague baseball, the game was played bare-handed. One by one, starting with the catcher and first baseman, the players began wearing gloves to protect whichever hand bore the brunt of the ball's impact. In modern times every player wears a glove when in the field.

The gloves are leather, with some degree of reinforcement (padding) in all cases. The catcher's glove is the largest and heaviest, thickly padded at all points except the middle of the palm, in which the pitched ball imbeds itself. It is all one piece, except for the cleft between the thumb and the index finger. The first baseman's glove, thinner and much more flexible than the catching mitt, is a solid expanse of leather for the four fingers. The thumb, however, is separate, with a webbing connecting it with the index-finger edge of the rest of the glove. The gloves worn by pitchers, infielders and outfielders are finger gloves, usually with a separate compartment for each finger and for the thumb. Two or more leather straps connect the thumb with the index finger, enabling the player to get a tighter hold on a swiftly moving ball.

4. Protective Equipment.—Except for the catcher, the player in the field is considered adequately armoured when he wears his regulation uniform and glove. The catcher wears a mask, chest protector and shin guards in addition. The mask, a padded metal

frame with solid bars across its open front, fits the front half of his head, so that the catcher has full visibility but is protected from being hit in the face or about the head, ears and throat by the ball. The chest protector is a solid padded framework extending up over both shoulders and down between the legs, folding at about the waistline to allow stooping. The catcher's shin guards are of light metal over the shins, with padded leather extensions that fit over the knees, and at the bottom are shaped to the shoes so that a catcher blocking home plate has reasonable protection from the spikes of a player sliding feet first.

At bat, the only protection worn by a player in addition to his regulation uniform is a "helmet." The most popular skull protector is a plastic cap, although a shell of composition, light metal or plastic fitting inside or outside the batter's cap on the side of his head which is presented toward the pitcher has been used.

The umpire, whose uniform is a navy blue serge business suit, with a cap of the same shade, likewise wears mask, chest protector and shin guards when on duty behind home plate. The mask is similar to the catcher's. Most umpires wear a special umpire's body protector over or under the outer clothing. The umpire's shin guards are worn under his trousers, which extend full length to the insteps, so that from the stands the umpire's only visible protection usually is his mask. (W. E. Br.; T. V. H.; D. Sr.)

V. ORGANIZED BASEBALL

As the national game, baseball is played informally by schoolboys on their playgrounds, by teams representing community groups—schools and colleges, factories, department stores, employed personnel of hotels, shipyards, mines, railroads, etc.—and by teams representing service units of the armed forces. While in the case of business firms some of the players receive financial compensation for their playing, the term "professional baseball player" applies exclusively to men employed as players by teams that are members of leagues subscribing to the authority and regulations governing what is known as organized baseball.

This system consists of a mutual agreement among the operators of teams representing cities and towns in leagues throughout the United States and in parts of Canada to recognize one central supreme authority, the commissioner, and to subscribe to the body of rules administered by this authority. Most important, these rules regulate the transfer of players from one league to another and among teams in the same league. The provisions aim at protecting the individual player from exploitation, while at the same time imposing restraint on his freedom of choice to the extent that at no time after signing up with any club in organized baseball can he, without the consent of his employer, obtain employment from any other club in organized baseball until he has received an unconditional release from the contract under which he plays in any given year.

The two major leagues and each of their member clubs are signatories to an agreement, called the Major League agreement, the first article of which creates the office of commissioner and sets forth its functions. The two major leagues, acting as one party, and the National association, representing the minor leagues as the other, are signatories to the Major-Minor League agreement, the first clause of which recognizes the office of commissioner as created by the Major League agreement.

As an aftermath of the Chicago White Sox scandal in the 1919 world series, involving the bribing of players to throw games (see *Later History: The "Black Sox" Scandal*, below), the commissioner's office in 1921 took the place of the National commission, a three-man board of arbitration established in 1903, made up of the presidents of the two major leagues and an elected chairman. The framework of the commission continued under the commissioner's office in the form of the advisory council, the two league presidents with the commissioner as chairman. Nearly all the authority formerly vested in the commission was transferred to the commissioner. Kenesaw Mountain Landis (*q.v.*), former federal judge in the Chicago district, was chosen national baseball commissioner, beginning a term of service which continued until his death, Nov. 25, 1944, a period of about 24 years. His successor, Albert B. Chandler, held the post from 1945 to 1951. Ford C. Frick was commissioner from 1951 to 1965.

The year 1953 saw the first break in a half century in the alignment of cities in the majors when Lou Perini, president of the Braves, succeeded in transferring his National league franchise from Boston to Milwaukee. The last previous change in the line-up of major-league clubs had occurred in 1903 when the Baltimore Orioles became the New York Highlanders, who later changed their name to the New York Yankees.

The St. Louis Browns figured in another major realignment in Sept. 1953, when the American league franchise of the Browns was sold to a Baltimore syndicate. Beginning with the 1954 season the former Browns became the Baltimore Orioles and moved into the Baltimore municipal stadium for their home contests. Another change in cities was effected before the start of the 1955 season when the Philadelphia Athletics' franchise was shifted to Kansas City. The New York Giants and the Brooklyn Dodgers played in their respective cities for the last time in 1957. The National league approved a change in locations prior to the 1958 season: the Giants to San Francisco and the Dodgers to Los Angeles.

In 1961 the Washington Senators moved their American league franchise to Minneapolis-St. Paul and were renamed the Minnesota Twins. A franchise for a new team, also to be called the Senators, was granted in Washington, and another, to a team to be called the Angels, in Los Angeles. Thus, the American league for the first time became a 10-team organization. The National likewise increased to 10 teams in 1962 by placing new teams in New York and Houston.

A radical revision of the minor league structure was effected following the close of the 1962 season. Once self-sufficient but now heavily subsidized by major league clubs, the minors were classified by population into leagues designated AAA (or Triple-A), AA (Double-A), A and Rookie leagues. Earlier there had been seven classifications, including B, C and D leagues. Rookie leagues are limited to players in their first season of professional play. Also, the majors conduct winter instructional leagues for prospective players. A variety of causes, but principally the introduction of live telecasts of major league games, gradually sapped the minors of their audiences and their financial independence. In the late 1940s about 60 minor leagues operated in more than 400 cities in the United States, Canada, Mexico and Cuba and attracted nearly 42,000,000 paid admissions. By the early 1960s the number had declined to 20 leagues in about 130 cities with approximately 10,000,000 admissions. Player contracts, once the most valuable operating asset of minor league clubs, were virtually all owned or controlled by parent major league clubs.

The two Triple-A leagues are the International, founded in 1884, and the Pacific Coast, organized in 1903. Both expanded to ten clubs from eight in 1963, absorbing large cities left without baseball following suspension of the six-club American association, a Triple-A organization in business since 1901. Unlike the majors, however, the newly enlarged leagues were divided into two five-club sections. In the International, a northern division included Toronto, Ont.; Buffalo, Rochester and Syracuse, N.Y.; and Richmond, Va. The southern cities were Jacksonville, Fla.; Atlanta, Ga.; Columbus, O.; Indianapolis, Ind.; and Little Rock, Ark. The last two were taken over from the American association.

The Coast league's western section included Honolulu, Hawaii; Portland, Ore.; and Seattle, Spokane and Tacoma, Wash. The eastern half was San Diego, Calif.; Salt Lake City, Utah; Denver, Colo.; Dallas, Tex.; and Oklahoma City, Okla., the last three from the American association.

The arrangement lasted until 1964 when Indianapolis and Little Rock were transferred to the Pacific Coast league which became a 12-club league of two six-member sections. The new clubs were added to the eastern division and San Diego shifted to the western. At season's close the division leaders play a best-of-seven-game series to decide the league championship. The International reverted to eight clubs.

The regular championship season was followed by a "Governors' Cup" knockout tourney (*see* below). Other minor leagues include teams from cities whose geographic locations are identified

by their titles, such as Eastern league (AA), Mexican league (AA), California league (A), Georgia-Florida league (A) and Appalachian league (rookie).

Until the minor league reorganization in Nov. 1962, resulting in the dissolution of the American association, the minor league counterpart of the major league world series was the junior or little world series played between the Triple-A champion teams of the International league and the American association.

The grading of leagues from top to bottom is part of the mechanism in organized baseball for assuring a player's opportunity for advancement. The grading represents different levels of salary limit. An annual draft empowers higher classification leagues to select players at fixed prices from leagues lower in the rating. Transfers of players' contracts are on a buy-and-sell basis, not only among teams in the same league, but in interleague transactions. There are fixed prices applying at the various levels for the drafting process.

Each year before the arrival of the draft deadline in October, players of unusual ability may be transferred to higher leagues by the sale of their contracts at prices higher than the fixed draft price that would be obtained if a player's club chose to keep his contract beyond the date of the draft deadline on the chance that he would be overlooked by scouts seeking reinforcements for teams in higher-rated leagues. This trading in players' contracts evolved out of the baseball wars of the 19th century. In the early years of organized baseball, rival clubs commonly raided each other's ranks and hired away each other's stars in free competition on an open market. In 1879, Arthur H. Soden, of the Boston club, effected the adoption of a resolution by the National league by which five players of each club might be named who could not be approached for hire by any other team in the league. This was the beginning of the Reserve rule, amplified in 1883 when Col. A. G. Mills, National league president, brought about an agreement among the National league and the American association, the two major groups operating at the time, and the minor leagues then in existence.

The Reserve rule, requiring the observance of each team's rights to the services of the players on its reserve list, is the cornerstone of organized baseball. The original list of 5 reserved players was increased to 11 as part of the 1883 agreement. The number of players permitted to be held on each club's reserve list was increased in all gradations of leagues in the intervening years. The modern maximum is 40. In an effort to eliminate excessive bonuses for promising new players, in 1964 the leagues adopted a free-agent draft with all college and other amateur players drawn from a common pool. The teams draft, by rounds, in reverse order of their final standings for the season.

In the 1940s major league players chose representatives from their own ranks to discuss problems and air any grievances with the club owners and the leagues' executive council. Higher travel allowances, pensions plans and other benefits are among the items handled by the athletes' spokesmen. The ownership of players resulted in a series of court fights in the 1950s, stemming from the baseball clause that bans a player from bargaining on his own with any club while he is under contract to another team. Charges that baseball violated the federal antitrust laws went as far as the United States supreme court, which on Nov. 9, 1953, reaffirmed a 1922 ruling that baseball was not a business within the purview of federal antitrust laws. The house of representatives judiciary committee, after an exhaustive survey of the monopolistic aspects of the sport, had issued a report in 1952 in which it found no grounds on which to recommend that the game be brought under antitrust regulations.

1. The Playing Rules.—"The Official Playing Rules of Professional Base Ball Clubs," as adopted at the meeting of the Joint Playing Rules committee of the National league and the American league, held at National league headquarters, New York city, March 2, 1904, and as amended in subsequent years by official major league committees, govern the playing of baseball not only in the professional leagues but universally.

2. The Averages.—Each league maintains a bureau in which are filed the statistics of all its contests. After each game the official scorer, appointed by the league, drafts a record of the game, with its detailed columns showing each player's hits, runs, errors, etc. At the end of each season, the official averages for the entire campaign are compiled. With expansion of the major leagues in 1961–62 all previous averages and statistics, based on a 154-game season, became obsolete and comparison between old and new records became a matter of controversy.

3. League Games.—As is made apparent by the rules of play, the pitcher is the central figure in the game, which is a succession of "plays." Each play begins when the pitcher delivers the ball to the batter and lasts until the pitcher holds the ball again, standing with his foot against the pitcher's plate or "rubber," in position to deliver the next pitch.

If the ball travels past the batter to the catcher and is then tossed directly back to the pitcher, it is a complete play in itself. If the ball is batted, the play goes on until the ball has been fielded, all base running has stopped and the ball returned to the pitcher for the next pitch.

A substitution may be made at any point in the game when time has been called by the umpire. A player taken out of the line-up cannot return in the same game. When the manager makes two or more substitutions at one time, he must specify them one at a time to the umpire, so that each substitute's place in the batting order is immediately established. Such substitutions may be made regardless of the positions played by the players involved. For instance, the manager may take out of his line-up his pitcher and second baseman, substituting a second baseman to bat in the pitcher's place in the batting order, the new pitcher batting where the second baseman formerly batted. He may send in as many substitutions at one time as he wishes, up to the limit of his nine names, but each substitute takes a fixed position in the batting order at the moment the change is made. Without making any substitution, the manager may at any time in the game shift his players from one fielding position to another. He may shift all nine positions in fielding, but can never legally change a man from one place to another in his batting order.

The visiting team always has the first inning at bat in modern baseball, the home team's inning, by choice, coming second. In common parlance "inning" includes an inning at bat for each team. Originally a game was described as consisting of nine innings for each side. Usage has erased the last three words. A game, in modern baseball language, consists of nine innings. A team's sixth inning is now its "half of the sixth." In written accounts of ball games this is followed out further, so that a play is said to have occurred "in the first half of the sixth," or simply "in the top of the sixth," which conveys to the reader the information that the visiting team was at bat at the time in its sixth inning. If the home team was batting, the writer would place the play "in the last half of the sixth." or, more likely, "in the bottom of the sixth."

Whichever team has scored the most runs at the completion of a game is the winner. If the home team has scored more runs in eight innings than the opposing side has scored in nine, the game ends after the first half of the ninth. If the score is even after nine full innings, play continues until one side has more runs than the other in even innings played. At any time, starting with the latter half of the ninth inning, that the home team in an inning acquires one run more than the visiting team, the game immediately terminates, whether there be none out, one out or two out at the moment the winning run is scored. There is one exception to this, coming when the winning run is scored by a base runner who was on base when a teammate hits a home run. In such a case, the hitter of the home run is permitted to make the circuit of the bases and score his run as the final transaction of the game. If more than one of his teammates were occupying bases when the homer was hit, the others also score runs. It is thus possible for the team last at bat to win an extra-inning game by as great a margin as four runs, although the almost invariable score of a home team's extra-inning victory is by a one-run plurality. A game may be terminated by the umpire because of rain, darkness or other cause which in his judgment interferes with further play. If at least five equal innings have been played, the umpire may declare the game a tie or a decided game, depending on the score.

A game may be suspended if there is light failure, a curfew requires play to stop, or under league time limits, and the suspended game is then completed at a later date.

4. The Baseball Season.—The championship season of a professional league extends from mid-spring until early fall. The major league season starts about mid-April and ends on the last Sunday in September or the first Sunday in October. The annual world series between the pennant winners of the two major leagues begins on the Wednesday following the closing day of the regular season. The world series continues until one of the pennant-winning clubs has won four victories, thus establishing it as the world champion of the year.

Preceding the opening of the championship season, each club has a period of spring training which lasts for a month or more during which time its men are conditioned for playing almost every day over a period of months (5½ in the majors). It is during this training trip that new candidates are tried out. The manager and his assistants extend their efforts to select and train the strongest line-up possible from their squad. Practice games are played between teams picked from the squad; also exhibition games against teams representing other organized baseball cities, preferably cities in other leagues, whose training camps are located within ready reach.

Except when war or other considerations play a part, each club does its spring training in a locale where the temperature is likely to approximate the level of the summer temperature in its home city. Major-league clubs ordinarily choose locations in Florida, Texas, Arizona and California. The number of games to be played by each team of a league is established so as to book an equal number of games home and away for each team against each of the other clubs. The major leagues in 1904 fixed on 154 games. With expansion of the major leagues to ten teams in 1961 (American) and 1962 (National) the figure was revised to 162.

However, it is a rare year when every club plays exactly the specified number of contests. When games end in ties, the statistics of such games go into the records of the individual players, although subsequent dates for play-offs of those deadlocked contests are arranged. Postponements because of inclement weather, especially late in the pennant campaigns, often cause a reduction in the allotted number of encounters for the clubs involved because travel schedules of the teams might prevent the opportunity for a play-off before the scheduled closing day of the season.

In common practice, the play-off of ties and postponed games takes the form of the double-header, in which two games are played on the same date, with a short rest period intervening. The popularity of the bargain bill with the public has resulted in double-headers being placed in the schedule in its original draft before the season's start, usually on holidays and Sundays.

The games are arranged to take in 25 week ends and the three holidays nationally celebrated, Memorial day (May 30), Independence day (July 4) and Labor day (first Monday in September).

Starting in the 1930s, additional big days appeared in league schedules in the form of night games. Experiments in playing games under artificial lighting were reported in 1880 (Nantasket Beach, Mass.), but because of the large area necessary to be illuminated to as near daylight level as possible, it was never tried in league games until 1930.

On April 28, 1930 (Muskogee at Independence, Kan., Western league), was played the first night game that counted toward a league pennant. Since to most patrons of professional baseball weekdays are workdays, the opportunity to see a game on a weekday evening instead of waiting until Saturday or Sunday came as a boon. Night baseball became popular.

By 1935 engineers had solved the problem of lighting the extensive areas of large stadiums, and in May of that year the first major league night game was played in Cincinnati (*v.* Philadelphia). By the 1960s all but one of the major league parks were equipped to play games at night. The Chicago Cubs of the National league continued to play all their home games at Wrigley field during the daylight hours. In 1965 the first indoor games were played, in Houston's air-conditioned Astrodome stadium.

5. The Championships.—Arranged in the order of their percentages, from the highest to the lowest, the list of clubs in a league on any given day is called the club standing. Half of the clubs, those with the higher percentages, are in the first division, the other half in the second division. After the last day of the season, the club standing at that point becomes the record for the year. The no. 1 team is victor, winning the right to fly from a flagpole in its home field a banner or pennant, combining the red, white and blue of the United States flag in a design of its own selection, with lettering and numerals proclaiming it the champion of its league for that year. This pennant is customarily raised at the champion's opening game at home the ensuing season and flown from the masthead throughout the new campaign.

For all but one of the clubs in each of the two major leagues, closing day means the disbandment of the players for the winter. The two pennant winners, however, meet in the world series (see *The World Series,* below), a postseason competition in which about half of the total cash receipts of the first four games forms a players' pool, to be divided among the first division teams of each league. The players of the pennant-winning teams, as world series opponents, fittingly receive the lion's share, 70%.

Most of the minor leagues conduct, each within its own membership, a postseason series known as the Shaughnessy play-offs, taking the name from Frank J. Shaughnessy, former president of the International league, who was primarily responsible for its introduction in 1933.

Played usually for a special trophy, the Governor's cup, etc., these series are participated in by the first four teams in the final standing of the regular pennant race. The team winning the Shaughnessy play-off is usually considered the league's champion, and the pennant winner often is beaten in the play-off.

(W. E. Bt.; T. V. H.; D. Sr.; Ha. S.)

VI. HISTORY OF BASEBALL

1. Origin of the Game.—On June 12, 1939, the National Baseball Hall of Fame and Museum was dedicated at Cooperstown, N.Y. This was the central ceremony of a countrywide, summerlong celebration of what was described as the national game's 100th anniversary. It was in Cooperstown, a village in Otsego county, north-central New York state, in the summer of 1839, that Abner Doubleday (later a general in the U.S. army) was alleged to have laid out the first baseball field and conducted the first game of baseball ever played. The players were cadets of the military preparatory school at which he was stationed as instructor. In 1919 the Cooperstown village fathers leased the site of the original playing field used by the cadets, dedicating it as a permanent memorial under the title Doubleday field, Sept. 6, 1920. On Sept. 29, 1923, permanent title to Doubleday field was transferred to the village of Cooperstown by a New York supreme court order. This version of the "creation" of what has come to be the U.S. national pastime was officially accepted by most of the major league leaders, but later research disproved it.

In the late 19th century, when baseball had grown to national stature as a professional sport, the question of its origin was a topic of wide discussion, because of its resemblance to rounders, a children's game originating in Great Britain, and to children's games flourishing in different sections of the United States, called town ball, one old cat, two old cat, three old cat and four old cat, all of which contained rudiments of baseball.

In 1907, A. G. Spalding, one of the most famous of the 19th-century players and founder of the sporting goods manufacturing company A. G. Spalding & Bros., appointed a commission of research to establish the exact date when the evolutionary transition of village green sports crystallized to a form from which 20th-century baseball could trace its direct descent.

The members of the commission were: Morgan G. Bulkeley, first president of the National league and subsequently a United States senator from Connecticut; A. G. Mills, third president of the National league; Nicholas E. Young, president of the National league from 1885 to 1902; Alfred J. Reach, big league player of the 1870s, president of the Philadelphia National league club for 20 years and senior member of the sporting goods firm of A. J. Reach & Co.; George Wright, the greatest player of baseball's

earliest days of league organization and head of the Wright and Ditson sporting goods company; Arthur Pue Gorman, U.S. senator from Maryland; and James E. Sullivan, president of the Amateur Athletic union. This commission published its report in the *Baseball Guide* of 1908. Its chief findings were two in number: first, that baseball is a distinctly American sport and had no connection with rounders or any other foreign game; secondly, that the first rules for playing baseball, according to all evidence obtainable to date, were devised by Abner Doubleday, in Cooperstown, N.Y., in 1839.

The playing field said to have been devised by Doubleday placed the bases at the corners of a 90-ft. square, called the diamond, a term also loosely used for the entire playing field. His fixture of base locations and distances between bases has never been changed. In the games of cat, which were played prior to baseball, it was necessary to bat, run and touch a base, or bases. The number of bases to be touched depended upon whether it was one old cat, two old cat or three old cat. A run was scored when the batter touched an outlying base, retraced his steps and regained the batsman's base, or home plate, as it later became known in baseball. One old cat could be played with three players, but more enjoyably with four or more. In two old cat, in three old cat and in four old cat the number of players could be increased to 10, 12, 14 or more. No organized teams played, nor were sides formally chosen. The object of the game was to "stay in" as batsman as long as possible, runs being considered merely an accessory to "staying in."

From this primitive method of "bat the ball, run and tally" developed the game of town ball, in which the selection of teams upon the field, or competition of sides previously agreed upon or chosen, engendered the method of team competing against team. Thus when baseball was devised by Doubleday, the fact of team competition had been determined in town ball. The Olympic Town Ball club was organized in Philadelphia in 1833. This appears to be the first team of that character assembled in the United States. Town ball was played with a field diagram laid out as a perfect square with four corners, or goals, each of them about 60 ft. apart. The batsman's position was halfway between the first and fourth goal. The catcher was behind the batsman and outside the square. There were no batted foul balls, and it was considered to be expertness on the part of the batsman to deflect the ball behind him.

Because town ball, also known as round ball, was thought by some to be the newly invented game of baseball, two entirely different games became identified with the name of baseball. In 1845 the Knickerbocker Baseball club of New York drew up the first code of rules and the first match game of record was played under these rules between the Knickerbocker club and a picked team which, for this game, called itself the New York club. The game was played at the Elysian fields in Hoboken, N.J., in 1846. Games were played by the Knickerbockers with the Gotham, Eagle and Empire clubs of New York city, and with the Excelsior, Atlantic, Putnam and Eckford clubs of Brooklyn, then a separate city from New York. There were other clubs than these.

(W. E. Br.; T. V. H.; D. Sr.)

The Controversy Over Baseball's Origin.—In the early days of modern U.S. baseball, no one who wrote of it seemed to doubt that it was an evolution from the English children's game known then and thereafter as rounders (*q.v.*). A simple change in the rules, according to these authorities, transformed it into a man's game. In rounders, as then played, the fielder put out a runner making for a base, or caught off base, by throwing the ball at him and hitting him with it. This precluded the use of a hard ball and, since a soft ball cannot be batted very far, limited both the size of the field and the activity of the players. Then, presumably about 1840, some American had the idea of putting out the runner by tagging him—touching him with the ball or with the hand holding it. It became immediately possible to use a hard ball—at first, a kind of miniature cricket ball. And the game suddenly grew up. The rules of the pioneer Knickerbocker Baseball club of New York, drawn up in 1845, constitute the earliest known documentary record of this change.

However, many of the old-time players refused to entertain the thought that a foreign nation had anything to do with inventing a great U.S. institution like baseball, and especially A. G. Spalding, who had made a fortune out of sporting goods. Hence the Spalding commission, composed not of skilled investigators but of baseball men assisted by a United States senator, was appointed ostensibly to investigate the origins of the game but really to prove its exclusively U.S. origin. In 1908 this commission reported in the official baseball guide that the game, including the essentials of the modern rules, the dimensions of the field and even the name, was invented in 1839 at Cooperstown, N.Y., by Abner Doubleday —afterward General Doubleday, a hero of the battle of Gettysburg—and that the foundation of this invention was an American children's game called one old cat. As most of the pioneer players were dead before 1908, this report caused so little controversy at the time that gradually even the standard reference books accepted its conclusions as seasoned history. Effective attempts to refute its data did not begin until 1939, the centenary of the alleged invention, when Robert W. Henderson, of the New York Public library, issued a pamphlet embracing some scholarly researches of his own, all casting doubt on the Doubleday theory and strengthening the case for an English origin. Others have since added a few corroborative details.

The main points in support of this contention are as follows:

The name "baseball" to designate some popular English game has been traced back to the first half of the 18th century. In the *Letters* of Mary Lepell, Lady Hervey, occurs a passage under the date of Nov. 8, 1748, satirizing Frederick Prince of Wales and his moronic habits: "The Prince's family is an example of cheerful and innocent amusements . . . they divert themselves at baseball, a play all who have, or have been, schoolboys, are well acquainted with." In *Northanger Abbey* (written about 1798) Jane Austen remarks of her heroine, "It was not very wonderful that Catherine, who had by nature nothing heroic about her, should prefer cricket, baseball, riding on horseback, and running round the country at the age of fourteen, to books."

But before this the name, and most probably the game, were already known in America. In 1744, *A Little Pretty Pocket-Book* was published in England. Illustrated with crude woodcuts, it pictures and describes in doggerel quatrains 26 children's sports—one for each letter of the alphabet. And "B" is represented by "Baseball." The text records that the batter hits the ball and runs from base to base. The illustration, which comprises only part of the field, shows a player at the plate, holding a bat with a curious flat, fanlike end, a catcher behind him, a pitcher preparing to throw a small ball underhand, two bases—marked by posts instead of bags—with a baseman beside each of them. This book, furiously popular in England, was reprinted twice in America—in New York city (1762) and Worcester, Mass. (1787).

There followed other references, some less definite, some good documentary evidence, to an American game of this kind. The journal of George Ewing, a soldier, written at Valley Forge in 1778, tells of "playing at base." Some boys "playing at ball" in the Wall street region of New York abandoned their game to join one of the riots which preceded the revolution. In 1787 the faculty of Princeton college forbade the students to "play with balls and sticks in the back common of the college." Thurlow Weed, editor and politician of Rochester, N.Y., mentioned in his memoirs "a baseball club organized about 1825." Corroborating this, Samuel Hopkins Adams turned up in a copy of Weed's newspaper dated in the 1820s an item stating that the Rochester Baseball club, with about 50 members, was in practice for its season's activities. The elder Oliver Wendell Holmes, Harvard 1829, mentioned to an interviewer that he had played a good deal of baseball while in college at Cambridge, Mass. These are only a few selected references from a number discovered incidentally and accidentally. Systematic search of books, documents and records before 1830 would most probably turn up many others.

Then came the unpretentious document that ties up English rounders to American baseball in their primitive forms. *The Boy's Own Book*, published in London in 1828 and so popular that it ran through many editions, was as the name suggests a treatise on boys' sports, with rules. The second edition includes a chapter

entitled "Rounders," with a note that the game is called "feeder" in London. As there described, it bears a far closer family resemblance to modern U.S. baseball than does Rugby football to its acknowledged offspring, U.S. intercollegiate football. It was played on a diamond with a base at each corner, the goal or fourth base identical with the plate beside which the batter stood. The batter might run whenever he hit the ball across or over the diamond. A ball hit in any other direction constituted a foul; he might not run on it. If he struck at it and missed it three times, he was out. A batted ball caught on the fly constituted an out. When a runner made the circuit of the bases, it counted one point or tally for his side. Then came the one vital difference which distinguished this from modern baseball. When a grounder was fielded, the fielder put the runner out by throwing the ball at him and hitting him with it. The same rule applied to a runner caught off base. The woodcut accompanying the article bears a strong resemblance to that illustrating the rhyme on "baseball" in *A Little Pretty Pocket-Book*. Even the bat is the same strange-looking implement. However, objects that look like flat stones serve as bases, and there seem to be two catchers—the second one, probably, to range for fly fouls. (W. I.)

Many English immigrants to America in colonial times were from those south counties of which Mary Lepell and Jane Austen were residents. That the old game was called "baseball" in that region, as it was called "feeder" in London and "rounders" in western England, and that south-county immigrants took both the name and the game to America seems a tenable hypothesis. There would seem to be little room for doubt that modern-day baseball evolved from such sport just as so many other present pastimes did from games of bygone eras.

As for the "old cat" versions, the critics of the Spalding report hold that in the 18th century those games were what they are today—substitutes for baseball when the boys did not have enough players for two full teams. In one old cat there was one base, one pitcher, one catcher and one batter. The more men available the higher goes the number of "old cats"—two, three, etc. Town ball seems to have been only another American name for rounders, feeder or old-time baseball, and near Boston the sport was known as the "Massachusetts game" at the turn of the 19th century. Reminiscences in the sporting periodicals of the 1850s and 1860s go to prove that it was played in New England even before 1833, when Philadelphia had a town ball club and drew up written rules. However, New England, unlike Philadelphia, distinguished between fair and foul balls. On the other hand, in part of New England, home base and batter's plate were not identical, but stood a few feet apart from each other, so that the line-up included a fourth baseman. Henderson's writings revealed the first United States book on baseball was the *Book of Sports*, written by Robin Carver in Boston in 1834. In it the author credits much of his material to the London publication *The Boy's Own Book*, put out six years earlier. Carver's book goes into details of the game of rounders, including an illustrated diagram for the placing of the posts (bases) in the shape of a diamond. Carver copied the English rules of rounders almost word for word yet called his game "base, or goal ball." Doubleday, Alexander J. Cartwright, a New York surveyor and amateur ball player, Harry Wright, who played as an amateur with the New York Knickerbockers and became a professional player and manager (Cincinnati and Boston), and Spalding have each been referred to as the "father of baseball." Doubleday no doubt did much to promote interest in the sport, probably while a cadet at West Point, for some sports historians place his years at the military academy as 1838–42. Unfortunately, the notes, statements and affidavits gathered by the Spalding commission were afterward lost in a fire, and only the finished report is extant. In this, an old resident named Abner Graves figured as the chief witness, and he testified that in the game taught to Cooperstown by Doubleday the fielder put out the runner by hitting him with the ball. This means, of course, that Doubleday's game was still much like the old English version and renders unlikely the statement that Doubleday laid out a diamond with the exact dimensions of the modern playing field, for any ball light and soft enough to be thrown full force against a player's head or body without danger of inflicting serious injury could scarcely have been batted out of an infield so large. Cartwright, who long had played the game with society friends about New York, became discouraged with the haphazard manner in which contests were conducted and organized a group to formulate a code of standard rules in 1845. Drawing heavily on Carver's book, the group submitted a set of regulations, which were adopted in Sept. 1845, and much of that original code is applicable today. It was then that tagging out a runner was adopted, which no doubt paved the way for the introduction of the hard ball that is the key factor of modern baseball.

Listing a few of the 1845 rules will reveal how closely they paralleled those in force in organized baseball of today. For example: (1) a ball knocked outside the range of first or third (outside foul lines today) is foul; (2) three balls being struck at and missed, and the last one caught is a hand out (one out), but if not caught, it is considered fair and the striker bound to run; (3) three hand outs, all out (batting side retired); (4) a player running the bases shall be out if the ball is in the hands of an adversary on the base and the runner is touched by the ball before he makes his base, it being understood, however, that in no instance is the ball to be thrown at him (a definite departure from rounders).

With the introduction of the new rules by the New York Knickerbockers, the sport gained quickly in popularity. The Knicks, who were about to be ousted from their Manhattan playing field, found a new site across the Hudson River in Hoboken, N.J., and made it their home field for the 1846 season. Their rules soon were taken up by such clubs as the Gothams, Eagles, Empires and Mutuals. The Olympic club of Philadelphia, although it had been playing town ball since 1833, did not switch to the Cartwright code until 1860. At about the time the new version of baseball was being popularized around the New York area the old soft ball variety had a sudden spurt in popularity in Boston. Until the Civil War, the game was called respectively Boston baseball and New York baseball. New York and New Jersey regiments taught their own versions of the sport to other Union soldiers, and when the war ended the more rugged and adult New York game held the field as the sport for grown men.

2. Later History.—From 1845 until 1854 baseball was played by the code of rules first written for the game. In 1854 there was a revision which provided specifications for the size and weight of the ball. On March 10, 1858, the first attempt was made at organization of clubs, their number having greatly increased and the game having expanded throughout the territory about New York city, extending to Philadelphia. Massachusetts still played town ball. In 1859 Washington, D.C., organized a baseball club, followed in 1860 by Lowell, Mass., Allegheny, Pa., and Hartford, Conn. From that time the game became more widespread, going to Maine, Kentucky and in 1866 to Portland, Ore. Baseball was played in towns and hamlets other than the cities mentioned during this period, but the clubs were considered to be town or minor clubs as against organized clubs, a distinction that has followed the progress of professional baseball since. The National Association of Baseball Players, organized in 1858, embraced 16 clubs in New York city. W. H. VanCott was its president. The Knickerbocker playing rules were amplified, and the ball and bat were made to conform to measurements approximating those of the present day. In 1863 the rules were further amplified. From 1861 to 1865 baseball languished except in the armies of the Civil War. In 1865 a convention was held in New York at which 91 clubs were represented, including the cities of St. Louis (Mo.), Chattanooga (Tenn.), Louisville (Ky.), Washington (D.C.), Boston (Mass.) and Philadelphia (Pa.). It was strictly an amateur organization without schedules for games, and its purpose was to preserve the stability of the rules and the amateur status of the sport.

In 1865 and 1866 professionalism began to make its appearance. Players did not derive their livelihood from baseball, but the more expert accepted sums of money as members of any club that would engage them for occasional games. This was a new development, somewhat unexpected, and it seriously perturbed the equanimity of the amateur players. Gentlemen players openly

avowed their objection to what they expressed in caustic language as deterioration. In addition to the disposition of some players to accept hire for their services, open pool selling and bribery by gamblers, some of which was successful, outraged the better element among players and organizers of clubs. This conflict between amateurism and professionalism eventually led to a professional organization, the first of its kind, and a puny affair compared with the later great associations of clubs in leagues.

In 1867 the Nationals of Washington, under the lead of Arthur Pue Gorman, afterward U.S. senator from Maryland, made the first trans-Allegheny tour. The team went as far west as St. Louis. In that year the Rockford, Ill., club began the practice of paying salaries to some of its players. In 1868 the Cincinnati team was organized on what was known as semiprofessional lines, a characterization of athletes peculiar to the United States. A semiprofessional does not play baseball for a living, but is hired in occasional games. In 1869 the Cincinnati team was hired as an outright professional organization and made a successful tour of the United States from New York to San Francisco. The Cincinnati team did not lose a game that year and was undefeated until June 14, 1870. During the successful career of the Cincinnati team rival clubs became imbued with an eager desire to win from it, throwing aside all restraint of policy relative to being amateurs in order to engage the best players available. Most of the important clubs abandoned every attempt to preserve an amateur standing, despite the fact that they were members of the National association, which was an amateur body. Once professionalism had entered the game it was impossible to keep the professional and amateur exponents of the sport reconciled. The organization of the professional Cincinnati team was followed by that of another professional team at Chicago, and in 1870 the National Association of Baseball Players was disrupted, the pure amateurs withdrawing from the annual meeting. A new amateur organization was effected in 1872 but died in 1874, the last of the concerted attempts to keep the control of the game within amateur influence. In 1871 the National Association of Professional Baseball Players was organized in New York. This embraced the Athletics of Philadelphia; Bostons of Boston; White Stockings of Chicago; Eckfords of Brooklyn; Forest Citys of Cleveland, O.; Forest Citys of Rockford, Ill.; Haymakers of Troy, N.Y.; Kekiongas of Fort Wayne, Ind.; Olympics of Washington; and Mutuals of New York. The affairs of the organization were loosely conducted. The circuit was not preserved intact. Many scheduled games never were played. Gambling and contract breaking became so repulsive to players of higher principle and to certain owners that they withdrew. The association dissolved in 1876 when the National League of Professional Base Ball Clubs came into existence with the seceders from the association backing it. It was organized in New York city, Feb. 2, 1876, with a membership made up of the Athletics of Philadelphia; Hartford, Conn.; Boston; Chicago; Cincinnati, O.; Louisville, Ky.; St. Louis; and the Mutuals of New York city.

The first president of the league was Morgan G. Bulkeley, afterward governor of Connecticut and also U.S. senator from that state. He served one year and was succeeded by William A. Hulbert, commended by all baseball folk when in 1877 he expelled from baseball for life four ball players found guilty of dishonesty. From this time confidence was established in the professional branch, and amateur baseball grew with the revived interest in professional baseball. Hulbert remained president of the league until his death in 1882. During his administration baseball had sufficiently developed to be regarded as an institution. Col. A. G. Mills, one of the most notable athletic authorities in the U.S., afterward prominent in the Olympic games, was elected president of the league in 1883. He resigned in 1885. Nicholas E. Young was elected to succeed him in 1885 and held office until 1903. Presidents in succession since then have been Harry Clay Pulliam, Thomas J. Lynch, John K. Tener, former governor of Pennsylvania, John A. Heydler, Ford C. Frick and Warren Giles.

In 1882 the American association was formed in cities not members of the National league circuit. National league owners attempted to equalize salaries of players, regardless of cities and local conditions, by a uniform scale of hire. The players opposed it, and in 1890, after forming a league known as the Players' league, took the field against the National league. In one year the player organization was wrecked. The American association engaged in open rivalry with the National league in 1891, a venture hopelessly destined to failure, and in the winter of 1891 was merged with the National league into a 12-club organization having a monopoly of major league baseball.

As "the" major league, the National operated with 12 clubs from 1892 to 1899, inclusive. Falling off of patronage in Baltimore and Cleveland, mainly due to the weakening of the two teams' line-ups by trades, resulted in the return to the eight-club membership, starting with the 1900 season. Baltimore, Washington, Cleveland and Louisville were dropped as National league cities, leaving Boston, Brooklyn, Chicago, Cincinnati, New York, Philadelphia, Pittsburgh and St. Louis. This resumption of an eight-club setup by the one and only major league in existence led to the rise of a rival circuit, the Western league, organized as a minor league in 1893, its membership midwest cities covering about the same territory as the present-day American association.

In 1900 Charles A. Comiskey, owner of the St. Paul, Minn., club of the Western league, moved his team to Chicago, and renamed it the Chicago White Sox, although Chicago was a member of the National league, with continuous membership from the league's inception in 1876, when its team was known as the Chicago White Stockings. In the same year the Western league shifted its Grand Rapids, Mich., team to Cleveland, one of the cities abandoned by the National league after 1899.

The move to Chicago by Comiskey received the assent of the National league, but when permission was sought to place teams for the 1901 season in Baltimore and Washington, the National league refused.

Two years of baseball war followed. Having changed its name to the American league, the militant former Western leaguers, headed by their president, Byron Bancroft ("Ban") Johnson, moved their Indianapolis (Ind.), Kansas City (Mo.), Minneapolis (Minn.) and Buffalo (N.Y.) clubs to Baltimore, Washington, Philadelphia and Boston for the start of the 1901 season.

The American league withdrew from the national agreement, the body of rules governing relations between all professional leagues, major and minor, their transfers of players from one league to another, and their territorial restrictions in the operation of clubs. Its 1901 line-up of eight cities listed, besides the newly invaded four eastern cities, Chicago, Detroit, Cleveland and Milwaukee in the west. For 1902 the Milwaukee club was moved to St. Louis, invading National league territory there, and for 1903 the Baltimore franchise was shifted to New York, establishing the American league's roster of cities as it continued to stand down through the decades after the baseball war until 1953.

In the "war" years, the American league made inroads on the National's galaxies of star players to such a degree that it became firmly established as a major league. When peace was made between the two leagues in midseason, 1903, the new agreement entered into by both gave each of the two leagues equal importance. The agreement forbade the consolidation of two clubs occupying one city into one ownership, prohibited shifting of teams from one city to another by either league without the consent of the other, set rules for transfers of players from one major league to another, as well as re-establishing the rules dealing with securing minor league players.

The "war" brought into prominence two men whose names became baseball tradition, Connie Mack (Cornelius McGillicuddy) and John J. McGraw. In 1901 Mack, a former National league catcher and manager of the Pittsburgh Pirates in 1894–96, was manager of Milwaukee when the Western league changed its name. In 1901 he was placed at the head of the American league's new Philadelphia team, the Athletics. In 1902 he won the first of a long line of championships with his Athletics. The success of the American league's rise to major league status was largely attributed to his leadership and inspiration.

McGraw, a star third baseman of the Baltimore Orioles, National league pennant winners three straight years in the middle

1890s, was manager of Baltimore's American league club starting the 1902 season. In June, a National league countermove to the raids on its ranks by the American league induced McGraw to jump back to the National as manager of the New York Giants. For the next quarter of a century McGraw and his Giants were headliners in the baseball world comparable in prominence to Mack and his Athletics in the American league.

"Ban" Johnson, first president of the American league, continued as president until 1927. He was succeeded by Ernest Sargent Barnard, who held office until his death in March 1931. William H. Harridge, secretary of the league from 1927 on, succeeded Barnard as president. Joseph E. Cronin became president in 1959.

During the period when organized baseball was governed by the National commission (1903–21) there was one attempt by outside interests to conduct championship baseball on a major league level independent of organized baseball. This outlaw organization was the Federal league, which conducted pennant races in 1914 and 1915. Baltimore, Brooklyn, Buffalo, Chicago, Indianapolis, Kansas City, Pittsburgh and St. Louis were represented in the 1914 season, with Indianapolis winning the pennant. In 1915 the Indianapolis team was transferred to Newark, N.J. Chicago won the 1915 pennant. The Federal league not only placed teams in organized baseball territory, but offered contracts to the outstanding players and managers of the two major leagues. Its raids were not so successful as those of the American league had been in securing stars. After the 1915 season came another "peace treaty," the Federal league passing out of existence. Two of the men who had backed the outlaw league heavily joined the major leagues as owners of the Chicago National league and the St. Louis American league clubs respectively. Players developed by Federal league clubs and not previously the "property" of organized baseball found places in organized baseball. Those who had left organized baseball to join up with the "Feds" returned to the clubs from which they had jumped.

The "Black Sox" Scandal.—The administrative structure of baseball and its future as a national game were severely tested in the period from 1919 through 1921. During these years eight members of one of the game's greatest all-time teams, the Chicago White Sox of 1919, confessed to accepting bribes to throw the world series of that year; the three-man National commission rule was dissolved and major league baseball decided on the one-man commission rule. One player above all the rest, George Herman ("Babe") Ruth, helped the major leagues regain the prestige and popularity they lost during this trying period.

The scandal that threatened for a time to destroy the public faith in the integrity of the sport was known as the "Black Sox" scandal. Eight members of the Chicago White Sox of 1919 were indicted on a charge of fraud and later were given lifetime bans from holding any position in organized (professional) baseball. They were: Edward Cicotte, who confessed to accepting money for the purpose of deliberately allowing the Cincinnati (National league) team to win the 1919 series, Oscar E. ("Happy") Felsch, Joseph ("Shoeless Joe") Jackson, Charles A. ("Swede") Risberg, Claude Williams, Frederick McMullin, Charles A. ("Chick") Gandil and George D. ("Buck") Weaver. Cicotte implicated his seven teammates, and, in Sept. 1920, all were indicted on a charge of fraud in Cook county, Ill. The presiding judge for the grand jury was Kenesaw Mountain Landis, who one year later was to be named baseball's first commissioner. Charles A. Comiskey, president of the Chicago White Sox, suspended the eight players for the 1921 season. In July of that year all eight were found not guilty by a jury, but Landis, then commissioner, was not so lenient. During this period "Babe" Ruth was becoming baseball's newest hero. He began smashing balls at a greater distance than any other hitter the game had known and was a tremendous factor in arousing the fans' desire to see a new idol who would go down in history as the greatest of all home run hitters.

The National and American leagues co-operated in arranging their schedules so that in cities represented in both leagues there would be a dovetailing of the home games, one team being away on all dates on which the other had a home game scheduled.

3. The World Series.—In the fall of 1903 the pennant winners of the two leagues met in a postseason series, won by the Boston Red Sox of the American league from the Pittsburgh Pirates, National league champions, 5 games to 3. This postseason series was no new idea. In seven successive years, starting with 1884, postseason games had been played between the pennant winners of the National league and the American association.

In the world series of the 1880s, the teams arranged matters between themselves, scheduling games and dividing the proceeds by mutual agreement. The 1903 world series was likewise arranged between the two clubs concerned. In 1904, the Boston Red Sox, who had won the 1903 world championship, won the American league pennant, and issued a challenge to the National pennant winners, the New York Giants. The Giants refused, on the ground that there should be formal rules and central supervision of a contest in which the prestige of the rival leagues was involved as well as that of the individual clubs. Boston claimed the 1904 world championship by default. The New York president, John T. Brush, offered a code of rules which were adopted for permanent use, starting with the 1905 world series.

Details in the Brush rules were changed through the decades following, but the main features were unchanged. For three years (1919–21) the number of victories required to win the series was raised to five, but was returned to the original four in 1922.

The scheduling of games originally involved choosing by lot or by tossing a coin. The major leagues now alternate in opening the series. In the even-numbered years the series opens in the park of the National league pennant winner. In the odd-numbered years the American league champion plays its first world series

*Record of World Series Competition**

Year	Winning team and games won		Losing team and games won	
1903	Boston (A.L.)	5	Pittsburgh (N.L.)	3
1904	No series			
1905	New York (N.L.)	4	Philadelphia (A.L.)	1
1906	Chicago (A.L.)	4	Chicago (N.L.)	2
1907†	Chicago (N.L.)	4	Detroit (A.L.)	0
1908	Chicago (N.L.)	4	Detroit (A.L.)	1
1909	Pittsburgh (N.L.)	4	Detroit (A.L.)	3
1910	Philadelphia (A.L.)	4	Chicago (N.L.)	1
1911	Philadelphia (A.L.)	4	New York (N.L.)	2
1912†	Boston (A.L.)	4	New York (N.L.)	3
1913	Philadelphia (A.L.)	4	New York (N.L.)	1
1914	Boston (N.L.)	4	Philadelphia (A.L.)	0
1915	Boston (A.L.)	4	Philadelphia (N.L.)	1
1916	Boston (A.L.)	4	Brooklyn (N.L.)	1
1917	Chicago (A.L.)	4	New York (N.L.)	2
1918	Boston (A.L.)	4	Chicago (N.L.)	2
1919	Cincinnati (N.L.)	5	Chicago (A.L.)	3
1920	Cleveland (A.L.)	5	Brooklyn (N.L.)	2
1921	New York (N.L.)	5	New York (A.L.)	3
1922†	New York (N.L.)	4	New York (A.L.)	0
1923	New York (A.L.)	4	New York (N.L.)	2
1924	Washington (A.L.)	4	New York (N.L.)	3
1925	Pittsburgh (N.L.)	4	Washington (A.L.)	3
1926	St. Louis (N.L.)	4	New York (A.L.)	3
1927	New York (A.L.)	4	Pittsburgh (N.L.)	0
1928	New York (A.L.)	4	St. Louis (N.L.)	0
1929	Philadelphia (A.L.)	4	Chicago (N.L.)	1
1930	Philadelphia (A.L.)	4	St. Louis (N.L.)	2
1931	St. Louis (N.L.)	4	Philadelphia (A.L.)	3
1932	New York (A.L.)	4	Chicago (N.L.)	0
1933	New York (N.L.)	4	Washington (A.L.)	1
1934	St. Louis (N.L.)	4	Detroit (A.L.)	3
1935	Detroit (A.L.)	4	Chicago (N.L.)	2
1936	New York (A.L.)	4	New York (N.L.)	2
1937	New York (A.L.)	4	New York (N.L.)	1
1938	New York (A.L.)	4	Chicago (A.L.)	0
1939	New York (A.L.)	4	Cincinnati (N.L.)	0
1940	Cincinnati (N.L.)	4	Detroit (A.L.)	3
1941	New York (A.L.)	4	Brooklyn (N.L.)	1
1942	St. Louis (N.L.)	4	New York (A.L.)	1
1943	New York (A.L.)	4	St. Louis (N.L.)	1
1944	St. Louis (N.L.)	4	St. Louis (A.L.)	2
1945	Detroit (A.L.)	4	Chicago (N.L.)	3
1946	St. Louis (N.L.)	4	Boston (A.L.)	3
1947	New York (A.L.)	4	Brooklyn (N.L.)	3
1948	Cleveland (A.L.)	4	Boston (N.L.)	2
1949	New York (A.L.)	4	Brooklyn (N.L.)	1
1950	New York (A.L.)	4	Philadelphia (N.L.)	0
1951	New York (A.L.)	4	New York (N.L.)	2
1952	New York (A.L.)	4	Brooklyn (N.L.)	3
1953	New York (A.L.)	4	Brooklyn (N.L.)	2
1954	New York (N.L.)	4	Cleveland (A.L.)	0
1955	Brooklyn (N.L.)	4	New York (A.L.)	3
1956	New York (A.L.)	4	Brooklyn (N.L.)	3
1957	Milwaukee (N.L.)	4	New York (A.L.)	3
1958	New York (A.L.)	4	Milwaukee (N.L.)	3
1959	Los Angeles (N.L.)	4	Chicago (A.L.)	2
1960	Pittsburgh (N.L.)	4	New York (A.L.)	3
1961	New York (A.L.)	4	Cincinnati (N.L.)	1
1962	New York (A.L.)	4	San Francisco (N.L.)	3
1963	Los Angeles (N.L.)	4	New York (A.L.)	0
1964	St. Louis (N.L.)	4	New York (A.L.)	3

*A.L.—American League; N.L.—National League †One tied game.

games at home. Instead of 3–3–1, the distribution of the games is 2–3–2. After the first two games in the series-opening park, the teams shift to the park of the rival league's champions for three games. If neither has won four games after five games have been played, the scene shifts back to the field on which its first game was played and remains there for as many more games as are necessary to decide the winner.

During World War II, starting with 1943, transportation emergencies changed this order. Again the system became three games in the series-opening park, then the shift to the other team's field, with the difference from the original Brush plan that regardless of how many games should become necessary, there would be no return trip to the first city. After the war the 2–3–2 system was once again adopted.

4. The All-Star Game.—Starting with 1933, the major leagues have played an annual All-Star game in July, one game between teams of players chosen from all the teams of both leagues. They oppose each other as league against league. No championship, flag or trophy is involved. The players do not receive any part of the gate receipts, which are donated to the players' pension fund and charitable purposes. The first All-Star game, held in conjunction with the Century of Progress exposition in Chicago, was played in Comiskey park, home field of the Chicago White Sox (American league). In subsequent years the leagues have alternated as "home" teams. From 1959 to 1962 the major leagues played two All-Star games each season.

5. Negroes in Baseball.—In 1947 infielder Jack Roosevelt ("Jackie") Robinson became the first Negro player in the major leagues since Welday and Moses Walker, brothers, played for Toledo in the American association, then a major league, in 1884. Robinson, brought into organized baseball by Branch Rickey, president of the Dodgers, then in Brooklyn, helped the Dodgers win the pennant in his first year and received the National league's Most Valuable Player award in his third. The Cleveland Indians followed Rickey's lead with Lawrence ("Larry") Doby, slugging outfielder, and, in 1948, with Leroy ("Satchel") Paige, then past 40, famous pitching star of the Negro leagues. Within a few years all of the major league teams had added Negro athletes to their rosters and there were many Negroes in the minors.

There had been several Negro players in the minor leagues in the 19th century and in the 20th century many Negroes played winter ball in Cuba, Mexico and Venezuela. The first professional Negro team, the Cuban Giants, of Long Island, was organized in 1885. A number of other Negro teams were formed and the Negro National league was set up in 1920 and the Negro Eastern league in 1921, inaugurating a world series in 1924, but these failed in 1932 because of the depression. A second Negro National league, founded in the late 1930s, was dissolved in 1952. The Negro American league, founded in 1936, formed an Eastern and a Western division in 1952 to conduct the annual Negro East-West classic.

After World War II the Negro leagues suffered the decline in attendance and revenue that affected the minor leagues of organized baseball (see *Organized Baseball*, above), accentuated by the loss of outstanding players to formerly all-white teams.

6. The Hall of Fame.—The National Baseball Hall of Fame and Museum is at Cooperstown, N.Y. (see *Origin of the Game*, above). It contains relics, pictures and documents, and its central chamber is Baseball's Hall of Fame in which are memorialized players and personalities who have made major contributions to baseball. The first five players selected for membership in the Hall of Fame in 1936 were "Ty" Cobb, "Babe" Ruth, Walter Johnson, John P. ("Honus") Wagner and Christy Mathewson. Additions to the roll of immortals are made from time to time by election in polls conducted by the Baseball Writers' Association of America and by the Hall of Fame committee appointed by the commissioner of baseball.

VII. GLOSSARY

The following are terms not defined or explained in the foregoing text but which are used in printed accounts of baseball games; some are vernacular expressions in common usage among players.

Ace.—The best pitcher on the team, the one who is most dependable, the manager's first choice for that position in his line-up whenever the pitcher has had enough rest and is otherwise physically fit.

Apple.—A baseball.

Arbiter.—An umpire.

Aspirin tablets.—A pitcher whose speed is dazzling in any given game is said to be throwing aspirin tablets.

"Average" player.—One who is more concerned with his personal feats than with the success of his team. He would rather make a hit in a losing game than go hitless in a game won by his team. In the field he would rather not get his hands in contact with a batted ball difficult to field than risk the danger of being charged with a fielding error.

Backing up.—A player on the fielding team who anticipates a throw about to be made to a teammate and who runs to a point where he can field the ball if his teammate fails to stop its course is said to "back up" his teammate. The term is also used when the ball is a batted ball and a fielder shifts to a position behind the man actually fielding the ball. Thus, on every grounder to an infielder, one or more outfielders will move so as to be ready in case the ball gets past the infielder. On flies to the outfield that are not driven directly to an outfielder, there are usually two outfielders converging toward the point where the fly is falling, one to catch it, the other deeper in the outfield as a "backer-up."

Bag.—Any base except home plate.

Bean ball.—A pitched ball that passes close to the batter's head or hits the batter's head.

Bench jockey.—A player with a sharp tongue, a quick wit and a voice that carries from the bench to the playing field. He rides the opposing team's players, preferably the pitcher, his aim being to arouse their emotional reactions and distract their attention from the performance of their assignments in the game.

Blank.—When a pitcher holds the opposing team runless in an inning, a succession of innings, or in an entire game, he is said to blank the team for that extent of play. Usually used in enumerating a series of consecutive scoreless innings credited to a pitcher's record.

Bleachers.—The section of a ball park's stands for spectators which is unroofed, usually located beyond the outfield's boundaries, and leaves the occupants unprotected from the sun's rays by any structural feature of the stands.

Blooper.—A Texas leaguer (*see* below).

Blow.—(noun) A safe hit.

Bobble.—To fail to hold on to a batted ball which has been fielded; applied both to a momentary hesitation in the execution of a play and to a true fielding error.

Boner.—A mistake of judgment or ignorance of some playing rule or of the existing situation in the game. Originally "bonehead play," now usually contracted.

Bonus player.—Usually a young amateur athlete—hence the phrase "bonus baby"—receiving a sum of money in excess of a maximum established by the commissioner's office for signing a contract with a professional club. The club is required to keep the player on its roster for two seasons under penalty of forfeiting its rights in him.

Book.—(*a*) The collective all-time records of baseball; (*b*) the rule-book; (*c*) a player's store of knowledge about the weaknesses of opposing players, batting, fielding or pitching. If a batter, for instance, has learned to detect some peculiarity in a pitcher's delivery which enables him to know beforehand when a curve is coming, he is said to have that pitcher "in his book."

Boot.—A fielding error. Originally it meant the missing of a grounder by an infielder expressed in verbal form as, "He booted it"; now means an error, the booting of a chance to retire an opposing player.

Break.—(*a*) A fortuitous happening which helps or hampers a player or a team in the course of a game, such as the oblique bounce of a grounder or the direction of a hard-hit drive when it points straight at a fielder; (*b*) the point of deviation of a curve pitch from the straight trajectory.

Brittle.—Adjective applied to a player who is frequently out of the line-up because of injuries.

Bunched hits.—Hits are said to be bunched when they occur in the same inning, thus scoring runs. When hits occur in the same inning with bases on balls and/or fielding errors, the team making the hits is said to bunch its hits with passes and errors.

Bush.—Term used loftily by major league players and writers to describe the baseball hinterland, the deeper minor leagues. A player new to the big leagues whose behaviour or speech does not please his associates is reprimanded by being called a "busher." When a player is transferred to the minors by a major league club, it is sometimes referred to as sending him back to the bush, or to the bushes.

Caught napping.—A base runner is said to be caught napping when the pitcher or catcher, by a quick throw to one of the bases, succeeds in effecting a tag-out of the runner as he tries to scramble to safety.

Caught stealing.—A base runner is caught stealing when he is retired at the base for which he was trying as the result of a throw by the catcher or pitcher.

Cellar.—Last place in a league.

Change of pace.—A slow ball pitched by a fast-ball pitcher is called a change-of-pace ball or simply a change of pace.

Charley horse.—Injury of a leg muscle, marked by pain and swelling,

usually the result of a sudden strain on some part of the muscle, tearing some of the fibre bundles.

Cheap, or Chinese, home run.—A home run that just clears the outfield barriers. Often teams wishing to increase the home runs hit by their batsmen will lower the barriers or bring them in closer. Another cheap home run is a normal fly ball that is carried by the wind out of the park.

Choke.—When a batter advances his hands along the bat toward its striking end farther than is customary with the average batter he is said to choke the bat. Some batters choke the bat habitually. Others choke it when they are about to bunt.

Circuit clout.—A home run.

Circus catch.—The capture of a fly ball by a fielder which involves his leaving the ground. He usually rolls over on the ground after catching the ball, like a circus tumbler.

Classic.—(noun) The world series.

Cleanup.—(adj.) Applied to a hit that drives home as many base runners as are on bases at the time, but no fewer than two. Fourth place in the batting order is called the cleanup position and the player batting in that position is the cleanup hitter.

Clinching the pennant.—A team clinches the pennant when it becomes mathematically impossible for any rival team to win the pennant even if it wins every remaining game on its schedule while the team in first place is losing every remaining game.

Clothesline.—A safe hit to the outfield which travels on a low line without touching the ground or rising more than 10 or 15 ft. above the ground.

Clubhouse lawyer.—A player given to argument on any or all points, particularly matters dealing with the conduct and operation of the team by its manager.

Clutch.—(noun) A crisis in the play of a ball game in which every player is on his mettle, since the fate of the game appears to be hanging in the balance. A player who becomes nervous or jittery or inexpert at such point is said to choke up or tighten up in the clutch.

Clutch hitter.—A player very dangerous when he comes to bat in the clutch, that is, at a crisis in the game when a hit can play a vital part in deciding victory and when failure to hit means the almost certain loss of the game. Players are rated as good or bad clutch hitters regardless of batting averages.

Collar.—*See* Horse collar.

College try.—When a player makes a desperate effort to field a batted ball that is hopelessly out of his reach, the attempt is called "giving the old college try" or, simply, "making a college try" for the ball.

Connect.—To hit the ball solidly, as "he connected for a two-bagger."

Cousin.—A pitcher whose deliveries are unusually easy for one batter, as compared with his teammates, is referred to as a cousin of that batter. Similarly, a given team that loses a large majority of its games to another team is known as the latter's cousin.

Cripple.—When the count on a batter is three balls and no strikes, the pitcher is said to be in the hole, meaning that he must try to pitch the next one over the plate, so that the batter does not reach first base on a base on balls. In his efforts to make sure the next pitch is over the plate, the pitcher often fails to use as much speed as on the previous pitches. Such a pitch is known as a cripple.

Crowding the plate.—A batter crowds the plate when he stands as close to home plate as permitted by the boundaries of the batter's box and in addition uses a crouching position, leaning forward so that his chin is actually over the top of the plate's inner margin.

Curtain raiser.—The first game of a double-header.

Cut.—(*a*) Forceful swing at the ball by the batter, whether he hits it or not; also used as a verb, to cut at the ball, with the same meaning; (*b*) one player's share of a lump sum of extra money won by the team as a whole; (*c*) a reduction in salary.

Double-header.—Two games played by the same two teams in the same park on the same day for one admission price.

Double steal.—When two base runners both advance safely to the next base without any batting of the ball occurring during the play, it is called a double steal. The term applies regardless of which two bases are stolen. The most frequent double steal comes with men on first and third. The runner on first steals second, and as the catcher throws unsuccessfully to that base, the runner on third dashes safely to home plate.

DP.—Double play.

Drag.—A batter bunting a ball between the pitcher and the first-base foul line, and starting to run to first base in the act of reaching for the ball with his bat, is said to drag the ball.

Duster.—A bean ball (*see* above), so-called because the batter, in dodging it, frequently falls to the ground and usually removes the dust from his uniform before resuming his batting position. A pitcher intentionally throwing the ball at the batter to make him dodge (a violation of the rules) is said to be dusting him off.

Fan.—(noun) A spectator at a ball game, or a person interested in baseball who discusses its events and personalities with others. (verb) To strike out.

Find the handle.—To field a grounder; often used in the negative when a fielder is slow in picking up a grounder, "He can't find the handle on the ball."

Foot in the bucket.—A timid batter with a tendency to fall away from the plate as he swings at the pitched ball is said to be batting with one foot in the water bucket, a phrase handed down from days when drinking water came in buckets instead of through the ball park's plumbing system. Every players' bench used to have its own water bucket.

Fungo.—A fly batted to the outfield in fielding practice. The batter holds the bat in one hand, tosses the ball into the air immediately in front of him, takes the bat in both hands and drives the ball high in the air in the direction of an outfielder waiting to catch it. This is known as fungo hitting. The fungo hitter uses a special fungo bat, lighter and thinner than the standard bats used in games. The flies he hits are sometimes called fungo flies, but usually merely fungos.

Garden.—The outfield.

Gonfalon.—The pennant, emblematic of the championship of the league for any given year.

Gopher ball.—A pitch that the batter hits for a home run, derived jocularly from the way the batters "go fer" it, hit it, and then "go fer" a home run.

Go the route, or the distance.—To pitch a complete nine-inning game.

Grand slam.—A home run with the bases full.

Grandstander.—A player who seems to be showing off, with an eye toward the approval of the spectators rather than concentrating all his attention on the playing of the game.

Grandstand manager.—A spectator given to shouting condemnatory expressions at the manager and/or players of the home team during the course of ball games, from his seat in the grandstand or the bleachers.

Grapefruit league.—The inter- and intra-league exhibition games played during the course of spring training.

Groove.—(noun) An imaginary line drawn across the middle of home plate from front to back. A pitched ball that crosses home plate waist high in a plane directly above this line on its way to the catcher is said to be in the groove, though it usually is hit by the bat before reaching the catcher. Also, as a verb, "to groove" means to pitch the ball just where the batter wants it, resulting in a solid hit.

Hall of Fame.—(*a*) The central court of the baseball museum at Cooperstown. (*b*) A nontangible "hall" in which a pitcher secures a permanent place for his name by pitching a no-hit game. Sometimes qualified as the "No-Hit Hall of Fame."

Handcuff.—A hard-hit batted ball, which seems to break through the hands of the infielder trying to catch it, is described as handcuffing the infielder.

Hawk.—An outfielder gifted with exceptional speed and keen judgment of the flight of batted balls, so that he can run far to make catches of long drives.

Hit the dirt.—To slide into a base.

Hook.—A curve pitch.

Horse collar.—A zero opposite a player's name in the bit column of a box score, meaning he made no hits in that game; also such a player is said to "go for the horse collar" or "collar."

Hot corner.—Third base, because batted balls hit toward that point are usually traveling faster than is the case when directed toward any other infielder; also known as far corner.

Hurler.—A pitcher; also called twirler.

In the hole.—(*a*) A drive that passes to the outfield halfway between two infielders is sometimes described as in the hole between short and third or first and second; (*b*) *see* Cripple.

Iron Man.—A pitcher of unusual endurance; in early baseball one who pitched and won both games of a double-header. *See* Rubber arm.

Ivory.—New talent added to a team's personnel from leagues of lower classification or from teams outside organized baseball. The talent scouts of professional teams are also called ivory hunters.

Jug handle.—A sharp-breaking and effective curve pitch.

Keystone.—Second base.

Kick.—(*a*) A voiced or gestured objection to an umpire's decision; also as verb, meaning to make such a protest; (*b*) to boot a grounder.

Knocked out of the box.—When the manager makes a substitution of one pitcher for another at some point during the opposing team's inning at bat and such substitution is made because of heavy hitting by the team at bat, the pitcher taken out of the game is said to be knocked out of the box.

Lead.—(*a*) The advantage that one team has over another, either in runs at some point during a game, as a two-run lead, or in games or points in a club standing at some point during a pennant race, as a four-game lead, or a 50-point lead. (*b*) A base runner takes a lead off a base when he moves two or three steps toward the next base as the pitcher takes his position to pitch to the batter.

Lead-off man.—The first player in a team's batting order.

Loop.—A baseball league or association.

Loose.—Adjective used to describe a pitcher whose delivery is smooth and rhythmic; also to describe any player who preserves his aplomb and effectiveness of operation regardless of how tense or fierce the action of a game becomes.

Muff.—The failure to hold a fly ball after getting hold of it or touching it with one or both hands.

Nightcap.—The second game of a double-header (*see* above).

No-hitter.—A game in which one pitcher prevents the opposing team from making a safe hit throughout the entire contest. Games of one or two hits for one of the contesting teams are termed one-hitters, two-hitters, etc., when describing the performance of the pitcher who thus restricted a team's batting efforts. A no-hitter in which no batter walks

or otherwise reaches first base is called a "perfect game."

Noisy strike.—A long fly ball that curves foul.

On deck.—The batter who will follow the man at bat at any given point is known as the man on deck.

Overhand delivery.—A style of pitching in which the pitcher's pitching hand passes his body at a level higher than his head and close to a vertical line drawn from the tip of his pitching shoulder.

Overrunning a base.—A base runner reaching a base but going past it, or being carried past it by the momentum of his body as he slides, is said to overrun the base.

Overthrow.—A throw to a base in an attempt to retire a base runner which is so high that the fielder cannot reach the ball at all, or block its flight enough to prevent its rolling out of control long enough for one or more base runners to advance one or more bases before control is regained.

Pass.—A base on balls, a "free ticket" to first base for the batter.

Passed ball.—A pitched ball within reach of the catcher which the catcher fails to hold and which rolls far enough for a base runner to advance at least one base before its recovery is scored as a passed ball. It is necessary that one or more base runners advance on the play for it to be scored as a passed ball, which counts as a fielding offense by the catcher, though it is not recorded in the error column of the box score (*see* Wild pitch).

Pinch hitter.—A player who is substituted for a man going to bat or already in the batter's box but with his turn at bat still unfinished.

Pop.—A pop, pop-up or pop fly is a weakly hit fly that travels steeply off the bat into the air.

Powerhouse.—A long-distance hitter.

Prima donna.—Temperamental player who must be coddled by his manager and teammates in order to perform at top efficiency.

Pull-hitter.—One who tends to drive the ball to the part of the playing field on the same side of home plate as the batter's box in which he is standing; *i.e.*, a right-handed batter who "pulls," hits his hardest drives to left field; a left-handed pull-hitter drives them to deep right.

Pull the string.—Every time a pitcher of good speed mixes in a slow ball, or change of pace, he is said to pull the string.

Rabbit ears.—A player, usually a pitcher, who is touchy and quick to flare into a rage. Pitchers and players in general, when the game is going on, give ear only to the voices of their own teammates, their manager and coaches. A player with rabbit ears can be disturbed and his efficiency impaired by comments from the opposing team's bench, from the coaches' boxes, or from the stands.

Rally.—An offensive outburst, usually two or more hits, made by a team that is behind in the score in a late inning of the game, whether or not the outburst is successful in tying or passing the other team.

Relieving a pitcher.—When one pitcher takes the place of another in the course of an inning, the new man is said to relieve the one who is leaving the game.

Rhubarb.—A heated argument resulting from an umpire's decision or rough tactics by a player and usually involving several players, managers and umpires.

Riding the bench.—A substitute player who has not played in his team's line-up for a long succession of games is riding the bench.

Rock.—A boner (*see* above).

Rookie.—A new player in the league.

Roundhouse.—A slow curve pitch.

Round-tripper.—A home run.

Rubber arm.—A pitcher who can pitch often and long without suffering any soreness of his arm or impairment of his pitching strength.

Run-down.—When a base runner is trapped between bases, and players of the fielding team toss the ball back and forth in their efforts to tag him out before he reaches a base safely, it is described as a run-down. They are running the base runner down.

Scattered hits.—Hits are said to be scattered when they occur in different innings of a game so that they are ineffective from the standpoint of scoring runs.

Scribe.—A baseball writer; also reporters and journalists in general.

Seventh-inning stretch.—A time-honoured baseball custom dating from the 19th century and in universal practice. As the home team prepares to go to bat in its 7th inning, the spectators stand up and remain standing until the first home batter steps into the batter's box. Fans rooting for the visiting team "stretch" at the start of the first half of the 7th inning. The idea is to bring luck to one's favoured team.

Shagging flies.—Pregame practice in which a succession of fungo flies are batted to the outfield for the outfielders to use in gauging the wind direction and speed prevalent produces a scene described as fly shagging. The activity of the outfielders (and also of pitchers and substitutes) is described as shagging flies.

Shake-off.—A pitcher seeing the catcher signaling for a fast ball may want to throw a curve, or vice versa. If so, he shakes his head. This is called giving the catcher the shake-off, or shaking him off.

Shave.—To pitch very closely—as close as a shave—to the batter, often forcing him to retreat from the front of the batter's box.

Shoestring catch.—The capture of a fly by a fielder, usually an outfielder, at the level of his shoetop, often after a long run.

Shutout.—A game in which one team fails to score any runs. The opposing pitcher is said to have shut out the team and to have pitched a shutout.

Sidearm delivery.—A pitching style in which the pitcher's arm extends laterally from his shoulder in the act of pitching the ball toward home plate, his hand keeping at about the level of his shoulder through the throwing action.

Skipper.—The manager; also called the pilot.

Slide.—A base runner approaching a base on a close play on which it is necessary for him to beat the ball and at the same time retain contact with the base after reaching it uses a slide to achieve his double purpose. The runner usually flings his body in the direction of the bag, feet first, aiming to stab the bag with one foot and to keep that foot in contact with the bag until his forward impetus expends itself. Some prefer the head-first slide, in which the runner dives face down toward the bag, usually not directly at it, but passing it within reach of one arm, so that his fingers clutch some part of the bag. This not only affords a better grasp of the object but also gives him more chance of eluding the tag of the fielder. Conversely, in sliding head first the runner does not have the advantage of his spikes, whose points form a hazard for a fielder guarding the bag when the play is close.

Slugger.—A batter who hits long drives.

Slump.—A losing streak (*see* below); a continued period of ineffectual batting or pitching.

Southpaw.—A left-handed pitcher.

Spray hitter.—A batsman who hits to all fields.

Streak.—A number of successive victories, defeats, hits, etc.

Stuff.—A pitcher whose fast ball is effective against opposing batters is said to have a lot of stuff. Curves, knuckle balls, screwballs, etc., are classified together as slow stuff.

Switch-hitter.—A player able to bat either right- or left-handed.

Take charge guy.—A player who, by reason of lending vocal support to his teammates or by stimulating others through his own excellent play, is a team leader.

Taking a pitch.—A batter is said to take a pitch when he makes no effort to swing or to bunt a ball pitched past him to the catcher.

Tally.—A run. (verb) To score a run.

Tee off.—Against a pitcher without much ability, or against a good pitcher when he has weakened, the batters are able to take full swings at the ball without waiting to gauge its speed or its degree of deviation from the straight trajectory. This lusty swinging is called teeing off when it results in long drives.

Texas leaguer.—A weakly hit fly that drops safe for a hit within a zone too far beyond the infield for the nearest infielder to catch it before it falls to earth and too close to the infield for the nearest outfielder to reach it before it falls.

Thrower.—Term used to describe a pitcher who does not have too much of a repertoire.

Time.—When a player or manager requests the umpire to stop the game for discussion, substitution or equipment change.

Trapped ball.—A fly or line drive caught by a fielder just after touching the ground for the first time and before rebounding more than an inch or two off the ground is said to be trapped by the fielder.

Triple-header.—Three games played by the same two teams in the same park on the same day, with admission charged only once; virtually unheard of in major league competition.

Triple steal.—When all three bases are occupied, and the man on third steals home, the other runners advancing to third and second bases respectively, without the ball having been hit by the batter, it is called a triple steal, even though no play is made on two of the base runners in question.

Twin bill.—A double-header, two games for one admission.

Twinight twin bill or double-header.—A double-header in which the first game starts about 2½ hours before sunset, the second under artificial lighting. The twinight double-header may also be divided into two games for which separate admissions are required.

Twirler.—A pitcher.

Two o'clock hitter.—A player who hits long hard drives during batting practice but bats weakly in the ball game; in reference to earlier times when games started at 3 o'clock rather than the present 1:30.

Waivers.—When a club in organized baseball wishes to send a player to a club in another league, it must first obtain permission to do so from all the other clubs in its same classification. The other clubs are asked to waive claim to the player. If any club refuses to waive claim, the club owning the player's contract may either call off the deal and keep the player or it may make a deal with one of the clubs in its own league, transferring the player to such club. It may also, without making any special arrangement, hand over the player to the club refusing to waive claim, to the lowest ranking club among those refusing to waive claim, if more than one club refuses. There is a fixed price in each league that must be paid by the club obtaining a player by this waiver method. The player is said to be sent by club A to club B on waivers.

Walk.—(noun) A base on balls. (verb) A batter receiving a base on balls "walks"; also used transitively, as "the pitcher then walked the next two batters."

Waste pitch.—In a situation where the pitcher has two strikes and no balls on the batter, the pitcher may deliberately throw a "ball" hoping the batter will misjudge it, swing, miss and thus strike out.

Whiff.—To swing and miss. In giving the number of strikeouts recorded by a pitcher in a game it may be said he "whiffed" so many.

Whitewashing.—A team that is held scoreless throughout a game is said to receive a whitewashing.

Wild pitch.—A pitched ball that strikes the ground before reaching the catcher or that is so high or so wide of its mark that the catcher cannot reach it. In scoring, it is necessary for a base runner to advance on such a pitch before it can be marked into the records. It is not a wild pitch, no matter how far the ball rolls, when there are no base runners on bases or when, with one or more runners on bases, none of them advances at least one base.

Wild throw.—A thrown ball that misses its mark so widely that the fielder cannot catch it in time to make the play.

Windup.—The preliminary swinging of the pitcher's arms as he prepares to make his pitch to the plate. With base runners on one or more bases, the pitcher dispenses with his windup, starting his pitch from a stationary position by merely drawing back his arm and throwing the ball, pivoting on one foot. In the windup, he rocks back and forth once or twice, with the ball in his bare hand, rotates the pitching arm in the shoulder socket at least once, then brings both hands together above his head, before starting the actual pivoting and drawing back of the pitching arm for the throw.

Yannigans.—The substitutes or scrub that form a team used to play the regulars of a team during spring training.

See also references under "Baseball" in the Index.

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BASEDOW, JOHANN BERNHARD (1723–1790), pioneer reformer of the Prussian state educational system, was born in Hamburg on Sept. 11, 1723. In 1753 he was appointed professor of philosophy in a Danish academy, but his unorthodox religious views caused his dismissal. After a similar experience at Altona, he abandoned theology and, inspired by Rousseau's *Émile,* he turned to educational reform. In 1768 he published *An Address to Philanthropists and Men of Property on Schools and Studies and Their Influence Upon the Public Welfare,* and asked for subscriptions to enable him to produce a textbook and to organize a model school.

Basedow was not an original thinker; his views, based on Comenius, Locke and Rousseau, were described in his *Book of Method for Fathers and Mothers of Families and of Nations* (1771). *The Elementary Work* (*Elementarwerk;* 1774), which sold widely, stressed the use of pictorial illustrations in teaching. His next venture, the establishment of a model school, the Philanthropinum, at Dessau, attracted many able teachers. However, they found difficulty in working with a man of such violent and unstable temperament, and in 1784 Basedow severed his connection with the Philanthropinum. He died at Magdeburg on July 25, 1790, the school surviving until 1793.

The enthusiasm on the continent of Europe for this type of institution may be likened to that which accompanied the Charity movement in England. Philanthropinums sprang up everywhere and drew the attention of Kant and Goethe. Some writers believe that Pestalozzi was indebted to Basedow.

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BASEL (BASLE; Fr. BÂLE), a canton of northwestern Switzerland, is traversed by the Jura and watered by, among other rivers, the Birs and the Ergolz, both left-bank tributaries of the Rhine. From 1803 to 1814 the canton was one of the six "directorial" cantons of the confederation. Since 1833 it has been divided into two half-cantons with independent constitutions. (*See* SWITZERLAND.)

The half-canton of Basel-Stadt, or Bâle-Ville, includes Basel city and two villages north of the Rhine. It has an area of 14 sq.mi. (37 sq.km.) and a population (1960) of 225,588, mainly German-speaking and Protestant. The cantonal constitution dates from 1889.

The enactment of any law by parliament can be made subject to a referendum, which requires 1,000 signatures. To justify the handing in of an initiative with a view to the enactment of any law or revision of the cantonal constitution, 2,000 signatures are required.

The other half-canton is Basel-Land, or Bâle Campagne, which is divided into four administrative districts and comprises 74 communes, its capital being Liestal. It has an area of 165 sq.mi. (428 sq.km.) and a population (1960) of 148,282, nearly all German-speaking. The cantonal constitution dates from 1892. The obligatory referendum applies to all laws, and a demand from 1,500 citizens is sufficient to initiate laws or a revision of the cantonal constitution.

Each canton division sends one member to the state council. Together they contribute 12 representatives (on the basis of the 1950 census) to the national council. These, with the executive, are all elected by a direct popular vote for the term of four years. For industries and bibliography, *see* BASEL (town).

BASEL (BASLE; Fr. BÂLE), the capital of the Swiss half-canton of Basel-Stadt (with which it is virtually coextensive), lies on the Rhine where the French, German and Swiss frontiers converge. Situated between the French Vosges to the northwest, the German Black Forest to the north-northeast and the Swiss Jura mountains to the south, Basel stands at the entrance to the Swiss Rhineland. Pop. (1960) 206,746.

The Rhine, bending northward, divides the town into two parts. Klein-Basel, lying to the north, is the Rhine port and industrial section where are the buildings of the Swiss Industrial fair and the German railway station, while Gross-Basel, south of the river, is the commercial and cultural centre. The two sectors are linked by six bridges, the most recent of which, the St. Alban-Brücke, was completed in 1955. Dominating the town from a terrace high above the south bank of the Rhine is the Münster, built of red sandstone with a roof brightly tiled in patterns of green and yellow. Consecrated in 1019, it was a cathedral until 1528 and is now an abbey church. There are several statues and bas-reliefs on the west front. The building is a mixture of Romanesque and Gothic styles. The most interesting features of the interior are the pulpit (1486), elaborately carved from a single block of stone, and a monumental slab, on one of the pillars, to Erasmus, who is buried there. Beside the church is the Pfalz, a terrace giving a view northward and northeastward into Germany, the Black Forest mountains being conspicuous.

BY COURTESY OF THE SWISS NATIONAL TOURIST OFFICE

THE MARKET PLACE AT BASEL, SWITZ., ON THE SOUTH SIDE OF THE RHINE RIVER. THE RATHAUS, OR COUNCIL HOUSE, ON THE LEFT WAS BUILT IN THE 16TH CENTURY. A WING WAS ADDED IN THE EARLY 20TH CENTURY

Nearby is the public art gallery (Kunstmuseum, 1936) which has fine collections of works by Conrad Witz, Hans Holbein the Younger and Arnold Böcklin, along with a superb collection of 20th-century art. Close by are the old buildings of the university, now housing the zoological faculty. The church of St. Martin, a short distance farther on, is the oldest religious foundation in Basel. The Historical museum occupies the former 14th-century Franciscan church in Barfüsser Platz; it also contains a collection of historical art. To the north on the market square is the late Gothic Rathaus (1504–14, one modern wing), with a red-painted façade and decorated with shields of the 18th-century cantons. Several former guild houses are on the Freie Strasse, Basel's main thoroughfare, running southeast from the Markt Platz. Just south of the Historical museum is the art gallery (Kunsthalle) for temporary art exhibitions. The St. Jakob monument is at the end of St. Jakobs Strasse; it commemorates the battle of St. Jakob in 1444, when 1,500 Swiss, of whom only 6 survived, opposed a French army of 30,000 under the dauphin, later Louis XI. Three of the medieval gates remain, the St. Alban gate, to the east of the city (north of the St. Jakob monument), the St. Johann's gate to the west, and the 14th-century Spalen (St. Paul's) gate, one of the finest medieval city gates in Europe. Close by the Spalen gate are the new university buildings in Peters Platz, completed in 1939. Northward is the new civic hospital, completed 1946, near the Dominican church which is now used by the Old Catholics. The Botanical gardens, also on Peters Platz, adjoin the university library, which has over 1,000,000 volumes and contains manuscripts of Martin Luther, Erasmus, Zwingli and Melanchthon, and of the acts of the great ecumenical council of 1431–49 (*see* BASEL, COUNCIL OF).

Basel is an important communications centre. It is one of the nodal points of the railways of Europe and through trains to most European countries can be seen in its station, from Oslo and Stockholm in the north, Rome and the Spanish frontier in the south, and Amsterdam and the Channel ports in the northwest to Istanbul and Athens in the southeast. It is an equally important river port, and great river barges trade with other ports on the Rhine or take goods for export overseas from Rotterdam. Regular air services operate from the international airport at Blotzheim, 8 mi. N.W. of the city, in French territory.

While Basel is a distributing centre for foreign trade it is also a major industrial city. Its chemical industries, which are the most important in Switzerland, manufacture dyestuffs, perfumes, drugs and other products. The Swiss Industries fair, first held in Basel in 1917 and now an annual event taking place in April, established the city's status as one of the chief financial and commercial centres in Switzerland and one of the first in Europe.

Originally a Celtic settlement of the Rauraci, the name Basilia first seems to have been applied to a Roman fortification mentioned by the emperor Valentinian I in A.D. 374. At the beginning of the 5th century the bishop of Augusta Rauracorum moved his see there, and under the secular power of succeeding bishops the prestige of the town steadily increased. In 1460 the University of Basel, the first in Switzerland, was founded by Pius II, who had been in Basel for the ecumenical council. Trade increased, having been stimulated by the presence of the council, and the wealthy burghers and the town guilds gradually supplanted the secular influence of the church. In 1501 Basel was admitted into the Swiss confederation. With the presence of Erasmus at the university, the town became one of the chief centres of the Reformation movement in Switzerland, the bishop retiring in 1528 to Porrentruy. A new bishopric was finally established at Solothurn (Fr. Soleure) in 1828. The Counter-Reformation brought skilled workmen as refugees from other parts of Europe, and by the 18th century political power was in the hands of the trade guilds which tended to favour the city at the expense of the rural districts. In 1831 the rural part of the canton revolted, proclaimed its independence the following year, and in 1833 was organized into the half-canton of Basel-Land, the city forming that of Basel-Stadt. For the area, population and government of the two divisions *see* BASEL (canton).

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BASEL, CONFESSION OF, which gives in 12 articles a moderate statement of Reform doctrine, was drafted in 1531 by Oecolampadius, compiled in fuller form by Oswald Myconius, and adopted by the Basel city authorities in 1534 and shortly afterward by the city of Mühlhausen in Alsace. It must be distinguished from the First Helvetic Confession, which is sometimes called the Second Confession of Basel (*see* HELVETIC CONFESSIONS). It held its place in the Church of Basel till 1872, when its use was discontinued.

For text, *see* H. A. Niemeyer, *Collectio Confessionum in ecclesiis reformatis publicatarum,* pp. 78–122 (1840). *See* also Schaff, *Creeds of the Evangelical Protestant Churches,* 5th ed. (1887).

BASEL, COUNCIL OF, a council of the church, was called by Pope Martin V a few weeks before his death in 1431 to fulfill a pledge made at the Council of Constance. It met at a time when the church was profoundly shaken by the intellectual and social crisis that characterized the transition from the medieval to the modern world, and when the prestige of the papacy had been weakened by the Great Schism (1378–1417), the need for reform and the persistent attempts to make the general councils of the church superior to the pope. Two major problems occupied the council: the Hussite heresy and wars, and the question of papal supremacy. (*See* also CONSTANCE, COUNCIL OF.)

Ever since the Council of Constance had condemned John Huss for heresy, Bohemia had been torn by demands for "reform"—a movement that became identified with Czech nationalism. Before the council met, Martin V had sent Giuliano Cardinal Cesarini to preach and organize a crusade in Germany against the Czech Hussites. The crusaders, however, were decisively beaten at Domazlice (Taus), Aug. 14, 1431; and Cesarini, who had been named to preside over the council, sought to achieve peace through it.

The council was determined to control negotiations with the Hussites and to ignore papal wishes. Three hundred Hussites came to Basel in Jan. 1433 to plead their cause, and, on failing to win over the council, returned to Prague with legates of the council for further discussion. There, in Nov. 1433, the *Compactata* of Prague were agreed to, whereby peace was to be restored and ecclesiastical censures against the Hussites removed. The Hussites were authorized to administer the chalice to the laity in Holy Communion, on the condition that they accept the faith and discipline of the church. It was further agreed that the clergy could retain as their own property what they received as gifts or inheritance but would be only administrators of church property. But the peace was soon broken, and years of civil war in Bohemia followed. (*See* also HUSSITES.)

News of the breach of the peace reached Basel just as the council learned that Pope Eugenius IV (1431–47), the successor of Martin V, ordered the council to transfer itself to Ferrara, Italy. This was the turning point in the long conflict between the council and the pope as to the ultimate authority in the church. Already in Dec. 1431 Eugenius IV had issued a bull dissolving it. The council in reply re-enacted on Feb. 15, 1432, the decree of Constance, declaring that it was the pope's duty to obey a general council and the council's to punish him if disobedient. No council could be dissolved or transferred without its own consent. The men at Basel insisted that Eugenius withdraw the decree of dissolution and threatened him until he finally yielded. On Feb. 5, 1434, a bull was read to the council in which Eugenius said that the decree of dissolution was null, that all his censures against the council were annulled and that it should continue its work and reform the papacy. Encouraged by the surrender, the council declared that it received its power directly from God and that the pope was bound to obey it. It arrogated to itself the judicial, administrative and executive functions of the pope and then cut off papal revenue. But all this vindictive legislation was voted by a council at which only 20 bishops and 13 abbots of the whole church were in attendance.

The conflict between the pope and council eventually was over-

come when the problem of reunion with the Greek Church became a possibility. The Greeks preferred to deal with the pope rather than the council. Aware of the declining prestige of the council, due to its excesses, and of the preference of the Greeks to meet in Italy, the pope in Sept. 1437 ordered the council to transfer its sessions to Ferrara, and in Jan. 1439, because of a plague at Ferrara, to Florence, where the union with the Greeks was proclaimed on July 6, 1439. Many of the bishops at Basel accepted and moved to Ferrara, but the die-hards remained at Basel as a rump council. (*See* FERRARA-FLORENCE, COUNCIL OF.)

When this rump suspended Eugenius he excommunicated its members (Feb. 15, 1438). The council in a session with only seven bishops present declared Eugenius deposed and elected in 1439 as his successor a layman, the duke of Savoy, Amadeus VII, who took the name Felix V. The next ten years of this rump council are important only because the princes used it to strengthen their control over the churches in their own territories. Thus Charles VII of France, against the will of the pope, accepted in the Pragmatic Sanction of Bourges (1438) the reform decrees of a council the pope had recently excommunicated. The king had regulated church affairs in France without papal authorization. In Germany likewise the princes used the decision of Basel to gain control of church property and ecclesiastical principalities, although to get them they had to recognize papal supremacy over a council.

On the death of Eugenius IV in 1447 his successor, the great humanist pope Nicholas V, gently but firmly brought about the abdication of Felix V and an end to the rump Council of Basel in April 1449.

See Philip Hughes, *A History of the Church*, vol. iii (1947); Ludwig von Pastor, *History of the Popes From the Close of the Middle Ages*, vol. 1, 2nd ed. (1899). (J. A. CT.)

BASHAN, a country often cited in the Old Testament and important also in the Roman empire, lying mainly in the Der'a *mohafazet* in the south of modern Syria. Approximately it extended westward to the edge of the plateau of Hauran; southward to the Yarmuk river or perhaps a few miles farther to the mountains of Gilead; eastward to the black volcanic Jebel Druze or sometimes perhaps into those mountains; and northward to Mt. Hermon on the Lebanon border. Bashan was the northernmost of the three ancient divisions of eastern Palestine (Moab, Gilead, Bashan). It is a tableland, between 1,600 and 2,300 ft. in height, well watered and very fertile. In the Old Testament Bashan was proverbial for the richness of its pasture, and in the writings of the prophets it also is coupled frequently with thickly forested areas such as Lebanon and Carmel, the cedars of Lebanon and the oaks of Bashan being mentioned together (Isa. ii, 13; Ezek. xxvii, 5–6). In New Testament times, when it comprised the districts of Gaulanitis and Batanaea, Bashan was one of the great granaries of the Roman empire.

The chief towns of Bashan to which reference is made in the Old Testament are as follows: Ashtaroth, one of the two capital cities of King Og (Deut. i, 4), usually identified with Tell Ashtarah, 21 mi. E. of Lake Tiberias (the Sea of Galilee); Edrei, Og's other capital (Deut. i, 4), identified with Der'a, about 27 mi. E. of Gadara and about 22 mi. N.W. of Bozrah; Golan (Deut. iv, 43), one of the cities of refuge, north of the Yarmuk, perhaps at Sahem Al Jaulan, about 17 mi. E. of the Sea of Galilee; and Salchah (Salecah, Deut. iii, 10), near Edrei, perhaps at Salkhad, 35 mi. E. of Edrei. Bozrah (*q.v.*; named Bostra by the Romans) was an important Nabataean and Roman city. Bashan contained the district of Argob (Deut. iii, 4 ff.), where Israel took 60 fortified cities, besides many unwalled villages, from Og.

In Numbers xxi, 33 ff. it is related that the Israelites defeated Og at his frontier city Edrei and took his land. The territory of Bashan was assigned to the half-tribe Manasseh (Deut. iii, 13). It was one of Solomon's administrative districts (I Kings iv, 13), and was smitten by Hazael (II Kings x, 32–33). In the 2nd century B.C. Judas Maccabee, in a victorious campaign against the armies of the Seleucid generals and their native allies, penetrated to Bozrah. From 84 to 81 B.C. Bashan was under the rule of Alexander Jannaeus of Judaea, but the land to the east belonged to the Nabataeans (*q.v.*). The Roman conquest of the area began when Pompeius and his legions drove the Nabataeans southward (64 B.C.), and Bozrah and Salchah became the northernmost Nabataean towns. Herod the Great, who had conducted war in this region (32 B.C.), was made its ruler by Augustus. By means of fortresses and a garrison of 3,000 legionaries he maintained a precarious peace and by proclaiming freedom from taxation attracted an ample population. Herod's son Philip succeeded to a tetrarchy comprising Gaulanitis, Batanaea, Trachonitis and Auronitis (4 B.C.), which later passed to Herod Agrippa I (A.D. 37–44). In A.D. 106 Trajan brought the whole Nabataean kingdom under the empire in creating the province of Arabia with Bostra (Bozrah) as capital (*see* ARABIA, ROMAN PROVINCE OF). Bozrah eventually became the ecclesiastical capital of the Hauran (cathedral built in 512) and as a trading centre was second only to Damascus. By 635 Damascus had fallen to the Muslims and thereafter Bashan's prosperity declined. The crusaders made two expeditions to Bozrah, in 1113 and 1119. For later history *see* SYRIA; DRUZE.

See D. Baly, *The Geography of the Bible* (1957). (E. D. GR.)

BASHI-BAZOUK, the conventional English spelling of the Turkish *bashi-bozuq*, a word meaning "whose head is turned, broken, spoiled" and, by extension, "leaderless, unattached." Originally describing the homeless beggars who reached Istanbul from the provinces of the Ottoman empire, it was later applied to all Muslim subjects not members of the armed forces and so came to mean "civilian." Finally it was applied to units of irregular volunteers (both infantry and cavalry) attached to the army but under independent officers and providing their own weapons and horses. These forces became notorious for indiscipline, plunder and brutality. They appeared at the end of the 18th century and fought in Egypt against Napoleon. During the Crimean War the allied generals made fruitless attempts to discipline them. Their excesses during the Russo-Turkish War of 1877–78 at last forced the Ottoman government to abandon their use. (A. D. A.)

BASHKIR, a Turkic people settled in the eastern part of European U.S.S.R., between the Volga and the Urals, and beyond the Urals. The Bashkir numbered over 840,000 in 1939 and had increased to 983,000 in 1959. Their territory forms the Bashkir Autonomous Soviet Socialist Republic of the Soviet Union. They are classified in the northwest or Kypchak branch of the Turkic language family, together with the Tatars of the Volga, Kazakhs, and others.

Bashkirs are mentioned in Arabic sources of the 10th century and after. They were originally nomadic pastoralists, together with their Turkic congeners. Their stock consisted of horses, sheep and, to a lesser extent, cattle and goats. The horses are small but powerful; the mare's milk is made into *kumys*, a fermented drink. Sheep are raised for wool, skins and meat, and are not milked; cattle are milked. At one time the Bashkirs bred camels. During the 19th century, through pressure of Russian colonists and colonial policy, the Bashkirs settled, gave up nomadizing and developed a primary dependence on agriculture for support. This is the case today; pastoralism plays a subordinate role in their economy.

In settling down they established themselves in fixed villages with houses of earth, sun-dried brick or logs. They were formerly divided into patrilineal clans and tribes. These groups bore names that are remembered today, but have lost most of their social significance: formerly the Bashkirs were organized, reckoned kinship, ran their affairs, sought help and regulated disputes within these clan and tribal structures. They do so no longer. The village and collective farm are the key social structures today. The religions of the Bashkir are Islam and the Eastern Orthodox rite.

See S. I. Rudenko, *Bashkiry* (1955). (L. K.)

BASHKIR AUTONOMOUS SOVIET SOCIALIST REPUBLIC (BASHKIRSKAYA AVTONOMNAYA SOVETSKAYA SOTSIALISTICHESKAYA RESPUBLIKA; also BASHKIRIA), an autonomous republic of the Russian Soviet Federated Socialist Republic, U.S.S.R., lies in the southern Urals and Urals foreland, covering an area of 55,444 sq.mi.

Physical Geography.—In the eastern part of the republic are the parallel ranges of the Urals, the major range being the Ural-tau. These ranges in general decrease in height southward. The highest peaks are Mt. Yaman-tau (5,374 ft.) and Mt. Iremel (5,203 ft.). The Belaya river (*q.v.*) flows south-southwest for 882 mi. between these ranges in a narrow, steep-sided valley, and then swings west before taking a sharp bend to the north, to flow through a broad, terraced valley that separates the mountainous east from the rolling hills of the Belebei upland in the west. In the north, between the Belaya and the Urals and drained by the Ufa, the chief tributary of the Belaya, is the ancient Ufa plateau. The mountains are heavily forested, largely with conifers and birch, while the foreland areas are open steppe, interspersed with "islands" of mainly deciduous forest, with birch, aspen, linden, oak and maple. In the valleys of the foreland are wide flood-plain meadows. Soils range from the thin mountain soils and the gray forest soils of the Ufa plateau to the *chernozem* ("black earth") of the Belebei upland and the clays of the flood plains. The climate is severely continental, much affected by the cold Siberian air masses. In late spring and summer the southern parts of the republic suffer from the scorching *sukhovey* winds from east and south, which bring droughts. Rainfall varies from 12 to 15 in. in steppe areas to 25 in. in the mountains.

Minerals.—The region is rich in minerals. The largest oil deposits of the Urals, part of the Second Baku (*q.v.*), occur around Kaltasy, Tuymazy, Shkapovo and Belebei in the west and Ishimbai on the middle Belaya. Natural gas is obtained in these areas. Iron ore is mined at Zugazin in the mountains, manganese near Beloretsk and Tavtimanovo, copper at Buribai and Sivai in the southeast, bauxite at Pervomayski in the northeast, gold in the southeast around Buribai and Baymak (Baimak), lignite around Yermolayevo and Mayachnoye in the south and salt near Sterlitamak on the Belaya.

History.—The Bashkirs are a Turkic people, former steppe nomads who settled there under the khanate of the Golden Horde. The area passed to Russia after the overthrow of the Kazan khanate by Ivan the Terrible in 1552. In 1574 the Russians founded Ufa and thereafter began colonization of the area, dispossessing the Bashkirs. This led to many uprisings of the Bashkirs, which were severely repressed. In the second half of the 18th century copper and iron working began, the first copper-smelting works being set up in 1745 and the first iron works 14 years later. Fuel demands began to make heavy inroads into the forests. In 1919 the Bashkir Autonomous Republic was set up, among the first such republics in the Soviet Union. Only after the Revolution did the Bashkirs acquire a written language. (*See* also BASHKIR.)

Population.—The population in 1959 was 3,335,000, the majority of whom were Russians. In 1959 there were 948,000 Bashkirs in the whole R.S.F.S.R., mostly, one may suppose, living in the Bashkir republic. Thirty eight per cent (1,279,000) of the population were urban. The most important of Bashkiria's 14 towns are Ufa (*q.v.*), the capital and cultural centre (546,000), Sterlitamak (111,000), Oktyabrski (65,000), Salavat (60,000) and Beloretsk (59,000). There are also 29 settlements of town type.

Economy.—Agriculture is most important in the Belaya valley and the foreland area. Nearly two-thirds of the sown area is under spring wheat. In the mountains and the north, rye and oats predominate. Maize (corn), flax, sugar beet, potatoes and sunflowers are also grown. Market gardening is well developed around Ufa and Sterlitamak. Stock rearing is important, especially in the Urals. There are more than 1,000,000 head of cattle and nearly 2,500,000 sheep and goats. Bashkiria is famous for its breed of horses. Beekeeping, a traditional Bashkir occupation, is widespread.

Among industries the first place is taken by the production, refining and processing of petroleum. A network of pipelines links the oil fields of the republic and of the neighbouring Tatar A.S.S.R. with the refineries of Ufa, Ishimbai and Salavat. After 1955 Bashkiria produced more oil than Baku. The main iron and steel centres are Beloretsk, specializing in steel cables and wire, and Tirlyanski for sheet steel. Engineering products of the republic include machine tools and equipment for the oil industry and mining, motor engines, electric cables and lamps, telephones and typewriters. The chemical industry is fast expanding, using oil and gas by-products and local salt. In the mountains the timber industry is important, the logs being rafted down to sawmills at Ufa, Sterlitamak and elsewhere on the Belaya. Much veneer is produced; Ufa makes furniture and matches and Krasny Klyuch, paper. Most of the power of Bashkiria is from electric plants using coal and oil; large power stations are located in Ufa, Sterlitamak and Ishimbai. As yet the considerable hydroelectric potential of the Ural area is little developed, but in the 1960s a hydroelectric station was constructed at Pavlovka on the Ufa. The main artery of communication is the Kuibyshev-Chelyabinsk railway through Ufa, one of the major trans-Ural routes. From Ufa a branch line follows the Belaya valley through Sterlitamak as far as Tyulgan. Motor roads link Ufa with Kazan and Orenburg and another connects Sterlitamak to Beloretsk and Magnitogorsk.

(R. A. F.)

BASHKIRTSEFF, MARIE (full name MARIYA KONSTANTINOVNA BASHKIRTSEVA) (1860–1884), Russian painter and author of a remarkable autobiographical journal kept in French from the age of 12 until 11 days before her death, was born of noble parentage, Nov. 23 (new style; 11, old style), 1860, near Poltava (Ukraine). She spent most of her life in Paris, where her mother settled in 1870 after parting from her husband. Precocious, gifted and soundly educated in the classics, modern languages and the arts, she became a cultivated society woman. Forced to abandon training as a singer because tuberculosis affected her voice, and driven by vanity and ambition to become famous, she developed as an artist of marked talent. Her naturalist paintings of everyday subjects—*e.g.*, "Le Meeting" in oils and a portrait in pastel, both now in the Musée du Luxembourg, Paris—promised a successful career. However, she died in Paris, Oct. 31, 1884. Determined that her name should survive, she had written a preface to her *Journal*—an autobiography of sensitive immaturity written with sincerity and unusual candour—anticipating its posthumous publication (2 vol., 1887; Eng. trans. 1890). Its novelty, perception and subtle self-analysis caused a sensation. Translated into several languages, it has a place in the history of autobiography.

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BASHŌ: *see* MATSUO BASHŌ.

BASIC ENGLISH. The need for a simple form of English to be used as a second or international language, or as a first step to wider English, has long been clear. But it was not till Winston Churchill (*The Second World War*, vol. v, 1952, pp. 571, 587–588), with the support of Franklin D. Roosevelt (*The Roosevelt Letters*, vol. iii, 1952, pp. 500–501), put forward the argument for Basic English in Sept. 1943, that the general public became interested in its future.

Basic was designed between 1926 and 1930 to give the learner an equal chance of exchanging ideas with learners in other countries. But it may have a further value which is frequently overlooked—as an instrument of thought and an apparatus for recording the latest discoveries of science. The question commonly put at this point by those who have never seen so limited a word list in operation is: And how would *that* be said in Basic? The answer may come as a surprise: for what they have been reading so far is normal Basic prose. But as a complete account of the system is given, in Basic, in *The ABC of Basic English*, this article may now be continued in the full vocabulary of standard English.

The 850 words that this B(ritish) A(merican) S(cientific) I(nternational) C(ommercial) auxiliary medium comprises were selected to cover the requirements of everyday communication, with the minimum of grammatical and structural addenda: the system is so constructed that these words work as a team with

the minimum of overlapping and irregularity; and the minor restrictions imposed on those familiar with the usages of wider English demand the minimum adjustment consistent with intelligibility to a learner who has been willing to spend 30–50 hours on a systematically graded course such as that provided by *Basic Step by Step*.

The background from which these minima emerged must be briefly indicated, if the difficulties attaching to any form of systematic simplification are to be understood.

Background.—Though a dictionary of the English language may contain in a single volume as many as 100,000 entries, or may run to upward of 500,000 (according to its philological or historical standards and the range of scientific nomenclatures included), there are not more than 60,000 "words" with which anyone but a specialist is likely to be concerned. But of these 60,000 at least 20,000 are of frequent occurrence in school textbooks or in reading matter regarded as suitable for the young.

The vocabulary barrier that separates the man of letters from the man of science or helps to isolate the literate thousands from the near-illiterate millions is constantly increasing; and the foreigner who elects to use English as his second language may waste several years on a smattering of phrases and idioms which would hardly qualify him to act as a commissionaire. Moreover, this arbitrary fraction of the language of his choice may deviate widely from that acquired by learners in other parts of the world, whereas what Churchill envisaged as "an aid to the building up of our new structure for preserving peace" was a truly basic nucleus, "a medium, albeit primitive, of intercourse and understanding" with a universal appeal for those who realize that "the Empires of the future are the empires of the mind."

One way of constructing a universal language is to make an inventory of the sorts of entities or referents for which a notation is required and then to devise suitable symbols or words defined to cover the charted field. This was the method adopted by Wilkins in his pioneer work on a *Universal Character* (1668), and a similar analysis, though in terms of "ideas," was projected by Leibniz as a *characteristica universalis*. Alternatively, existing languages may be used as a start and their vocables or the meanings attributed to them may be matched, taking the fundamental "parts of speech" from the grammars based on a formal analysis of vocabularies and structure.

Unfortunately, the grammars in question have been based largely on one another, and ultimately on those derived from early attempts to summarize the peculiarities of Latin—in the ages when the truth was supposed to be discoverable by a verbal approach. "Here is the first distemper of learning," wrote Francis Bacon, "when men study words not matter"; but insofar as any existing language has proved itself effective for both international and scientific communication, it is likely to contain the elements necessary for an auxiliary medium if the right selection can be achieved.

Basic was therefore the result of combining both methods of approach. At the practical level of pointing and gesture, there are three chief kinds of referents for which names are required: objects, acts and directions. These are represented by the nouns, verbs and prepositions, and to them may be added qualities, without deciding where the various sorts of adjectives that name the qualities should be regarded as pointing, when sensations and feelings have been distinguished from their causes or correlates in the external world. The orthodox grammatical account of the elements was content to list these four "parts of speech" almost on an equality with four others: pronouns, conjunctions, adverbs and interjections; though for several centuries confusion was caused by a miscellaneous tribe of "particles," a sort of residuary star dust collected from the verbal firmament, which was not finally dissipated till Horne Tooke explained (1786–98) the nature of abbreviation (on a dubious etymological ideology) and prepared the way for Jeremy Bentham's analysis of fictions (1813–21).

Thus it was possible in the Basic selection to distinguish four types of words that name concrete referents, each with its fictional analogues, and four types of abbreviation, which, with a minimum of rules for derivatives and syntactic order, complete the system. Of the 850 words in the Basic vocabulary, 600 are names of things or events (nouns), 150 are names of qualities or properties (adjectives) and the remaining 100 put the system into operation.

Structure of the System.—The principles of Word Economy relevant to any language with a fully developed verb system are outlined in *Basic English and Grammatical Reform*, where the distinction between the small group of words that name the primary operations and the much larger group that cover both an operation and a direction is illustrated by examples of its application in Basic. By retaining only 15 of the primary group, together with *be* and the auxiliaries *may* and *will*, about 4,000 common English verbs can be eliminated. These 15 verb forms and the pronouns follow the paradigms by which "correct" English has so far been prevented from regularizing itself as pidgin; and almost the only other grammatical rules are those for the five sets of affixes (for plurals, comparison, the formation of adjectives and nouns by means of the *-er*, *-ing* and *-ed* suffixes, the adjectival prefix *un-*, and the adverbial suffix *-ly*), which follow the normal English procedure. Secondary senses, compounds and the 250 Basic idioms listed in *The Basic Words* are related to root uses in *The ABC* and *The Basic Teacher*. Word order, where it does not correspond with that of gesture language, is specified and illustrated by model routines.

The numerals, the calendar, currencies and the various units of measurement are treated, like proper and geographical names or similarly capitalized titles, as part of the Basic system, though not listed as full learning items. In addition there are about 50 common words, at the level of *radio*, *hotel* or *club*, which are now universally understood, and the list is likely to grow very rapidly as tribal and geographical barriers are eliminated and the world of telecommunications and aeronautics continues to contract. This contraction and the diffusion of English during the past four centuries have led to the international acceptance of a wide range of general and technical terms which Basic can be used to operate. So an occasional explanation or footnote serves to make clear such other words as may be introduced for any special purpose or subject matter. But in scientific and technical fields, Basic becomes an instrument for bringing into action the international terminologies and nomenclatures of science. A short defining glossary may sometimes suffice to link the specialist with his Basic interpreter, but with 100 words for science in general and 50 for any of its main branches (a total vocabulary of 1,000), the standard of exposition and abstract in *Basic for Science* and its companion volumes can readily be achieved.

Methods of Teaching.—The units of any language are collected for convenience of reference in a dictionary. These units are words, which may be (1) the names of things, or referents of any sort, about which information is conveyed to a reader; and (2) any other separable parts of the sentences by which that information is conveyed. The letters that make up the words in a dictionary are marks on paper, and the words, or groups of such marks, serve as signs for the reader who interprets them. So language is not essentially speech, whatever the origin of words may have been; and those who define it primarily in terms of speech for particular purposes will find that the "breath groups" and "phonemes" elicited by their analysis constitute a very unsatisfactory basis for further linguistic education. The spoken form of language is still of great importance insofar as writing, typewriting and printing have not taken the place of talking. But the sounds made for conversational purposes are not essential to the interpretation of the written or printed characters by which thought and feeling are recorded, information is conveyed and knowledge is increased.

If freedom from word magic, from the power of language to mislead and distract, is ever to be won, an understanding of how words work is necessary. Such an understanding will enable clearer thinking, more intelligent writing and less mechanical talking and reading. Fluency with current phrases and idioms has too long been a classroom ideal, and one of the merits claimed for Basic is that it can be used to awaken what may be called the

OPERATIONS, etc. 100

COME
GET
GIVE
GO
KEEP
LET
MAKE
PUT
SEEM
TAKE
BE
DO
HAVE
SAY
SEE
SEND
MAY
WILL
ABOUT
ACROSS
AFTER
AGAINST
AMONG
AT
BEFORE
BETWEEN
BY
DOWN
FROM
IN
OFF
ON
OVER
THROUGH
TO
UNDER
UP
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OF
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THAN
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EVERY
NO
OTHER
SOME
SUCH
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THIS
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AND
BECAUSE
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WHILE
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WHEN
WHERE
WHY
AGAIN
EVER
FAR
FORWARD
HERE
NEAR
NOW
OUT
STILL
THEN
THERE
TOGETHER
WELL
ALMOST
ENOUGH
EVEN
LITTLE
MUCH
NOT
ONLY
QUITE
SO
VERY
TOMORROW
YESTERDAY
NORTH
SOUTH
EAST
WEST
PLEASE
YES

THINGS

400 General

ACCOUNT
ACT
ADDITION
ADJUSTMENT
ADVERTISEMENT
AGREEMENT
AIR
AMOUNT
AMUSEMENT
ANIMAL
ANSWER
APPARATUS
APPROVAL
ARGUMENT
ART
ATTACK
ATTEMPT
ATTENTION
ATTRACTION
AUTHORITY
BACK
BALANCE
BASE
BEHAVIOUR
BELIEF
BIRTH
BIT
BITE
BLOOD
BLOW
BODY
BRASS
BREAD
BREATH
BROTHER
BUILDING
BURN
BURST
BUSINESS
BUTTER
CANVAS
CARE
CAUSE
CHALK
CHANCE
CHANGE
CLOTH
COAL
COLOUR
COMFORT
COMMITTEE
COMPANY
COMPARISON
COMPETITION
CONDITION
CONNECTION
CONTROL
COOK
COPPER
COPY
CORK
COTTON
COUGH
COUNTRY
COVER
CRACK
CREDIT
CRIME
CRUSH
CRY
CURRENT
CURVE
DAMAGE
DANGER
DAUGHTER
DAY
DEATH
DEBT
DECISION
DEGREE
DESIGN
DESIRE
DESTRUCTION
DETAIL
DEVELOPMENT
DIGESTION
DIRECTION
DISCOVERY
DISCUSSION
DISEASE
DISGUST
DISTANCE
DISTRIBUTION
DIVISION
DOUBT
DRINK
DRIVING
DUST
EARTH
EDGE
EDUCATION
EFFECT
END
ERROR
EVENT
EXAMPLE
EXCHANGE
EXISTENCE
EXPANSION
EXPERIENCE
EXPERT
FACT
FALL
FAMILY
FATHER
FEAR
FEELING
FICTION
FIELD
FIGHT
FIRE
FLAME
FLIGHT
FLOWER
FOLD
FOOD
FORCE
FORM
FRIEND
FRONT
FRUIT
GLASS
GOLD
GOVERNMENT
GRAIN
GRASS
GRIP
GROUP
GROWTH
GUIDE
HARBOUR
HARMONY
HATE
HEARING
HEAT
HELP
HISTORY
HOLE
HOPE
HOUR
HUMOUR
ICE
IDEA
IMPULSE
INCREASE
INDUSTRY
INK
INSECT
INSTRUMENT
INSURANCE
INTEREST
INVENTION
IRON
JELLY
JOIN
JOURNEY
JUDGE
JUMP
KICK
KISS
KNOWLEDGE
LAND
LANGUAGE
LAUGH
LAW
LEAD
LEARNING
LEATHER
LETTER
LEVEL
LIFT
LIGHT
LIMIT
LINEN
LIQUID
LIST
LOOK
LOSS
LOVE
MACHINE
MAN
MANAGER
MARK
MARKET
MASS
MEAL
MEASURE
MEAT
MEETING
MEMORY
METAL
MIDDLE
MILK
MIND
MINE
MINUTE
MIST
MONEY
MONTH
MORNING
MOTHER
MOTION
MOUNTAIN
MOVE
MUSIC
NAME
NATION
NEED
NEWS
NIGHT
NOISE
NOTE
NUMBER
OBSERVATION
OFFER
OIL
OPERATION
OPINION
ORDER
ORGANIZATION
ORNAMENT
OWNER
PAGE
PAIN
PAINT
PAPER
PART
PASTE
PAYMENT
PEACE
PERSON
PLACE
PLANT
PLAY
PLEASURE
POINT
POISON
POLISH
PORTER
POSITION
POWDER
POWER
PRICE
PRINT
PROCESS
PRODUCE
PROFIT
PROPERTY
PROSE
PROTEST
PULL
PUNISHMENT
PURPOSE
PUSH
QUALITY
QUESTION
RAIN
RANGE
RATE
RAY
REACTION
READING
REASON
RECORD
REGRET
RELATION
RELIGION
REPRESENTATIVE
REQUEST
RESPECT
REST
REWARD
RHYTHM
RICE
RIVER
ROAD
ROLL
ROOM
RUB
RULE
RUN
SALT
SAND
SCALE
SCIENCE
SEA
SEAT
SECRETARY
SELECTION
SELF
SENSE
SERVANT
SEX
SHADE
SHAKE
SHAME
SHOCK
SIDE
SIGN
SILK
SILVER
SISTER
SIZE
SKY
SLEEP
SLIP
SLOPE
SMASH
SMELL
SMILE
SMOKE
SNEEZE
SNOW
SOAP
SOCIETY
SON
SONG
SORT
SOUND
SOUP
SPACE
STAGE
START
STATEMENT
STEAM
STEEL
STEP
STITCH
STONE
STOP
STORY
STRETCH
STRUCTURE
SUBSTANCE
SUGAR
SUGGESTION
SUMMER
SUPPORT
SURPRISE
SWIM
SYSTEM
TALK
TASTE
TAX
TEACHING
TENDENCY
TEST
THEORY
THING
THOUGHT
THUNDER
TIME
TIN
TOP
TOUCH
TRADE
TRANSPORT
TRICK
TROUBLE
TURN
TWIST
UNIT
USE
VALUE
VERSE
VESSEL
VIEW
VOICE
WALK
WAR
WASH
WASTE
WATER
WAVE
WAX
WAY
WEATHER
WEEK
WEIGHT
WIND
WINE
WINTER
WOMAN
WOOD
WOOL
WORD
WORK
WOUND
WRITING
YEAR

200 Pictured

ANGLE
ANT
APPLE
ARCH
ARM
ARMY
BABY
BAG
BALL
BAND
BASIN
BASKET
BATH
BED
BEE
BELL
BERRY
BIRD
BLADE
BOARD
BOAT
BONE
BOOK
BOOT
BOTTLE
BOX
BOY
BRAIN
BRAKE
BRANCH
BRICK
BRIDGE
BRUSH
BUCKET
BULB
BUTTON
CAKE
CAMERA
CARD
CARRIAGE
CART
CAT
CHAIN
CHEESE
CHEST
CHIN
CHURCH
CIRCLE
CLOCK
CLOUD
COAT
COLLAR
COMB
CORD
COW
CUP
CURTAIN
CUSHION
DOG
DOOR
DRAIN
DRAWER
DRESS
DROP
EAR
EGG
ENGINE
EYE
FACE
FARM
FEATHER
FINGER
FISH
FLAG
FLOOR
FLY
FOOT
FORK
FOWL
FRAME
GARDEN
GIRL
GLOVE
GOAT
GUN
HAIR
HAMMER
HAND
HAT
HEAD
HEART
HOOK
HORN
HORSE
HOSPITAL
HOUSE
ISLAND
JEWEL
KETTLE
KEY
KNEE
KNIFE
KNOT
LEAF
LEG
LIBRARY
LINE
LIP
LOCK
MAP
MATCH
MONKEY
MOON
MOUTH
MUSCLE
NAIL
NECK
NEEDLE
NERVE
NET
NOSE
NUT
OFFICE
ORANGE
OVEN
PARCEL
PEN
PENCIL
PICTURE
PIG
PIN
PIPE
PLANE
PLATE
PLOUGH
POCKET
POT
POTATO
PRISON
PUMP
RAIL
RAT
RECEIPT
RING
ROD
ROOF
ROOT
SAIL
SCHOOL
SCISSORS
SCREW
SEED
SHEEP
SHELF
SHIP
SHIRT
SHOE
SKIN
SKIRT
SNAKE
SOCK
SPADE
SPONGE
SPOON
SPRING
SQUARE
STAMP
STAR
STATION
STEM
STICK
STOCKING
STOMACH
STORE
STREET
SUN
TABLE
TAIL
THREAD
THROAT
THUMB
TICKET
TOE
TONGUE
TOOTH
TOWN
TRAIN
TRAY
TREE
TROUSERS
UMBRELLA
WALL
WATCH
WHEEL
WHIP
WHISTLE
WINDOW
WING
WIRE
WORM

QUALITIES

100 General

ABLE
ACID
ANGRY
AUTOMATIC
BEAUTIFUL
BLACK
BOILING
BRIGHT
BROKEN
BROWN
CHEAP
CHEMICAL
CHIEF
CLEAN
CLEAR
COMMON
COMPLEX
CONSCIOUS
CUT
DEEP
DEPENDENT
EARLY
ELASTIC
ELECTRIC
EQUAL
FAT
FERTILE
FIRST
FIXED
FLAT
FREE
FREQUENT
FULL
GENERAL
GOOD
GREAT
GREY
HANGING
HAPPY
HARD
HEALTHY
HIGH
HOLLOW
IMPORTANT
KIND
LIKE
LIVING
LONG
MALE
MARRIED
MATERIAL
MEDICAL
MILITARY
NATURAL
NECESSARY
NEW
NORMAL
OPEN
PARALLEL
PAST
PHYSICAL
POLITICAL
POOR
POSSIBLE
PRESENT
PRIVATE
PROBABLE
QUICK
QUIET
READY
RED
REGULAR
RESPONSIBLE
RIGHT
ROUND
SAME
SECOND
SEPARATE
SERIOUS
SHARP
SMOOTH
STICKY
STIFF
STRAIGHT
STRONG
SUDDEN
SWEET
TALL
THICK
TIGHT
TIRED
TRUE
VIOLENT
WAITING
WARM
WET
WIDE
WISE
YELLOW
YOUNG

50 Opposites

AWAKE
BAD
BENT
BITTER
BLUE
CERTAIN
COLD
COMPLETE
CRUEL
DARK
DEAD
DEAR
DELICATE
DIFFERENT
DIRTY
DRY
FALSE
FEEBLE
FEMALE
FOOLISH
FUTURE
GREEN
ILL
LAST
LATE
LEFT
LOOSE
LOUD
LOW
MIXED
NARROW
OLD
OPPOSITE
PUBLIC
ROUGH
SAD
SAFE
SECRET
SHORT
SHUT
SIMPLE
SLOW
SMALL
SOFT
SOLID
SPECIAL
STRANGE
THIN
WHITE
WRONG

NO 'VERBS'

IT
IS
POSSIBLE
TO
GET
ALL
THESE
WORDS
ON
THE
BACK
OF
A
BIT
OF
NOTEPAPER
BECAUSE
THERE
ARE
NO
'VERBS'
IN
BASIC
ENGLISH

A
WEEK
OR
TWO
WITH
THE
RULES
AND
THE
SPECIAL
RECORDS
GIVES
COMPLETE
KNOWLEDGE
OF
THE
SYSTEM
FOR
READING
OR
WRITING

EXAMPLES OF WORD ORDER

THE
CAMERA
MAN
WHO
MADE
AN
ATTEMPT
TO
TAKE
A
MOVING
PICTURE
OF
THE
SOCIETY
WOMEN
BEFORE
THEY
GOT
THEIR
HATS
OFF
DID
NOT
GET
OFF
THE
SHIP
TILL
HE
WAS
QUESTIONED
BY
THE
POLICE

WE
WILL
GIVE
SIMPLE
RULES
TO
YOU
NOW

RULES

ADDITION OF 'S'
TO THINGS WHEN
THERE IS
MORE THAN ONE

ENDINGS
IN 'ER,' 'ING,' 'ED'
FROM 300 NAMES
OF THINGS

'LY' FORMS
FROM
QUALITIES

DEGREE
WITH
'MORE' AND 'MOST'

QUESTIONS
BY CHANGE OF
ORDER,
AND 'DO'

FORM-CHANGES IN
NAMES OF ACTS,
AND 'THAT,' 'THIS,'
'I,' 'HE,' 'YOU,'
'WHO,' AS IN
NORMAL ENGLISH

MEASURES
NUMBERS
DAYS, MONTHS
AND THE
INTERNATIONAL
WORDS
IN ENGLISH
FORM

THE
ORTHOLOGICAL
INSTITUTE

"linguistic conscience" and to remove difficulties that the old grammars and logics failed to illumine.

A reform of the technique of language learning appropriate to systematically graded material does not, however, imply the acceptance of a lower standard of training for speech than that attained by so-called modern methods. At the level where mass illiteracy can be alleviated by community singing or filmstrips, the memorizing of a few hundred Basic words and phrases may help merely to extend the field for verbal and emotive propaganda. But if more than this is desired, the drill and practice required for conversational fluency can best be provided at a stage when confidence has been established by the gradual substitution of words for the signs by which travelers have succeeded in dealing with concrete situations throughout the ages. For a restricted vocabulary in which more than 60% (514) of the 850 words are monosyllables, irregularities of pronunciation are correspondingly limited, and the rules given in *Word-Stress and Sentence-Stress* are a Basic contribution to phonetics by which a proper attention to the sounds of the dictionary items can be effectively supplemented. In this as in other respects, teachers who add to, or subtract from, the system by arbitrary deviations deprive the learner of much of its practical and educational value.

History and Progress.—It is with this educational aspect of language that those responsible for the origination and development of the Basic movement have been chiefly concerned. So long ago as 1892, Karl Pearson, in *The Grammar of Science,* had envisaged a fundamental "study of the right use of language, the clear definition and, if needful, invention of terms—*Orthology.*" The Orthological institute (founded by C. K. Ogden [*q.v.*]), a research organization to focus attention on just such a study of the uncharted borderlands of linguistics and psychology, came formally into being in 1927; and Basic (1930) was the most encouraging outcome of its initial undertaking. Orthology, thus generalized to cover the entire "normative science of symbols," has little in common with any of the subsequent interpretations of what the French linguist Michel Bréal (1897) called "Semantics"; its historical relations being rather with the less publicized "Semeiotic" of C. S. Peirce and the "Significs" of Lady V. Welby (projected in the 11th edition of the *Encyclopædia Britannica*). The advantages of a new diagrammatic technique, elaborated for lexicological purposes as "panoptic conjugation," made it unnecessary to rely on the cruder frequency methods still in favour with certain compilers of textbooks.

Less than ten years later, the institute had representatives in more than 30 countries and over 100 books in, or about, Basic had appeared under its auspices. The outbreak of World War II crippled the organization that had been built up, and during the entire period of paper rationing only a very small number of the prewar publications could be kept in print. It was therefore impossible without further facilities to meet the demand created by the support of Winston Churchill in 1943; and these facilities were not yet provided. In April 1947, however, the Basic English foundation was established as a Charity trust under English law with a small maintenance grant from the British government, and a program which included the training of teachers and the preparation of further Basic publications was undertaken for the trustees by members of the institute's staff.

The foundations of a practical world language have been laid, but much work still remains to be done. The original objective for Basic will not have been attained until a complete range of picture material has rendered the teaching method independent of verbal exposition in other languages. The verbal exposition itself may be regarded as fragmentary until a standard radio course and text can be offered from any station in at least 30 of the world's most familiar tongues. As a supplement to such courses and an incentive to the reader to treat his second language as more than a temporary expedient, two Basic libraries, general and scientific, each of 1,000 volumes with the original and the Basic parallel, could be produced and kept up to date. Though several million Basic books have been acquired by learners in all parts of the world such projects will require substantial endowment if the progress of "debabelization" is to be accelerated.

See also PIDGIN; UNIVERSAL LANGUAGE.

BIBLIOGRAPHY.—C. K. Ogden, *Basic English,* 9th ed. (1944), includes "A Short Guide to Basic English" written in Basic; *The Basic Words, The ABC of Basic English* and *Basic Step by Step* further explain the system; *Basic English and Grammatical Reform* covers the research background (detailed in *Psyche,* vol. viii–xiii) while *Basic English versus the Artificial Languages* replies to the animadversions of Esperantists and others; *The General Basic English Dictionary* gives the Basic definitions of 20,000 common English words and a further 20,000 of their uses. *The Basic Teacher* by L. W. Lockhart is a complete graded course for translation into the main European languages; and "The Basic Way" is similarly graded for class use in India, Africa and the middle east. *Basic for Science* is supplemented by *Basic for Economics, Basic for Geology, A Basic Astronomy, The Growth of Science* and other Basic presentations of scientific material. *See* also *Basic Science Dictionary* (1962). The complete *Bible in Basic English* was published in 1949. The Basic list also includes, along with *A General History* and school editions of works by Plato, Shakespeare, Shaw and Marryat, versions of *Treasure Island, Pride and Prejudice* and *The Time Machine.* (C. K. O.)

BASIC OXYGEN STEEL: *see* CONVERTER STEEL.

BASIC SLAG: *see* SLAG.

BASIL, SAINT, THE GREAT (*c.* 330–379), one of the great Cappadocian Fathers (with Gregory of Nyssa and Gregory of Nazianzus; *qq.v.*), famous for his organization of Greek monasticism. Born at Caesarea Mazaca in Cappadocia (modern Kayseri, Turk.), he came from a family which included the saintly Macrina, his sister, and his brothers Gregory of Nyssa and Peter, bishop of Sebaste. Educated at Athens with Gregory of Nazianzus, he became a rhetoric teacher like his father Basil; but he was soon converted to a monastic way of life through the influence of Macrina. She had organized a monastic community on the family property at Annesi in Cappadocia; and Basil, after visiting the various anchoretic groups in Egypt and Syria about the year 357, founded another settlement near his sister's, for which apparently he composed his *Longer* and *Shorter Rules.* Ordained priest about 364 by Eusebius, he succeeded him as bishop of Caesarea in 370, and thereafter his primary efforts were engaged in ecclesiastical business and in the suppression of heresy. Tenaciously upholding the doctrine of Nicaea, he opposed the Arianism of Valens, attacked Sabellianism and wrote against Eunomius and Apollinaris of Laodicea. His appointment of his younger brother Gregory as bishop of Nyssa was for a time an occasion for regret; and it was not until after Basil's death that Gregory's true worth as an ecclesiastical ruler and mystical theologian could fully emerge.

Basil has been called a Roman among the Greeks because of his penchant for organization and conservatism in contrast with the speculative tendencies of the Eastern Church. His strict orthodoxy in Trinitarian theology was matched by his moderation and common sense in the direction of the consecrated men and women under his care. With these he constantly opposed all ascetical excesses, urging the importance of works of charity and obedience to a spiritual director. He was one of the first Greek Fathers to take a firm stand on the value of pagan literature in the education of Christian youth. Indeed, the Greeks seem to have had a greater problem with their pagan literature than the Latin Fathers had with theirs; the problem of adaptation was much more keenly felt in the east than in the west. Basil's classic solution, put forward in his *Address to the Youth* (sermon 22), is sometimes called the theory of the honeybee: for he insists that pagan literature must not be condemned in principle; rather Christians must, like the bee, select what is to their profit and reject what is inacceptable to the Christian point of view.

Basil was not so profound or original as his brother Gregory; it was really Gregory who gave a deep philosophical and mystical direction to the sound monastic structure erected by Basil. Basil's genius lay rather in his administrative talent and in his ability to grasp clearly the ideals of the growing church in a realistic fashion. This may be seen in his energetic efforts to have the Nicaean doctrine accepted at the council of Constantinople in 381, as well as in his dispute with Pope Damasus over the Meletian schism. The hostels and hospitals he supported on the outskirts of Caesarea are proof of his practical spirituality.

Of an extensive ascetical corpus the most important works are the *Longer* and *Shorter Rules* and the *Moralia;* of the theological,

the treatises *On the Holy Spirit* and *Against Eunomius* and the *Commentary on the Six Days of Creation* (Hexaemeron). But the most interesting part of his literary remains is the great collection of letters (over 300 are authentic), which offer a vivid picture of his daily life and work. His feast day is June 14.

For the text the reader must still rely on the edition by J. Garnier and P. Maran, 3 vol. (1721–30; 2nd ed. by L. de Sinners, 1839), reprinted by J. P. Migne, *Patrologia Graeca,* vol. 29–32 (1857). There are, however, many improved editions, for example, of the letters by R. J. Deferrari in the Loeb Library, 4 vol. (1926–34); of the treatise *On the Holy Spirit* by B. Pruche, *Sources chrétiennes,* 17 (1947); and of the *Commentary on the Hexaemeron* by S. Giet, *Sources chrétiennes,* 26 (1950). For selected works in English translation, *see* B. Jackson, *Nicene and Post Nicene Fathers,* vol. viii (1895); W. K. L. Clarke, *The Ascetic Works of St. Basil* (1925); Sister Agnes Clare Way, *Letters,* in *The Fathers of the Church,* vol. xiii and xxviii (1951, 1955), and Sister Monica Wagner, *Ascetical Works,* vol. ix (1950). For the manuscripts, *see* S. Y. Rudberg, *Études sur la tradition manuscrite de S. Basile* (1953).

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BASIL I (d. 886), Byzantine emperor from 867 to 886, founder of the Macedonian dynasty which lasted till 1056, was of peasant origin and probably of Armenian descent, although his family had been settled in Macedonia. While still a young man, he was employed in the imperial stables in Constantinople. His good looks and physical prowess gained him the favour of the reigning emperor, Michael III, who ultimately made him his chamberlain. With Michael's connivance, in 865, Basil assassinated the powerful Caesar Bardas, the emperor's uncle. In 866 he was crowned co-emperor, and in 867 he was powerful enough to have Michael assassinated and then to take over complete control of the government. He adapted himself in a remarkable manner to his imperial position, and in the period of recovery that followed he played an important role, continuing the policies of the Amorian dynasty. Among his greatest achievements was the inauguration of legal reform. During his own reign two small manuals, the *Procheiron* and the *Epanagoge,* appeared, but the great codification planned was not ready until the reign of his successor, Leo VI; this was the Basilica (*q.v.*), a collection of 60 books in Greek, which formed the basis of the medieval Byzantine legal system.

In his ecclesiastical policy Basil had succeeded to the quarrel between Photius (*q.v.*) and Ignatius, to some extent involving a clash between the more liberal and the stricter tendencies in the Orthodox Church; the pope also had been drawn in, and for a time relations between Rome and Constantinople had been broken off. Basil tried to conciliate Rome and also to win support at home by reinstating the former patriarch Ignatius in place of Photius, who was excommunicated at the ecumenical synod held in Constantinople in 869–870. Though the schism was ended, bitter feeling remained because the young Bulgarian kingdom, disappointed at Rome's failure to grant a metropolitan, turned to Constantinople and was once and for all brought within the sphere of the Orthodox Church, being granted its own archbishop together with other special privileges. Byzantine influence thus was assured there as elsewhere in the Balkans where Greek missionaries were at work. At Constantinople Photius was restored to the patriarchate on the death of Ignatius in 877; but no "second schism" with Rome occurred, and at the synod of 879 he was recognized by Rome.

Abroad, Basil continued a successful war in the east against the Arabs, raiding as far as the Euphrates; his policy foreshadowed the planned attacks on the eastern frontier that were to be so notable a feature of the following century. He waged war on Arab pirates in the Adriatic and elsewhere; he attempted to consolidate his position in southern Italy and eventually had some success in re-establishing Byzantine authority in its southern Italian provinces, though he failed to drive the Arabs from Sicily. His achievement was the more remarkable in view of his antecedents, for he not only added to the prestige of the empire but demonstrated a fine appreciation of the age-long traditions of imperial office.

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BASIL II Bulgaroctonus ("the Bulgar-slayer") (*c.* 958–1025), Byzantine emperor from 976 to 1025, son of Romanus II and Theophano and great-great-grandson of Basil I, was crowned co-emperor in April 960. On their father's death (963) he and his younger brother and co-emperor, Constantine, were still minors, and the senior emperor was first Nicephorus II Phocas, their stepfather, then John I Tzimisces. On the death of John I (Jan. 10, 976) Basil and Constantine reigned without a colleague, though Constantine always remained in the background. The administration was at first in the hands of their great-uncle, the eunuch Basil the Chamberlain. Basil II waited and watched without interfering until in 985 he was strong enough to inaugurate his independent rule with the downfall of the Chamberlain. During this time the throne was endangered by the respective ambitions of two generals from powerful families, Bardas Sclerus and Bardas Phocas, who were not finally crushed until 989. During 988 Basil had the help of a Russian contingent, which remained in Byzantine service and became famous as the Varangian guard. Vladimir of Kiev was rewarded for this timely aid with marriage to Basil's sister Anna, on condition that the Kievan state adopted Christianity.

Basil made ruthless war upon the system of immense estates that had grown up in Asia Minor and elsewhere, which Romanus I had endeavoured to check. He sought to protect the lower and middle classes.

Basil gained some successes against the encroachments of the Fatimites in Syria (995–996); but his most important work in the east was the annexation of the greater part of Armenia. He created in those highlands a strongly fortified frontier, which, if his successors had been capable, might have proved an effective barrier against the invasions of the Seljuk Turks. The greatest achievement of the reign was the complete subjugation of Bulgaria. After the death of John Tzimisces (who succeeded in reducing a considerable part of the Bulgarian kingdom), the power of Bulgaria had been restored by the tsar Samuel, who extended his rule along the Adriatic coast and imposed his lordship on Serbia. War was renewed in 996 and continued till 1014, when the Bulgarian army suffered an overwhelming defeat. Basil blinded 15,000 prisoners, leaving a one-eyed man to every 100 to lead them to their tsar, who fainted at the sight and died two days later. The Bulgars were finally subdued by 1018 and to some extent conciliated by Basil II's statesmanlike settlement of the country and the church. Basil also hoped to regain authority in southern Italy, where the Byzantine provinces were reorganized as a catapanate. He was planning to send a naval expedition to recover Sicily from the Arabs when he died on Dec. 15, 1025.

Basil's reign marked the highest point of the power of the Eastern Roman empire since Justinian I. Building on the foundations of his Amorian and Macedonian predecessors, he dedicated himself unsparingly to the laborious duties of ruling, and he devoted himself to breaking the powerful opposition of the great magnates. He was a ruthless general and a great statesman, but without the usual Byzantine interest in learning or culture. He was unmarried.

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BASILAN ISLAND, an island that makes up a part of the province of Zamboanga del Sur, Republic of the Philippines. (*See* Zamboanga.) Pop. (1960) 156,046. Area 433 sq.mi. Until 1948 it was politically a part of Zamboanga City, but is separated from the city and the Zamboanga peninsula of Mindanao by Basilan strait, a five-mile channel with strong tidal currents. The island and nearby small isles became the chartered city of Basilan in

1948. Most of the island consists of rugged or rolling forested uplands with several peaks of more than 2,000 ft. Large lumber mills have operated on Basilan for at least a half century. The soil is more fertile than in most of Mindanao. Lying close to the equator, it is south of the typhoon belt and has a truly tropical rain-forest climate.

The natives are the Yakans, descendants of early Papuan settlers who were converted to Islamism during the 14th century. Unlike the Moros of Jolo and Zamboanga, they are not beach dwellers and fishermen but live on higher lands and make their living by agriculture. As more land is cleared by the lumber companies, Christian Filipinos from the Visayan Islands migrate to Basilan in considerable numbers.

Basilan differs from most of the Philippines in that it has a higher percentage of plantation agriculture, with rubber dominating. Other crops are coconuts, rice, corn, abacá (Manila hemp), coffee, cacao, pepper and bananas. Rubber, which has been grown on Basilan since 1911, is processed into crude rubber on the plantations and sold to Manila rubber factories. The University of the Philippines owns a 10,000-ac. land grant on the northern coast of the island. The principal towns are Isabela and Lamitan, both on the north coast. (AN. C.)

BASILDON, an urban district and New Town in the Billericay parliamentary division of Essex, Eng., 25 mi. E.N.E. of London by road and rail. The name of the urban district (constituted in 1934) was Billericay until 1955 when, because of the new town within it, it was changed to Basildon. It includes the four townships of Billericay, Laindon, Pitsea and Wickford. Pop. (1961) 88,459. Area 42.2 sq.mi.

Except for 288 ac. in Thurrock, the whole of BASILDON NEW TOWN lies within the urban district of Basildon; its area, designated in 1949, is 7,834 ac. and its population in 1956 was 37,000. Formerly an agricultural area, the depression in the farming industry and the building of the railway led to the splitting up of the land for building.

After World War I a great many people from London settled in the district. This resulted in the "rural slum" villages of Pitsea, Vange, Old Basildon, Laindon, Langdon Hills and Lee Chapel, all of which are included in the area of the new town. Building and engineering operations began in 1951. The main industries are light engineering, chemical and joinery works, milk bottling, printing and the making of clothes and carbon black.

BASILIAN FATHERS (PRIESTS OF THE COMMUNITY OF ST. BASIL; C.S.B.), a congregation founded in France in 1800 and now established chiefly in Canada; the mother house is at Toronto. The Basilian Fathers' work is primarily educational; they operate the Pontifical Institute of Medieval Studies and five colleges. *See* ORDERS AND CONGREGATIONS, RELIGIOUS.

BASILICA, in the Roman Catholic Church, is a canonical title given to certain churches which are thereby endowed with special privileges. There are major basilicas, which have the holy door and papal altar, and minor basilicas, which have precedence over all churches except cathedrals.

In architecture, basilica is a word frequently used in Latin literature to designate a large, roofed building dedicated to public use. Markets, courthouses, covered promenades and meeting halls were all occasionally so known. Little by little the word was limited to buildings of a more or less definite form, having a central area, aisles or galleries at the sides and a raised platform, sometimes apsidal. These elements, nevertheless, are not constant, the Basilica Julia in Rome having no apse and that at Timgad no aisles. The basilica was usually in a forum (Basilica Julia, Trajan's basilica, the basilica at Pompeii). For what a Roman architect considered a normal basilica one may consult Vitruvius v, 1–4 and vi, 3–9.

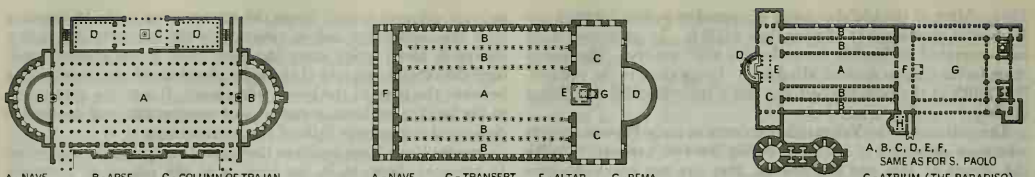
The earliest basilica known is that at Pompeii, which dates, probably, from the 2nd century B.C. It shows an already highly developed form in which the aisle runs entirely around the central area. The raised platform appears as an alcove, screened by columns, at the end opposite the entrance. This seems the normal plan for the larger basilicas. The basilica begun by Maxentius and completed by his successor, Constantine, is, however, of an entirely different type. There the attempt was made to dispense with the colonnades and to concentrate the supports into a few enormous piers, which carry the three bays of the groined vault over the central area and at the same time furnish the dividing line between the bays of the lower side aisles. It was the application to the basilica problem of the type of construction and decoration developed in the great halls of the Roman baths.

Besides these large basilicas there were many smaller examples. In some of these, as in the basilica of the palace of Domitian on the Palatine hill, the type comprising a nave with aisles at the sides only and an apse at the end had appeared. It was this type that the early Christians adopted for their churches, possibly because similar halls, in large private houses, had been used for Christian worship prior to the Edict of Toleration. It would appear that, in the earliest examples, side aisles were frequently lacking. After the time of Constantine, however, the existence of side aisles was universal, and was perhaps due to the fact that they were included in the three enormous basilicas—those of St. Peter, S. Paolo and St. John Lateran—which he built. The church of Sta. Maria Maggiore, dating in its present form from the early 5th century, is similar to its three predecessors. In the Constantinian basilicas another unit, the transept (*q.v.*), made its appearance, and the cross-shaped plan thus developed became the controlling plan of the larger Christian churches in the west throughout the middle ages.

In the typical early Christian basilica the nave (*q.v.*) was separated from the side aisles by borders of columns which carried either arches or an entablature. In the later basilicas these columns, having been taken from older pagan buildings, frequently had misfit capitals. Above the entablature or arches rose the blank wall behind which were the side aisle roofs. This wall continued up as a clerestory and was pierced with a row of either square or arched windows. The nave roof was of timber, sometimes with exposed beams and sometimes with a rich, panelled wooden ceiling, carved and gilded. Side aisles (*see* AISLE) were either single or double, and occasionally of two stories, the upper serving as a gallery for women. The side aisle ceilings, with the roof immediately above, were usually as low as the columns would permit; but in old St. Peter's, Rome, the inner aisles were much higher than the outer, which were vaulted. The apse (*q.v.*) opened from the nave by a great arch known as the triumphal arch.

Occasionally, when there were transepts, another triumphal arch separated the transept from the nave. A narthex (*q.v.*), or vestibule, extended the entire width of nave and aisles, frequently open at the front with a colonnade. In addition to these general elements, there was frequently a transept, usually without aisles, at the extreme end. At the entrance end, in addition to the narthex, there was often a court or atrium (*q.v.*), surrounded by either colonnades or arcades. After the 10th century a campanile (*q.v.*), round or square, of great simplicity and usually very high, was added.

Such a building was basically simple; the exterior design was crude to the point of being barnlike, although there were occasional exceptions: old St. Peter's at Rome had a façade richly covered with mosaic, and S. Lorenzo, Rome, has a handsome colonnade across the front. After the fall of Rome the interiors likewise showed architectural poverty, all sorts of pagan Roman fragments being put together in meaningless and incoherent jumbles. All, however, possessed interior interest and an inherent beauty due largely to the richness of their furniture and ornamentation. The decorative scheme showed that the feeling for colour and texture increased as the purely architectural sense decayed, and the development of a technique of glass mosaic offered great opportunities for impressive effects. The lower portions of the walls were usually sheathed in coloured marbles which were frequently of rich design around the apse. Above the arches or entablatures of its flanking columns the nave wall was sometimes completely covered with mosaic; where this was absent, painting of similar character doubtless existed. The church of Sta. Maria Antiqua, at the base of the Palatine hill, shows many examples of such painting.



PLANS FOR THREE BASILICAS OF ROME: (LEFT) TRAJAN, 1ST CENTURY; (CENTRE) S. PAOLO OUTSIDE THE WALLS, 4TH CENTURY; (RIGHT) OLD ST. PETER'S, 4TH CENTURY

The climax of the decorative scheme was the triumphal arch and the mosaic of the dome of the apse. There is no formula for these decorations. They vary from the Byzantinesque figures of Sta. Maria in Trastevere to the rich spirals of the vine of S. Clemente. They are always full of complete symbolism. The furniture consisted of a choir screen with one or two ambones (*see* AMBO), the clergy seats and the bishop's throne in the apse, and the altar, with a baldachin (*q.v.*) or canopy above it. All this furniture was as lavishly ornamented as possible. Its framework was usually of white marble, in which were inserted plaques and roundels of dark marble and bands of mosaic, gold, red and green. Frequently the floor was also rich with marble and mosaic (*q.v.*) of this type, known as *opus Alexandrinum*.

Although the basilica is primarily characteristic of Rome, there are many examples elsewhere. In addition to the one at Parenzo, the basilica of S. Apollinare Nuovo, erected by Theodoric at the beginning of the 6th century and that of S. Apollinare in Classe 50 years later, both at Ravenna, are particularly noteworthy. In the east, the great church of St. Simeon Stylites in Syria is of modified basilica type. The church of the Nativity at Bethlehem is a basilica, as is also the church of St. John Studios in Constantinople, but the finest example in the Eastern empire was St. Demetrius at Thessalonike (Salonika). Owing, however, to the example set by Justinian's great church of Hagia Sophia at Constantinople, the basilica form gradually passed out of use in the Eastern Church. Few remains exist of the earliest churches built in the north and west of Europe. England shows occasional fragmentary ruins, such as the foundation of the 4th-century basilica at Silchester.

Romanesque rebuilding everywhere except in Italy destroyed these early churches, yet the basilica type left an ineradicable stamp on all church building that succeeded and the basilica plan, with its nave, aisles and apse, became, with the development of vaulting, and the changes necessitated by it, the typical church building of the Western Church. *See* GOVERNMENTAL ARCHITECTURE; RELIGIOUS ARCHITECTURE; ROMAN ARCHITECTURE. (T. F. H.)

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INTERIOR OF BASILICA OF S. APOLLINARE IN CLASSE, RAVENNA, ITALY. 6TH CENTURY

BASILICA, the name of a code of law, drawn up in the Greek language at the end of the 9th century, with a view to putting an end to the uncertainty that prevailed throughout the Eastern Roman empire regarding the authorized sources of the law. This uncertainty had been brought about by the conflicting opinions of the jurists of the 6th century as to the proper interpretation to be given to the legislation of the emperor Justinian, from which had resulted a system of teaching that had deprived that legislation of all authority, and the imperial judges were at a loss to know by what rules of law they were to regulate their decisions. There has been considerable controversy about the part that the emperor Basil I (*q.v.*) took in framing the new code. There is, however, no doubt that he abrogated the ancient laws, which had fallen into desuetude, and the more probable opinion is that he caused a revision to be made of those laws that were to continue in force and divided them into 40 books. This code of laws was subsequently enlarged to 60 books by his successor, Leo the Philosopher (Leo VI, *q.v.*).

No perfect manuscript has been preserved of the text of the Basilica, and the existence of any portion of the code seems to have been ignored by the jurists of western Europe until the important bearing of it upon the study of the Roman law was brought to their attention by Viglius (*q.v.*) in his preface to his edition of the Greek *Paraphrase of Theophilus,* published in 1533. A century, however, elapsed before an edition of the 60 books of the Basilica, so far as the manuscripts then known to exist supplied materials, was published in seven volumes, by Charles Annibal Fabrot, under the patronage of Louis XIII of France. A newly restored and far more complete text of the 60 books of the Basilica was published at Leipzig in six volumes (1833–70), edited by K. W. E. and G. E. Heimbach.

The great bulk of the code was an obstacle to the multiplication of copies of it, while the necessity for them was in a great degree superseded by the publication from time to time of synopses and enchiridions of its contents, composed by the most eminent jurists, of which a very full account will be found in the *Histoire du droit byzantin,* by I. A. Mortreuil, published in Paris in 1846.

See also BYZANTINE EMPIRE: *Government: Legislation.*

BASILICATA (LUCANIA), a region of southern Italy comprising the provinces of Potenza and Matera. Area 3,856 sq.mi., pop. (1961) 602,661. It falls into a western mountainous section, dominated by the Lucanian Apennines, and an eastern section of low hills and wide valleys, while along the Ionian sea the sand and clay hills overlook narrow coastal plains. The extinct volcano of Mt. Vulture (4,354 ft.) stands isolated from the Apennines in the north.

The mainstay of the economy is agriculture; most of it, however, is characterized by low yields. Wheat and rye are the principal cereals; sheep, goats and pigs the farm animals. New crops introduced in the eastern and coastal areas include tobacco, vegetables, sugar beet and flowers. Dairy and beef cattle are raised in increasing numbers. In the early 1960s, except for olive presses and flour mills, industry was nonexistent, though natural gas was discovered around Matera. Potenza, the administrative centre, and Matera (*qq.v.*) are the only cities of any size. The main railroad line of the Basilicata links Naples and Battipaglia in the

northwest through Potenza with Taranto to the east, connecting also with the Ionian railroad (Taranto-Reggio di Calabria). Local lines radiate from Potenza and from Matera in several directions and bus services reach all of the villages of the region.

During medieval times Basilicata was first under Lombard rule, controlled by the duke of Benevento and, later, of Salerno; after an interval of Byzantine control, the Normans took over and made Melfi the capital of one of their important dominions. Until the fall of the Hohenstaufen, Basilicata played a significant part in the affairs of southern Italy; afterward, passing through Angevin and Spanish hands, it remained part of the kingdom of Naples, until reunited with Italy in 1860. The region was coextensive with Potenza province until the establishment of Matera province in 1927. *See* also LUCANIA. (G. KH.)

BASILIDES (2nd century A.D.), one of the most celebrated of the Gnostics, probably a pupil of Menander in Antioch, was teaching in Alexandria at the time of the Roman emperors Hadrian and Antoninus Pius (second quarter of the 2nd century). Very little is known of his life. Clement of Alexandria says he claimed to have received a secret tradition from Glaucias, interpreter of Peter; according to Hippolytus the apostle Matthias communicated to him secret sayings (*logoi apocryphoi*) he had heard from Jesus Christ. He wrote a "gospel" and a commentary on it in 24 books, entitled *Exegetica*. Clement quotes several passages from the 23rd book, dealing with the problem of suffering. Basilides also composed psalms and odes of which nothing remains. The statements about Basilides' system given by Clement and Origen contradict those of Hippolytus and Irenaeus, so it is impossible to get a clear idea of his doctrine. It is also impossible to determine the sources from which he drew. There is certainly influence of Platonism, of other Gnostic systems and of the New Testament, but much remains obscure. The theory that the doctrine of Basilides was influenced by Buddhism seems improbable.

Basilides had many disciples, among whom was his son Isidorus, and the sect he founded still existed in Egypt in the 4th century. His followers were the first to keep the day of Christ's baptism on Jan. 6 or 10, celebrating it with an all-night vigil.

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BASILISCUS (d. 477), usurping Eastern Roman emperor (475–476), was the brother of Verina, wife of the emperor Leo I (457–474). He was given supreme command in 468 of a vast Eastern Roman force designed to expel the Vandals from Africa. Because of his incompetence it was totally defeated by the Vandal leader Gaiseric while still at sea off Mercurium, the modern Cape Bon; but Verina procured for Basiliscus the emperor's pardon. When the reigning emperor Zeno (474–491) was driven from Constantinople in Jan. 475, Basiliscus ascended the throne. As emperor he favoured Monophysitism and aroused opposition by his decree against the Council of Chalcedon. During his reign a disastrous fire in Constantinople destroyed much of the city and many famous works of Greek art. When Zeno returned to the capital in Aug. 476, Basiliscus was exiled to Cappadocia and was there beheaded. (E. A. T.)

BASILISK, a name now applied—because of a certain fanciful resemblance to the legendary monster called basilisk, or cockatrice (*q.v.*)—to an American genus of lizards (*Basiliscus*, family Iguanidae). These lizards are characterized by the presence, in the males, of an erect crest on the head, on the back and at the base of the long tail. *Basiliscus basiliscus* reaches the length of one yard; its colours are green and brown, with dark crossbars, while the crest is reddish. This omnivorous animal is abundant on the banks of rivers and streams of Central America and Mexico. The lizards lie upon the branches of bushes overhanging the water, into which they plunge at the slightest alarm. They may dive to the bottom, or, more remarkably, dash across the surface of the water in a semierect position propelled by rapid strokes of their hind limbs, with a shower of spray rising on each side.

(K. P. S.; X.)

BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

DOUBLE-CRESTED BASILISK (BASILISCUS PLUMIFRONS)

BASIN, THOMAS (1412–1491), French bishop and historian, notable for his opposition to Louis XI, was born at Caudebec in Normandy. He studied at Paris, at Pavia and at Louvain, traveled in Hungary and took part in the Council of Basel before returning to teach canon law at Caen. In 1447 he became bishop of Lisieux. After the French recovery of Normandy, he served Charles VII faithfully and was appointed one of the royal counselors. His refusal to support the revolt of the dauphin Louis was the cause of the latter's bearing him a grudge when he became king as Louis XI. Having joined the League of the Public Weal against Louis in 1465, Basin had to go into exile and renounce his bishopric. In 1474, however, Pope Sixtus IV made him titular archbishop of Caesarea. Basin died at Utrecht in the Netherlands on Dec. 3, 1491.

Basin's principal work, a history of the reigns of Charles VII and Louis XI, written between 1471 and 1487 in a style imitating that of the classical historians, is valuable as his testimony on his times but is marred to some extent by his dislike for Louis XI. From the 17th century to the 19th it was regarded as the work of a priest of Liège, whose name Amelgard is only Basin's pseudonym. Basin's other works include a memorandum composed for the rehabilitation of Joan of Arc (1453) and a justification of himself against Louis XI's accusations (1473–74). There are editions of the history by J. Quicherat, with a summary in French, four volumes (1855–59); and by C. Samaran, with French translation (1933–). (MI. M.)

BASIN, in geology, a broad shallow trough or syncline, a structure in the bedrock, not to be confused with a physiographic river basin, although the two may coincide. Some of the better-known geological basins are the southern Michigan basin of gently downwarped Paleozoic rocks, the Wind river and Big Horn basins in Wyoming, largely filled with early Tertiary continental deposits after downwarping of their Mesozoic and Paleozoic rocks and accompanying uplift of bordering mountain ranges, the London basin, a shallow trough of Tertiary, Cretaceous and Jurassic rocks, the Paris basin of strata of the same systems, and the numerous coal basins of England. Lakes may occupy basins that have been caused by the removal in solution of some of the more soluble constituents (rock salt, etc.) in the underlying strata; occasionally lake basins have been formed directly by crustal movements or by collapse of volcanic cones. (L. W. P.)

BASINGSTOKE, a municipal borough in the Basingstoke parliamentary division of Hampshire, Eng., 47 mi. W.S.W. of London by road. Pop. (1961) 25,940. The town is by-passed by the Great Southwest road on the northeast side of the London gap, where the chalk down land diminishes and provides an open way between the London and Hampshire basins. The neighbouring downs are rich in prehistoric remains and there are traces of Roman occupation; Silchester (*q.v.*), the Roman Calleva Atrebatum, lies 6 mi. to the north. Basingstoke, of very old foundation, appears in Domesday Book as a royal manor with three mills and a market. Charters were granted from 1227 and medieval grants of fairs were confirmed by charters of incorporation in 1623 and 1641. In the early 17th century there was a considerable cloth industry which later died out but was re-established in the 20th century.

The parish church of St. Michael is mainly Late Perpendicular; the public museum contains comprehensive local exhibits. At Queen Mary's school (before 1852 the Holy Ghost school) Gilbert White was a pupil. By Basing village are the remains of the

Elizabethan Basing house, famous for its prolonged defense (1643–45) against the parliamentarians. Once Basingstoke was primarily a market town, and it still contains half-timbered houses round the market square, but industries were established, chiefly agricultural machinery, commercial vehicles, precision tools and instruments, leather, clothing, mineral water and drugs; market gardens still flourish. The Basingstoke canal to Weybridge was opened in the 1790s but was filled in after losing its trade to the railways.

BASKERVILLE, JOHN (1706–1775), English printer and inventor of a type of rare distinction, was born at Wolverley, Worcestershire, Jan. 28, 1706. He became a writing master at Birmingham, but in 1740 established a japanning business, the profits from which enabled him to experiment in type founding. He set up a printing house and in 1757 published his first work, a *Virgil* in royal quarto, followed in 1758 by a famous edition of Milton. Appointed printer to Cambridge university, he undertook editions of the Bible and the Prayer Book. He published a singularly beautiful *Horace* in 1762; the success of a second edition (1770), in quarto, encouraged him to issue a series of quarto editions of Latin authors. He died at Birmingham, Jan. 8, 1775.

The bold quality of Baskerville's print derived from his use of a highly glossed paper and from his invention of a really black ink. But his typography was much criticized in England, and after his death his types were purchased by the French dramatist Beaumarchais. Their subsequent history is uncertain, but in 1917 the surviving punches and matrices were recognized and in 1953 they were presented to Cambridge university. Baskerville type has been revived, its clarity and balance making it a good type for continuous reading. *See* also PRINTING TYPE; TYPOGRAPHY.

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BASKET, a container made by hand by interlacing or coiling and sewing vegetable fibres (twigs, roots, canes, grasses or other materials). The word is of unknown origin; it does not occur in Teutonic or Romance languages, nor does it appear in English before the 13th century. Basketry is a convenient though ill-defined term including actual baskets, wattlework, matting and ornamental plaitwork made by hand without the aid of a frame or loom.

An ancient craft, basketmaking may be considered one of Neolithic man's contributions to culture history. Some of the techniques employed in Egyptian basketwork 5,000 years ago are still widely used in Africa. Among historic primitive peoples women are usually the basketmakers. However, in Borneo and among the Indians of British Guiana men are skilled at this craft.

Basketmaking is a manual operation that cannot be imitated by machinery. Containers of pottery, wood, metal, cloth or plastic have largely replaced baskets among civilized peoples. They rarely make coiled baskets. The twining technique used by the ancients in building fences, fish weirs and house walls survives in the construction of such common household articles as wastebaskets, bread and laundry baskets and wicker furniture.

PRIMITIVE BASKETRY

Basketmaking is one of the oldest and most nearly universal crafts of primitive man. Yet it may never be possible for archaeologists to determine the antiquity and early distribution of this craft in some parts of the world, because the vegetable fibres from which baskets are made are perishable materials. Nevertheless, numerous prehistoric examples have been preserved in arid sands, dry caves and under other favourable conditions in both hemispheres. In the Americas basketmaking developed before the potter's craft. Specimens have been discovered in several early Indian sites in the Great Basin west of the Rocky mountains. Basket-yielding cultural level II at Danger cave near Wendover, Utah, has been dated by radiocarbon methods about 7000 B.C. At Huaca Prieta on the coast of Peru several varieties of twined baskets said to be at least 5,000 years old were unearthed. The name Basket Maker has been given to a simple hunting and collecting culture of the period *c.* A.D. 1–700 in the southwestern United States because fine cooking, storage and burden baskets were distinctive products of that culture.

In the near east mud impressions of plain weave mats reveal the existence of basketry at Jarmo, Iraq, in the period 5270–4630 B.C. A radiocarbon test of corn found in basket-lined granaries in the sands of the oasis of Fayum, Egypt, yielded the date 4784–3929 B.C. The first evidence of basketry in Europe appears about 2500 B.C., in the form of carbonized fragments in both coiled and twined techniques made by the Swiss Lake Dwellers. Examples of early Bronze Age baskets, dating about 2000 B.C., have been recovered in the British Isles. Apparent impressions of basketry weaves were found on pottery of a late Neolithic Chinese culture (Yangshao) of about 3000 B.C.

That basketmaking appears in rudimentary as well as in early stages of civilization is indicated by the fact that in historic times baskets of high quality were produced in some of the world's most backward areas. Such culturally unsophisticated peoples as the Tasmanians, the Andaman Islanders, the Yahgans of Tierra del Fuego and the Seri of Lower California were skillful basketmakers. Pomo Indian women of northern California gained the reputation of the world's most expert basketmakers. Not only was their coiled basketry more complicated than any made in the old world but their twined basketry was remarkable for its fineness and evenness of weave. Yet Pomo Indians grew no crops. They made a living by hunting, fishing and gathering acorns and other wild plant foods in season.

Uses.—Basketry has served a wide variety of religious and secular functions through the ages. A votive stone in the Louvre commemorating the building of the temple of Ningursu in Lagash portrays the Sumerian priest-king Ur-Nina (*c.* 3000 B.C.) carrying a basket of mortar on his head. Countless basketloads of earth were carried by prehistoric Indians of eastern United States in building burial and effigy mounds and high earthen platforms for their temples. According to tradition the first Christian church in Britain was a rude, thatch-roofed structure having walls of wickerwork, erected at Glastonbury in Somerset in the 1st century A.D.

Primitive peoples have used basketry in house construction and furnishing (for walls, roofs, doors, partitions, rugs, chairs, hammocks and mattresses), as household utensils (for preparing, cooking and serving foods and for storing food, clothes, trinkets and jewels), in transport (rush balsas, mat rafts, and sails, carrying and collecting baskets, cradles and coffins), in hunting and fishing (corrals, traps, fish weirs, dip nets, creels, bait baskets), as clothing (hats, collars, capes, skirts, arm bands, belts, footgear), in warfare (shields, helmets, body armour) and as musical instruments (rattles and drums). They also have made gambling trays, cult symbols and ceremonial bowls of basketry. The Ovimbundi Negroes of Africa interweave marks into large conical baskets used to measure quantities of corn, meal or beans.

The sizes, shapes and to some extent the weaves were determined by the baskets' intended uses. Some Pomo Indian women made toys of almost perfect symmetry little larger than ½ in. in diameter. The Vakwanyama of southern Angola, on the other hand, wove grain storage baskets five feet high. Openwork weaves in cradles and burden baskets provide needed strength with little weight. However, the greatest triumph of the primitive basketmaker was the perfection of the watertight container. Hupa Indians of California made a pot-shaped cooking basket so closely twined that they could boil soup or acorn mush in it simply by dropping hot stones into the liquid. Other peoples made them watertight by lining or coating their surfaces with waterproofing materials. Thus Admiralty Islanders store coconut oil in large basketry jars coated with crushed *Parinarium* nuts which harden and set into a firm, impervious mass.

Materials.—Basketmaking materials vary from place to place depending upon the availability of wild plants and the preferences of craftsmen. In tropical and semitropical regions palms have been most extensively employed. African Negro tribes use palmyra and raffia palms. Coconut palm leaf baskets are common in Oceania. The world-renowned Panama hat is woven from carefully selected, boiled and sun-dried leaves of the native species *Carludovica palmata* in Ecuador, Colombia, Central America and

Jamaica. The abundance of single rod coils of rattan in Malaysian basketry reflects the ready availability of rattan in that area. Pandanus and bamboo also are widely used in the tropics.

A greater variety of plants are used by peoples of the temperate zones. In 1902 the botanist Frederick V. Coville identified 87 plants employed by North American Indians in making and colouring baskets. Some of these plants, such as reeds, rushes and sedges, flourish in marsh areas in many parts of the world and have been widely used since early times.

Esparto grass, tall and wiry, was a favourite fibre of ancient man in the Mediterranean region. Baskets of this material were found in the tomb of Tutenkhamon and in the Murcielagos cave in Spain. In arctic and subarctic regions grass is the primary material. For about 1,000 years Aleutian Islanders have woven closely twined baskets from wild rye grass which is abundant in their locality, selecting strong young blades. By control of curing methods Aleut women can produce a range of colours from green through light yellow to white. The Yahgans, southernmost people in the world, employed three or four stems of coarse grass as the foundation element for their unique halfhitch coiled baskets.

Cultivated plants have also furnished some materials. The ancient Egyptians made baskets of wheat straw, the Swiss Lake Dwellers employed flax stems, and the Iroquois Indians of New York wove simple masks of corn husks.

Plaited Work.—All basketwork is either plaited (or woven) or coiled. Plaited basketry is made by the crossing of two or more sets of elements, called (by analogy with weaving) warp and weft. When the warps are indistinguishable by rigidity or direction, both sets of elements may be called wefts.

The main varieties of plaited work are: (1) Check, in which the warp and weft pass over and under each other singly in the familiar over-one-under-one checkerboard pattern. This includes wattlework, in which the warp stakes are planted in the ground and the weft branches bent in and out between them. (2) Twilled, in which each weft passes over and then under two or more warps. Diagonals are formed by the regular progression of the weft element one to the right (or left) on each successive movement around the basket or across the mat. (3) Wrapped, in which flexible wefts are wrapped around each warp in passing. (4) Twined, in which two or more wefts pass alternately in front of and behind each of the warps, crossing them obliquely. Twining with two or three wefts is technically "fitching" or "waling," respectively. In wrapped-twined, "bird cage" or latticework, the foundation consists of both horizontal and vertical elements, often rigid, at the crossings of which the weft or wefts may be twined or wrapped. (5) In hexagonal work the wefts, instead of being horizontal and vertical, are worked in three directions, forming in open work hexagonal spaces, in close work six-pointed stars. The well-known *anyam gila* or "mad weave" of Malacca is a more complicated hexagonal weave in which the wefts are doubled back, not simply interlaced in the flat.

Coiled Work.—A sewing rather than a weaving technique, coiled work consists in sewing a spiral foundation of twigs, cane, grass or other material securely in a flat or ascending coil. An awl (or needle if the foundation is grass) is used to make the holes through which the wrapping is passed. The commonest varieties of coiled work are: (1) Simple oversewn coil—each stitch passes over the new coil and pierces a portion of the coil below; (*a*) furcate coil—the new stitch splits the stitch in the preceding coil, producing a forked effect superficially suggestive of crochet; (*b*) bee-skep coil—the stitches are spaced widely apart and are not in direct contact with stitches in the preceding coil. (2) Figure of eight (or Navaho), in which the stitch is worked in a figure of eight, passing behind, up and over and down in front of the new coil; then behind, down and out and under the preceding coil. (3) "Lazy squaw," in which the long stitch passes over two coils at once. The sewing passes in front, up and over the new coil, winding round it one or more times, then it passes behind and down under the preceding coil and up over the new coil, completing the characteristic long stitch. (4) Crossed figure of eight (or knot stitch). The stitch passes in front, up and over the new coil, and behind, down and under the preceding coil, as in the long stitch of the "lazy squaw," but the sewing is next brought out between the two coils, to the right of the last long stitch, which it crosses, giving the appearance of a knot. (5) Cycloid or single-element work, consists of coils, usually of cane, looped into each other. Although this may be grouped with coiled work, it has no foundation. This technique is especially characteristic of the Malay area.

In both plaited and coiled work decorative patterns sometimes are made by overlaid wefts, often of contrasting shades or colours,

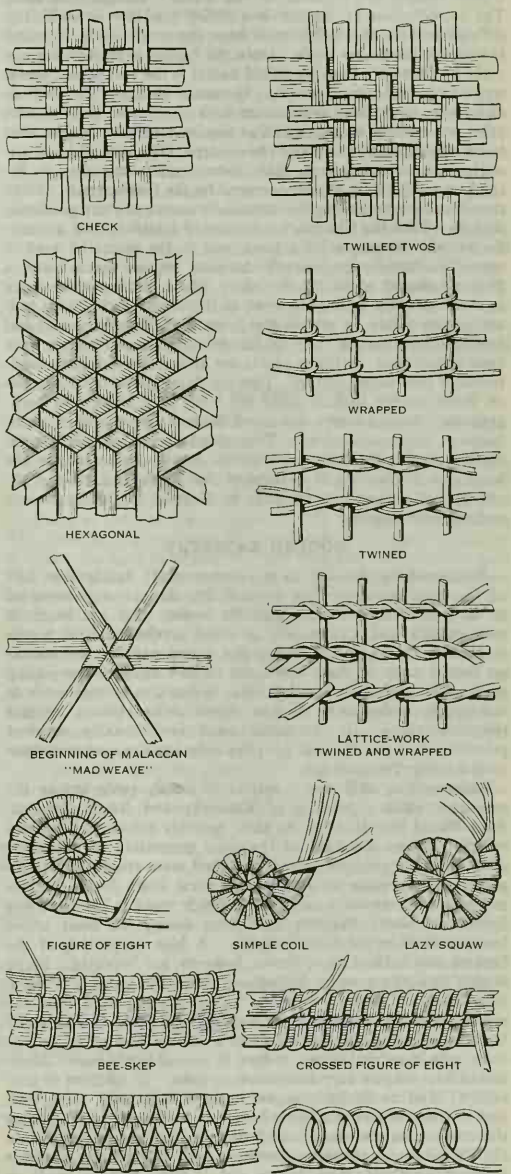


FIG. 1.—MAIN VARIETIES OF PLAITED AND COILED WORK USED IN THE CRAFT OF BASKETRY

which appear only on the surface. The imbricated basketry of the Indians of the American northwest (Washington and British Columbia) is an ingenious example. The surface weft is doubled back before being stitched to the coil, and the coil stitch is concealed under it.

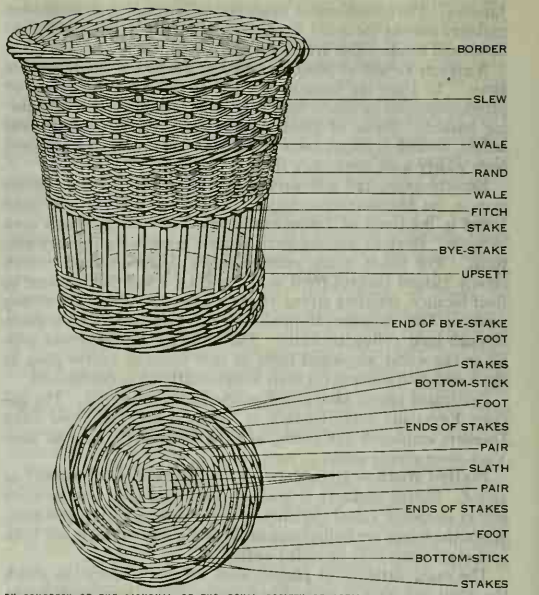
Decoration and Design.—Skilled basketmakers take pride in the closeness and evenness of their sewing or weaving as well as in the over-all balance and symmetry of their finished products. Intricate designs are evidence of the maker's manipulative skill. The introduction of designs into coiled basketry is especially difficult because the maker must have the entire design in mind before she begins her work. Once the basket is started she can make no changes. Copying an old basket is the easiest and surest way of obtaining good results. In woven basketry the medium also places limitations upon design forms. Because the elements cross one another at angles and at regular intervals, designs tend to be straight-lined geometric ones—steps, diamonds, zigzags, triangles and hollow squares. Life forms, rarely attempted in designs on old baskets, were encouraged by the tourist trade. Some primitive basketmakers give naturalistic names to their geometric designs. Thus the Chitimacha Indians of Louisiana call a meandering line "worm track," a black spot in the centre of a white cross "blackbird's eye," small chevrons "mouse tracks" and a diamond-shaped motif "little fish." These Indians achieved a four-colour effect by dyeing some of the canes black (black walnut), some yellow (a certain root), some red (another root) and leaving other canes in their natural colour. Vegetable dyes have been widely used. Striking effects are also obtained by using materials of contrasting colours. Thus the dark redbud-bark triangles on Pomo burden baskets stand out from light sedge root backgrounds. Some peoples decorated baskets by attaching shells, beads or feathers to them. This added decoration might completely conceal the basketry material itself. Examples are the handsome feathered gift baskets of the Pomo Indians and the cowrie shell-decked baskets made by Negroes of the Cameroons and northern Nigeria.

MODERN BASKETRY

Basketmaking declined as a common craft in the first half of the 20th century. The demand for cheaper containers led to the production of substitutes for baskets that can be made more quickly and economically of wood, cardboard, light metals or plastics. Also, the relatively low wages paid to basketmakers forced many of these craftsmen to seek other, better-paying work. The professional basketmaker is found most commonly in industrially undeveloped regions where skilled labour remains relatively cheap. In industrial areas basketmaking survives primarily as an employment for physically handicapped craftsmen or as a hobby for amateurs.

Basketmaking skill was a matter of family pride among the mountain white population of Kentucky and North Carolina. After World War II, however, their basketry production declined sharply. Many members of the older generation of craftsmen died, while the younger persons accepted more remunerative employment. In some sections of the rural south Negro basketmakers offer their wares for sale at roadside stands. The Cherokee Indians of North Carolina have been among the most active basketmakers in the United States. A high proportion of the baskets sold in the United States, however, are imported. Many florists' baskets are woven in Europe (especially Germany, Poland, Yugoslavia and Italy). Novelty baskets are imported from the orient (especially Japan), Latin America and Europe. Many gift baskets are woven in Mexico, from a coarse reed called tule or from palm in natural colour or dyed in several bright hues. Mexican basketry styles vary from town to town. In addition to containers, Mexican basketry export items include mats, sombreros, fans and handwoven miniature horses and riders of tule. Among the commonest and most useful basketry articles imported into the United States are rattan furniture from Hong Kong, women's summer handbags from Japan and laundry baskets made in Madeira.

In London the Worshipful Company of Basketmakers, one of the city's oldest craft guilds, remains active. Other important basketmaking centres in England are Birmingham, Lancashire, Yorkshire and Somerset. The English basketmaker is required to serve an apprenticeship of three years. A large proportion of them are physically handicapped persons.



BY COURTESY OF THE "JOURNAL OF THE ROYAL SOCIETY OF ARTS"

FIG. 2.—CONSTRUCTIONAL PARTS OF A SIMPLE WICKERWORK BASKET
The modern process of manufacture differs little from that employed by primitive weavers several thousand years ago

The willows commonly used in English basketmaking grow best in medium-weight clay soil. The withies are cut in winter, sorted into lengths and graded, boiled for several hours in large tanks, then peeled. Among the common products of modern English basketry are trade hampers, laundry and shopping baskets, pram and cycle baskets, wicker chairs and tables, garden furniture, picnic and fishing baskets, dog and cat baskets and wicker dog kennels. The basketry panniers of British air-borne divisions in World War II were so strongly made that they were dropped without parachutes.

How Baskets Are Made.—Reference to the accompanying illustration will help the reader to understand some of the methods employed in modern basketmaking and some of the terms commonly used by basketmakers in describing their work. The foundation of the round or oval basket is the slath formed by interweaving one series of parallel rods with another series crossing the first one at right angles. The stakes which comprise the rigid framework of the sides are driven in at each side of the bottom sticks. The bye-stakes are merely inserted in the upset. The commonest weaves (or strokes) employed in the construction of an ordinary basket are: the rand, a single strand manipulated in a simple over-and-under weave; the slew, two or three parallel strands employed instead of one; the fitch, two strands worked alternately one under the other; the pair, two strands worked alternately one over the other (used especially in filling up bottoms and covers of round or oval baskets); and the wale or three-ply or more coil weave, three or more strands worked alternately, forming a binding course. Plaiting and other weaves are used in bordering and finishing.

In addition to willow, several other materials are commonly grown and sold commercially for use in basketmaking. Among the commonest are: pulp reed in several thicknesses, the thickest of

which (no. 10) generally is used for stakes; Hong Kong grass, a strong grass twine sold in hanks of twisted strands weighing three to four pounds per hank; cane, used especially for chair seats; and rush, employed for the same purpose. Raffia is much used by young people's handicraft projects for making imitations of American Indian coiled basketry.

"Machine-Made" Basketry.—In the United States the term "basket" is applied to a variety of containers used in the transportation and storage of fresh fruits and vegetables. The standard sizes of these "baskets" were prescribed by the Standard Container acts of 1916 and 1928, administered by the Production and Marketing administration of the U.S. department of agriculture. Five types of baskets are specified in these acts: (1) berry and till baskets, (2) hampers, (3) round stave baskets, (4) climax baskets and (5) splint or market baskets. Of these only the market baskets are true baskets in the sense that they are made by interweaving of elements. The other "basket" types are constructed by overlaying, bending, binding and stapling wooden staves or pieces of wood veneer. They are made wholly or partially by machinery.

Many patents have been issued for labour-saving basketmaking machinery. As early as 1847 a patent for a machine for preparing basket splints was issued to A. and G. Van Riper of Bergen county, New Jersey. The first fully automatic "basketmaking" machine was patented by Emmett Horton of Dundee, N.Y., Nov. 27, 1894. This machine assembled Concord grape "baskets" of wood and metal; it did not weave them. So-called machine-made baskets adopted the name but not the technology of the basketry craft. No satisfactory automatic basket-weaving machinery has been perfected. True basketry, therefore, remains a handicraft.

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BASKETBALL. The only major sport of strictly U.S. origin, basketball was invented in Dec. 1891 by James Naismith (1861–1939), a Canadian, a graduate of McGill university and Presbyterian Theological college, who went in 1890 to the International Young Men's Christian Association training school (now Springfield college) at Springfield, Mass., as a student in physical education. A year later he became an instructor. An outstanding athlete at McGill, an incident in a rugby contest convinced Naismith, as he later wrote, that "there might be more effective ways of doing good besides preaching." He decided to "drop the ministry and go into this other work." (*Basketball, Its Origin and Development*, p. 23, Association Press, New York, 1941.)

The students at Springfield, studying to become Y.M.C.A. secretaries, were bored with the Swedish, German and French forms of calisthenics of that period. To fill the void that existed between football and baseball, Luther Gulick, head of the physical education department, asked Naismith to devise an indoor game. After several unsuccessful attempts to modify popular outdoor games for indoor use, he prepared a set of 13 rules embodying 5 principles that still govern the game:

1. There must be a ball—large, light and handled with the hands.
2. There shall be no running with the ball.
3. No man on either team shall be restricted from getting the ball at any time it is in play.
4. Both teams are to occupy the same area, yet there is to be no personal contact.
5. The goal shall be horizontal and elevated.

A pair of peach baskets, nailed to the balcony 10 ft. above the floor, became the goals. The class of 18 was divided into two 9-man teams.

The game instantly became popular and the students, no longer recalcitrant, were eager to introduce the game in nearby localities. Upon hearing of basketball's immediate acceptance, many wrote to Springfield for copies of the rules. During the summer of 1892, several of the students took up new positions in various Y.M.C.A.s and in foreign countries, thus popularizing the game. At Cornell in 1892, class basketball was played with 50 on a side. Geneva college (Beaver Falls, Pa.) and the University of Iowa are believed to be among the first colleges to play the game, but it was its acceptance by Yale in 1894 that induced other institutions to follow suit. The game was played in Canada in 1892, and was introduced in France in 1893 by Mel Rideout who also demonstrated it in London in June 1894 on the 50th anniversary of the founding of the Y.M.C.A. (*see* also *International Basketball*, below).

RULES AND EQUIPMENT

Originally, players had a choice of three kinds of uniforms: knee-length trousers, borrowed from football; jersey tights, as commonly worn by wrestlers; and short padded pants, forerunners of today's uniforms. The original soccer ball was soon replaced by a larger, laced ball, which, in 1937 gave way to the laceless ball, and in 1941, to the molded ball. In 1893, the Narragansett Machine Co. of Providence, R.I., made the first hoops. Originally a ladder was used to remove the ball from the net following each successful throw. Later a pole was used to retrieve the ball, then a chain fastened to the bottom of the net with a cord that extended within reach of an official. Subsequently, a hole was cut in the net, thus permitting the ball to fall through. In 1895, a 4 × 6-ft. screen was introduced for a backboard to prevent spectators from interfering with any toss. Glass backboards were legalized by the professionals in 1909. Fan-shaped backboards were made legal in 1940–41 and the transparent backboards, although commonly used in public auditoriums since the mid-1930s, were finally authorized in 1946–47.

In the early days, the courts were of irregular shapes with occasional obstructions such as pillars, stairways or offices that interfered with play. In 1903, it was ordered that all boundary lines must be straight. In the early years, the number of players upon a team varied according to the size of the playing area but in 1895 the number was set at five. Gulick rewrote the rules through questionnaires mailed to numerous groups and individuals until he helped form the first official rules committee in 1896. The composition of this committee, as with the girls' rules committee, has varied through the years with the withdrawal and return of certain bodies. In 1913 there were as many as five sets of basketball rules: the collegiate, Amateur Athletic union-Y.M.C.A., state militia groups and two varieties of professional rules.

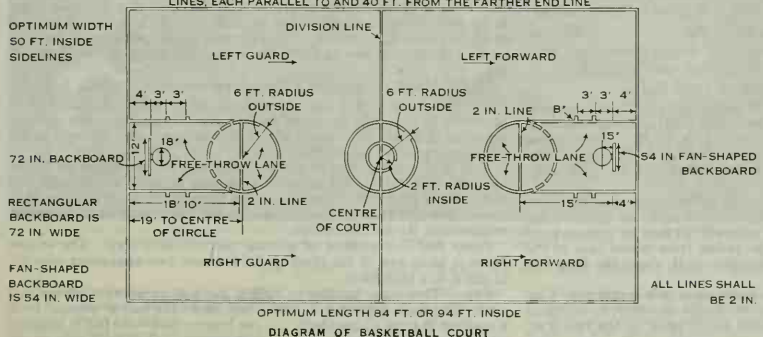


DIAGRAM OF BASKETBALL COURT

(Left) Large backboard for college games; (right) smaller backboard for high school, Y.M.C.A. and A.A.U. optional

Growth of Game.—Major

collegiate rules changes over the years were as follows:

1894–95—Free-throw line moved from 20 to 15 ft. of basket.
1895–96—Field goal changed from 3 to 2 points, foul shots from 3 to 1 point.
1897–98—Player could not touch ball with both hands more than once.
1900–01—Dribbler could not shoot for a basket. This restriction was withdrawn in 1908–09.
1905–06—Colleges formed own rules committee until 1915, when the National Collegiate Athletic association, the Amateur Athletic union and the Y.M.C.A. formed joint rules committee.
1909–10—Player disqualified upon committing his fourth personal foul. Glass backboards legalized.
1913–14—On out-of-bounds ball, opponent of last player to touch ball would put it into play. Bottom of net left open.
1918–19—Player may re-enter once. Before this, once player left game, he could not re-enter.
1920–21—Backboards moved in 2 ft. from walls of court. This prevented players from "climbing" up wall for a shot and also cut down the number of out-of-bound plays on ends of the court.
1921–22—Running with the ball became a violation, no longer a foul.
1923–24—Each player, when fouled, must attempt his own free throw. Heretofore, each team had its most accurate marksman attempt all free throws.
1929–30—The double referee system was introduced.
1930–31—Maximum circumference of ball was reduced from 32 to 31 in., its maximum weight from 23 to 22 oz.
1932–33—It became mandatory for a team, under penalty of forfeiting possession of the ball, to advance the ball beyond mid-court within 10 sec. No player may stand within the foul lane with the ball for more than 3 sec.
1934–35—Circumference of ball was set at 29½ to 30¼ in.
1935–36—Player may re-enter a game twice.
1936–37—To limit effectiveness of extremely tall players from securing easy baskets, no member of a team having the ball was allowed to stand—with or without the ball—more than 3 sec. within the foul lane. The number of time-outs allowed a team was increased from 3 to 4.
1937–38—The laceless ball was made legal. The centre jump, after a field or foul shot, was eliminated; the ball was put into play from out-of-bounds on the end line where the last score was made. Any defensive player was prohibited from interfering with the ball if his arm or hand touched the other team's basket.
1938–39—Circumference of the ball was reduced to 30 in. Teams were granted 5 time-outs.
1939–40—Backboards were moved in 4 ft. from the end line to eliminate frequent stepping out-of-bounds.
1940–41—Fan-shaped backboards were legalized.
1944–45—The number of allowable personal fouls per player was increased from 4 to 5. Goal tending became illegal, a defensive player no longer could touch a ball upon its downward flight while the ball was above the level of the hoop. Teams were permitted to substitute players without restriction.
1946–47—Transparent backboards were authorized.
1948–49—Players were permitted to consult their coaches during a time-out.
1949–50—The molded ball was made the official ball.
1956–57—The free-throw lane was widened from 6 to 12 ft.

Synopsis of Rules.—The National Basketball committee of the U.S. and Canada meets annually to formulate rules for the N.C.A.A., National Federation of State High School associations, the Y.M.C.A., the Canadian Intercollegiate Athletic union and Canadian Amateur Basketball association. Rules for women, professional and international basketball groups vary slightly.

The college and high school basketball rules follow:

Equipment.—The ideal playing court (*see* diagram) for colleges and adult groups is a rectangular surface, free from obstructions, measuring 94 × 50 ft.; for teams of high school age, 84 × 50 ft. In the latter case, if the court should be less than 74 ft. long, it is divided by two lines, each parallel to and 40 ft. from the farther end line, thus providing a greater front court.

The backboard is of flat, rigid material, midway between the sidelines, 4 ft. in from the end lines. There are two styles of backboards: rectangular 6 ft. horizontally and 4 ft. vertically (it may be transparent) or fan-shaped, 54 in. wide with a 29 in. radius from centre base to the top. The top of the rectangular backboard is 13 ft. above the floor and the fan-shaped board is 12¼ ft.

The basket, rigidly attached to the backboard, is a metal ring ¾ in. thick, painted bright orange, with an 18 in. inside diameter, 10 ft. above and parallel to the floor, with the nearest inside point of the ring 6 in. from the surface of the backboard.

The cord of the net is to be from 120 to 144-thread seine twine, and so constructed as to check the ball momentarily as it passes through.

The ball is spherical, of the molded type, 29½ to 30 in. in circumference, weighing 20 to 22 oz., inflated so that, when dropped to a solid wood floor from a height of 6 ft., it should rebound to a height of from 49 to 54 in.

Officials.—The officials shall consist of a referee, umpire, two timers and two scorers. The referee shall check and approve all equipment, the timers' and scorers' signals and the score at the end of each period.

The National Association of Approved Basketball Officials, founded in 1920, trains officials and governs the ethics of referees who officiate almost every college and high school contest played in the U.S.

Players and Substitutes.—Each team shall consist of five players, one who will act as captain and who shall speak to the official on matters of interpretation of rules and essential information in a courteous manner. A substitute may enter a game upon reporting to the scorers and being recognized by the referee. There is no limit upon the number of substitutions a team may make. All players must wear numbers on front and back of shirts. Home teams wear white or light uniforms, road or visiting teams wear dark uniforms. Numbers 1 and 2 must not be used, and it is recommended that no number have a digit greater than 5.

Scoring and Timing.—The visiting team has the option of choosing either basket for the first half and the teams change baskets for the second half. If a player tosses the ball into his opponents' basket, it shall count for his opponents.

A successful toss from the floor (field goal) counts 2 points. A successful free throw from the foul line counts 1 point. The team with the greater number of points at the end of the playing time shall be declared the winner.

For teams of college and adult age, a game consists of two 20-min. halves, with a 15-min. half-time intermission. Teams of high school age play four 8-min. quarters, with a 1-min. intermission between quarters and 10 min. between halves; for teams younger than high school age, 6-min. quarters are recommended.

In the event of a tie upon the expiration of regulation playing time, teams of college age play as many 5-min. extra periods as are necessary to decide the contest. High school teams play an extra period of 3 min. If, at the conclusion of that overtime, the score is still tied, the game shall continue, after a 1-min. intermission, with as many extra 3-min. periods as needed until one team has acquired a 2-point lead. The game thus ends at that point, called "sudden death."

If any period terminates after the ball has left a player's hand, the toss, if successful, shall count. The decision of the referee at all times is final.

A team may have five 1-min. time-outs during regulation time and an extra time-out for each overtime period played. Any additional time-out requested incurs a technical foul.

Time-out occurs and the game clock stops when an official signals a foul, jump ball, unusual delays in getting a dead ball alive, or for an injury or a conference with the scorer or timer. A player also may request a time-out while his team has the ball or when play is suspended.

Fouls.—Basketball is a noncontact game. A player may pass or bounce (dribble) the ball to secure a position whereby he or a teammate may make a successful toss from the floor. A foul is committed whenever one player makes such contact with an opponent so as to put him at a distinct disadvantage. It provides the offended player with an unhindered throw for a goal from behind the foul line, which is 15 ft. from the basket. If the offended player was fouled while in the act of shooting, he has two free throws if he missed his shot—one free throw if his toss was successful. Unsportsmanlike conduct by a player or coach incurs a technical foul and possible banishment.

Violations.—A violation occurs when a player (with the ball) takes an excessive number of steps; causes the ball to go out-of-bounds; steps over the foul line while tossing for a free throw; steps over the end line while tossing the ball in to a teammate or fails to pass the ball in within 5 sec.; runs with, kicks or strikes the ball with his fist; dribbles a second time after having once concluded his dribble; remains more than 3 sec. in his free-throw lane while he or his team has the ball; causes the ball to go into his backcourt; or retains the ball in the backcourt more than 10 sec. Penalty is loss of the ball—opponents throw in ball from the side.

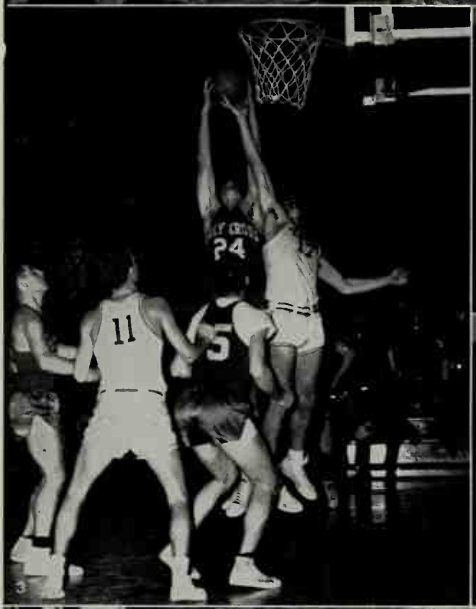
Definitions.—Basketball terms and definitions are as follows:

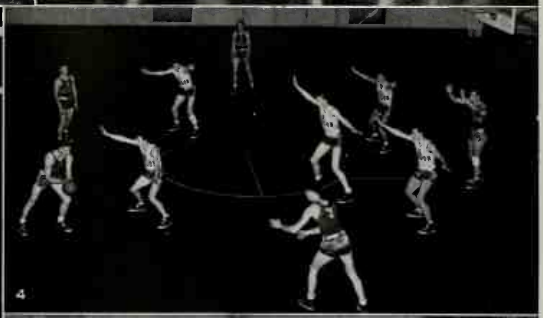
Dribble.—This is ball movement by a player who taps the ball in the air or to or on the floor and then touches (bounces) it one or more times. A dribble ends when a player touches the ball with both hands simultaneously or loses contact with it.

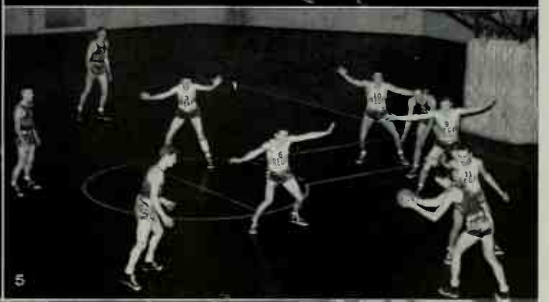
Held Ball.—When two opponents have one or two hands so firmly upon the ball that neither can gain possession without undue roughness it is called a held ball. It occurs in the front court when a player is so closely guarded that he cannot pass or try for a goal or is obviously withholding the ball from play.

Jump Ball.—A method of putting the ball into play. The referee tosses it up in one of the three circles between two opponents who try to tap it to a teammate.

Pass.—Throwing, batting or rolling the ball to another player is a pass. The main types are (1) the chest pass—the ball is released from a position in front of the chest; (2) the bounce pass—the ball is bounced on the floor to get it past a defensive opponent; (3) the roll pass on the floor; (4) the hook pass (side or overhead); and (5) the baseball pass





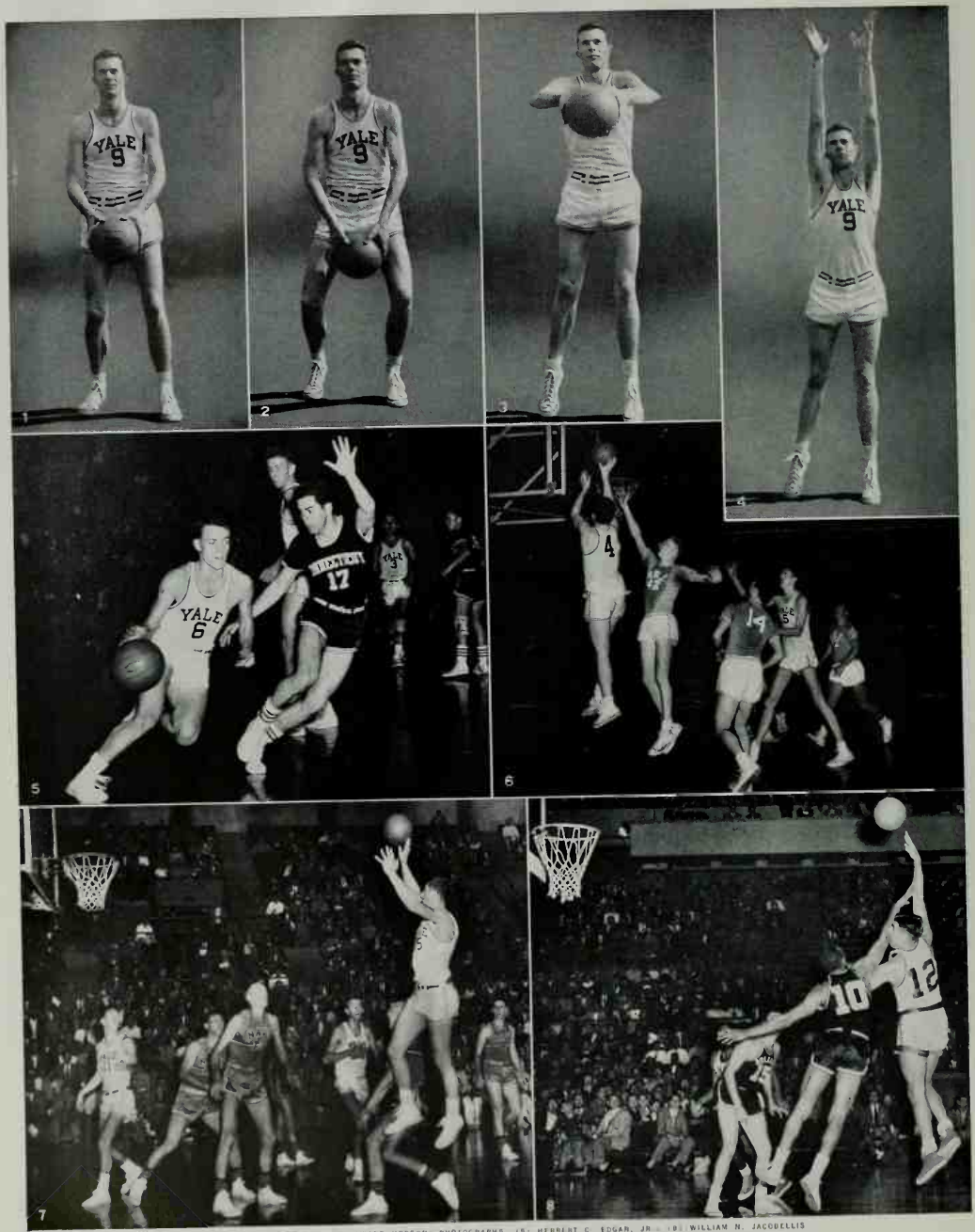


BY COURTESY OF (1) HENRY W. PECK AND WILLIAM N. PECK, JR., (2, 3) HOWARD HOBSON, (4, 5, 6) FROM "BASKETBALL ILLUSTRATED" BY HOWARD A. HOBSON, COPYRIGHT 1948 BY A. S. BARNES & COMPANY INC.; PHOTOGRAPHS, (2) J. F. BATTICK, (3) "YALE DAILY NEWS" STAFF PHOTO

AN EARLY BASKETBALL TEAM AND COURT STRATEGY

1. The Yale university team of 1896–97, the first to play a game of college basketball with five men on a side (*v.* University of Pennsylvania, March 20, 1897).
2. The centre jump, start of the game
3. The rebound. Control under the basket is a major factor in team play
4. Shifting zone defense, with the ball outside at a guard position
5. Shifting zone defense, with the ball inside at a forward position
6. Man-to-man defense demonstrated on an outdoor court

BASKETBALL



BY COURTESY OF [illegible], THE SEAMLESS RUBBER [illegible] (5-8); HOWARD HODSON, PHOTOGRAPHS, (5); HERBERT C. EDGAR, JR. [illegible]; WILLIAM N. JACOBELLIS

SOME BASIC BASKETBALL SHOTS AND TECHNIQUES

1–4. The underhand toss, once universally used for free throws
5. The dribble. Offensive player keeps body and ball turned away from defensive player
6. Short, or lay-up, shot under the basket
7. The jump shot from outside
8. The hook shot

—a pass is made a longer distance with one hand in a manner similar to a baseball throw.

Shots From the Field.—The main field shots are: the lay-up (the shooter jumps and lays the ball against the backboard so it will rebound into the basket) and the over-the-rim shot (the player jumps and shoots or lays the ball over the rim). From a distance of 12 to 24 ft. from the basket many players use a one-hand shot from a stride, jump or standing position, and a hook shot, which is overhead. From longer range, so-called set shots may be the two-hand shot starting from a chest position or the one-hand shot.

Free-Throw Shot.—This shot may be the one-hand, two-hand chest or underhand toss style.

Pivot.—A movement which takes place when a player with the ball steps once or more than once in any direction with the same foot while the other foot (pivot foot) is kept at its point of contact with the floor.

Rebound.—This occurs after any try for a basket from the floor or foul line is unsuccessful but the ball does not go out-of-bounds and remains in play, both teams attempting to gain possession of the ball.

Running With the Ball (Traveling).—A term which denotes progressing in any direction in excess of the prescribed limits while holding the ball.

Screen.—This is legal action of a player who, without causing contact, delays or prevents an opponent from reaching his desired position.

Blocking.—Any personal contact which impedes the progress of an opponent who does not have the ball is called blocking.

Live Ball.—The ball when it is in play; *dead ball* is one not in play.

PLAYING THE GAME

Each period starts with an official putting the ball in play by tossing it up at centre court between the opposing centres, usually the tallest member of each team or the one who can jump the highest. After each successful basket or foul shot the ball is again put in play by the team that is scored on tossing in the ball from behind the end line where the score was made. As basketball progressed, various teams and coaches devised skillful plays or maneuvers to facilitate their offensive movements. Some systems put the emphasis upon speed and high scores, others upon ball possession and intricate ball handling, definite play patterns and low scores.

Defense also developed over the years. There are two kinds of major defense patterns with numerous variations of each. One is called man-for-man defense, whereby each player guards a specific opponent wherever he moves except when it might be better for him to guard another player in a more threatening scoring position, in which instance a teammate guards his opponent. This is called "switching." The other is the zone or 5-man defense. In this system a player guards a specified area irrespective of which opponent plays in that area. The pressing defense exists when a team guards an opponent so thoroughly that it forces the opposition to hurry its movements, especially to commit errors.

According to a study completed by Howard Hobson and reported in his *Scientific Basketball*, the average U.S. college team, in an average game, tries 68 shots a game, converting 24; attempts 32 free throws, making 21; and scores 69 points. There are approximately 102 rebounds in an average game, 11 jump balls, 21 personal fouls, 17 occasions when the ball is lost on misplays and 14 interceptions.

The game, while largely a winter sport, is played in the U.S. on a 12-month basis in summer playgrounds, churches, schools, municipal and industrial halls, schoolyards, backyards, Y.M.C.A.s, etc.—often on an informal basis between two or more players. Youngsters are known to start playing as soon as they can lift an undersized basketball.

"Biddy" basketball was introduced in 1950 for youngsters less than 12 years old with the ball smaller than the official ball and baskets lowered to 8 ft. above the ground. An international tournament is held annually in the city of the defending champion. Junior high schools and grammar schools also hold intracity tournaments.

BIG TIME BASKETBALL

Intersectional college contests were a rarity up to Dec. 29, 1934 when Ned Irish, former New York city newspaperman, introduced big time basketball at Madison Square Garden with Notre Dame meeting New York university and St. John's playing Westminster (Pa.) college before an audience of 16,138. Other arenas in principal cities followed suit as air travel permitted teams, especially during the Christmas recess, to cover tremendous distances, even from coast to coast. Some teams participated in as many as nine games upon such excursions. Such innovations brought about a more uniform interpretation of officiating and helped introduce new styles of shooting, offense and defense and focused even greater attention on the game and its better-known players. In the second half of the 20th century as many as 40 pre-season tournaments have been staged in all sections of the nation, largely in December, thus allowing colleges to face opponents or appear in areas they otherwise would not reach.

During the mid-1920s and again after World War II, many colleges and universities constructed large field houses that helped popularize the game even more. *See* also STADIUM.

Tournaments.—The first A.A.U. tournament, staged in 1897, was won by the 23rd street Y.M.C.A. of New York city. Curiously, while the Y.M.C.A. was prominently identified with the growth of the game, it did not hold its first national tournament until 1923. Naismith played a prominent role in the inception of the first national collegiate tournament, in 1938, through the National Association of Intercollegiate Athletics which consists largely of 450 of the smaller colleges. In that same season, the New York city basketball writers organized the National Invitation tournament, annually played at Madison Square Garden under the auspices of the Metropolitan Colleges association. In 1939 the N.C.A.A. started its tournament, now called the university division, and, to accommodate its smaller college members, the so-called college division in 1957.

Players and Coaches.—Some of the leading college players over the years have been John Schommer, University of Chicago, 1909; Forrest DiBernardi, Westminster (Mo.) college, 1921; Howard Cann, New York university, 1920; Vic Hanson, Syracuse university, 1927; John Wooden, Purdue university, 1932; Jack McCracken, Northwest Missouri State college, 1933; Edward McNichol, University of Pennsylvania, 1917; Hank Luisetti, Stanford university, 1938; Mike Novak, Loyola university (Chicago), 1939; George Mikan, DePaul university, 1946, who was tabbed in the Associated Press poll of 1950 as the game's "greatest basketball player of the first half-century"; Bill Russell, University of San Francisco, 1956, greatest defensive centre of all time; and Wilt Chamberlain (7 ft. $1\frac{1}{16}$ in. tall), University of Kansas, 1959.

Basketball statistics first came into prominence in the early 1930s and records of most college teams and players are maintained by national bodies on a weekly and seasonal basis. Throughout each season, coaches, radio, television, newspaper and magazine writers participate in numerous all-America, sectional, tournament, state and conference polls to provide greater recognition to the more outstanding teams and players. Upon a more local scale, high school players are named to all-conference, district and all-state teams.

Among the game's more prominent and successful coaches have been Forrest C. Allen, who, upon his retirement in 1956, had coached 49 teams to 770 wins and 233 losses; Adolph Rupp, of Kentucky, with the best all-time coaching percentage; W. E. Meanwell; H. C. Carlson, who introduced the "figure eight" in the late 1920s; Henry Iba, the greatest exponent of the ball-control game; and Frank W. Keaney, who introduced the "race horse," high-scoring game in the early 1940s.

Spectators.—Basketball is played before more spectators in the U.S. than any other sport. The nation's 19,000 high schools perform before 100,000,000 fans in any season. The state of Indiana reports 10,000,000 fans in one season and the various elimination and final rounds of the state tournament draw more than 1,000,000. The Minnesota State High School championship final at the University of Minnesota's Williams arena draws over 19,000 annually. U.S. colleges attract between 15,000,000 and 20,000,000 fans in any season.

INTERNATIONAL BASKETBALL

Y.M.C.A. instructors from the United States introduced basketball to other countries soon after the turn of the 20th century.

U.S. soldiers took the game to the Philippines in 1900, and U.S. service teams further developed the game in Europe after World War I. The biggest influence, however, came from U.S. service teams during and after World War II. Thousands of these teams played basketball in many countries and increased interest and participation outside the U.S. Girls and boys both play, and outdoor courts predominate.

Basketball was demonstrated at the 1904 Olympic games, played at the inter-Allied games in Paris in 1919, and 21 nations sent teams to the Olympic games at Berlin in 1936. The game was a part of the Olympic games (*q.v.*) schedules thereafter.

The development of air travel aided international basketball, and many games and tournaments are held each year. The Harlem Globetrotters, for example, have played all over the world to huge crowds.

U.S. college and other amateur teams have toured Europe, South America, the far east and other areas. On one tour the Yale university team played 30 games in eight countries of South America in less than two months. There were also visits of teams from other countries to the U.S. after 1943, when the University of Havana defeated Long Island university in Madison Square Garden.

Basketball is second only to soccer as an international sport. International tournaments in addition to the Olympic games include the Pan-American games, the national A.A.U. championships and numerous annual sectional tournaments such as the European, Mediterranean and South American. The International Federation of Basketball, with representatives from many countries, formulates rules and policies for the international games.

WOMEN'S BASKETBALL

Girls' basketball was first played by teachers of the Buckingham grade school of Springfield, Mass., soon after the game was founded. The women were accustomed to paying periodic visits to the college gym and, on taking an interest in the new game, asked that they be permitted to play it too. One of these teachers was a Maude Sherman, who later became Mrs. Naismith. Smith college, in 1892, became the first women's college to play basketball although it always has been upon an intramural basis.

Clara Baer, who introduced the game at Newcomb college in New Orleans, La., had a hand in fashioning the women's style of play with her set of women's rules, published in 1895. On receiving a diagram of the court from Naismith, Miss Baer mistook dotted lines, indicating the areas wherein the players might best execute team play, to be restraining lines with the result the forwards, centres and guards confined their activity to specified areas. This seemed appropriate since many felt that the men's game was too strenuous for women. Women's rules over the years frequently have been modified; there are six players on a team, instead of five as in men's basketball, and the court is divided so that the three forwards play in the forecourt and do all the scoring, while the three guards are confined to the back court.

Few women's colleges participate upon an intercollegiate basis. Most high schools girls' teams play preliminary to the boys' varsity games. However, girls' basketball is so popular in Iowa that the annual state elimination draws more than 250,000 spectators.

Among the more outstanding girls' teams of all-time, the Baskin (La.) high school team won 218 in a row, 1947–53, and the Wayland (Tex.) Flyers concluded their 1956–57 season with 104 wins in succession. The Edmonton Grads of Canada, former students at the McDougall Commercial school of that city, played from 1915 to 1940, winning 502 of 524 games—78 successively.

PROFESSIONAL BASKETBALL

In its early years, basketball became so popular at the various Y.M.C.A.s that the organization banned the sport because the contests monopolized the use of the gymnasiums which formerly were available to five or six times as many members. In 1897, the North branch of the Philadelphia Y.M.C.A. outlawed the game and the disgruntled members dropped their membership and formed independent teams that played in social halls, armouries, vacant warehouses and public auditoriums before paid gatherings. The first team to exact a profit from such contests was the Trenton (N.J.) team whose captain, Fred Cooper, former Princeton soccer coach and subsequent recreation director for Trenton, was paid off first and thus became basketball's first professional.

The professional game prospered in Philadelphia, New York city and Worcester, Mass. The first great professional team was the Buffalo Germans, members of the Buffalo Y.M.C.A. who organized in 1895 as 14-year olds and, with newcomers, played together for 44 years, winning 792 out of 878 games. They traveled throughout the nation and at one point won 111 games in a row.

Some of the more prominent stars of the early years were Harry Hough, Lew and Ed Wachter, Jack Inglis, Winnie Kinkaid, Willie Kummer, Joe Fogarty and Andy Sears.

Possibly the most famous of professional teams was the Original Celtics, largely consisting of players from the sidewalks of New York city, organized in 1915 and disbanded in 1928. They were managed by James and Thomas Furey, and then by Tex Rickard and, through the occasional addition of superior players, were regarded as the game's best by 1919. In their heyday their stars were "Horse" Haggerty; Chris Leonard; Johnny Beckman, the highest paid; Dutch Dehnert, who invented the pivot play; Nat Holman; Pete Barry; Dave Banks; Ernie Reich; Benny Borgman; Joe Lapchick and Elmer Ripley. The Celtics played every night and almost exclusively on the road. During the 1922–23 season, they won 204 of 215 games, rarely lost a series to an opponent and, in one Sunday afternoon-evening doubleheader against the Cleveland Rosenblooms, appeared before 22,000 spectators.

The first professional league was the National Basket Ball league, formed in 1898 largely to protect the players against unscrupulous promoters and to save the sport from extinction because of rough play. The game differed from the college rules in that a netting separated the players from the spectators and players bounced off the ropes like prize fighters in a ring. There was no outside ball. Because of the inequality of the teams or inability of some clubs to meet expenses, leagues did not survive for more than three or four seasons and such circuits as the Inter-State, Western Pennsylvania, Philadelphia, Central, Eastern, Hudson River, New York State and American leagues successively came into existence. As a rule, the same players performed in all the circuits, some playing for several cities or clubs in the same season.

The depression of the 1930s hurt professional basketball and the new National league was organized in 1938 in and around the upper midwest but the play-for-pay ranks took on major league status in 1946 with the organization of the Basketball Association of America under the guidance of Walter A. Brown, president of the Boston Garden. This organization and the National league combined in 1949, after a costly players' war, to form a 17-team National Basketball association which attracted the top college stars. Weaker clubs were dropped until by 1954–55 only eight remained. In 1961 a ninth team was added and a rival organization, the eight-team American Basketball league began competition.

The professional game was saved through three radical changes during the 1954–55 season: (1) the 24-sec. rule which forced a team to make a try for a basket within 24 sec. after acquiring possession of the ball; (2) a bonus free throw anytime the opposing team committed more than six personal fouls in a quarter or more than three personal fouls in any overtime; and (3) two foul shots for any backcourt foul.

The Harlem Globetrotters, organized in 1927–28, hold a unique position and are considered to be one of the greatest basketball attractions in the world. Three units annually appear on all seven continents.

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BASLE: *see* BASEL.

BASNAGE, JACQUES (1653–1723), minister of the French

Reformed Church, remarkable for his historical and patristic learning, was born at Rouen on Aug. 8, 1653, of a distinguished Norman Huguenot family. He studied classics at Saumur and theology at Geneva under Francis Turretin and at Sedan under Pierre Jurieu. He was ordained to the ministry at Rouen in 1676, but because of the revocation of the Edict of Nantes in 1685 his congregation was proscribed. Basnage, however, was permitted to withdraw to Holland, where he received a refugee's pension until he was appointed to the Walloon Church at Rotterdam in 1691. There he opposed Jurieu for sympathizing with the revolt of the Camisards (*q.v.*), since Basnage, like Calvin, repudiated the right of the subject to revolt against royal authority. In 1709 he was appointed to the French church at The Hague. By his part in assisting the grand pensionary A. Heinsius in preparing for the peace of Utrecht, his skill became known to the French diplomatists who sought his guidance at The Hague from 1715 in negotiating the treaty of the triple alliance of 1717. Basnage obeyed the French government's request for his aid, when renewed Protestant revolt was threatened, by writing *Instructions pastorales aux réformés de France sur l'obeissance due au souverain* (1720). He hoped, in vain, to be able to use his influence with the French government to obtain relief for Protestants. He wrote *Annales des provinces unies* (1719) after being appointed Dutch historiographer, but his chief historical works, among 25 other writings, were *Histoire des Juifs* (1706; Eng. trans. 1708) and *Histoire de l'église* (1699)—incorporating his earlier *Histoire de la religion des églises réformées* (1690)—in which patiently and with great erudition he rebutted Bossuet's *Histoire des variations des églises protestantes* (1688), which attacked Protestantism.

See A. Mailhet, *Jacques Basnage* (1880); E. and E. Haag, *La France Protestante*, vol. i (1877). (B. H.)

BASOCHE (Bazoche), an ancient French guild of clerks, from among whom advocates and legal representatives (*procureurs*) were recruited. This organization eventually disintegrated, dividing up into the specialized bodies of advocates and of legal representatives. In early days, and until the first half of the 16th century, the *Basoche* was organized in companies in a military manner and held periodical reviews or parades (*montres*), sometimes taking up arms in the king's service in time of war.

Later, satirical and literary entertainments, as well as public morality plays, were given by clerks of the Palais de Justice; these played an important part in the history of the national drama, particularly of comedy.

BASOV, NICOLAY GENNADIEVICH (1922–), Soviet physicist awarded the 1964 Nobel Prize for physics, jointly with A. M. Prokhorov and C. H. Townes, for fundamental research in quantum electronics (masers and lasers), was born in Leningrad, U.S.S.R., on Dec. 14, 1922. He saw active service in the Ukraine during World War II; and from 1946, after demobilization, studied physics at the Moscow Physical Engineering Institute. His graduate research work was done at the P. N. Lebedev Institute of Physics, Moscow—one of the main research institutes of the U.S.S.R. Academy of Sciences—under A. M. Prokhorov; and he obtained his doctorate in 1956. In the 1960s he was serving as a deputy director of the Lebedev Institute. In 1952 he and Prokhorov suggested the maser principle and for this were awarded a Lenin Prize in 1959. *See* also Laser; Maser.

See J. P. Gordon, "Research on Maser-Laser Principle . . .," *Science*, vol. 146 (Nov. 13, 1964). (D. T. H.)

BASQUE, a people who live in a region bordering the Bay of Biscay and encompassing the western foothills of the Pyrenees. The Basque territories in Spain comprising 6,824 sq.mi. are the provinces of Navarre (Navarra) and the "Provincias Vascongadas," Guipúzcoa, Álava and Biscay (Vizcaya), and in France, Basse-Navarre, Labourd and Soule in the *département* of Basses-Pyrénées. They are differentiated from other peoples of France and Spain by their traditional culture and language and by the sentiment of being Basques.

The population of the four Spanish provinces numbers 1,568,759, but this figure includes a considerable number of persons attracted from other parts of Spain to the industrial centres of the region, particularly Bilbao. Moreover, the inhabitants of the southern zone have lost something of their Basque character so that not more than 750,000 can be considered truly Basque. The French Basques number between 100,000 and 120,000. Few persons from other parts of Spain or France have ever settled in the Basque countryside. On the other hand, many Basque surnames are found in other parts of Spain.

In physique the Basques are not notably different from the other peoples of western Europe, though the skeleton of the face is peculiarly narrow and orthognathism, or absence of forward protrusion of the jaws, is also very marked. They are, however, quite exceptional in the frequencies of their blood groups. They have a rather high frequency of blood-group O, an exceptionally low frequency of blood-group B and a frequency of Rh negative higher than any previously recorded. The frequency of the CDe chromosome is high and that of cDE the lowest recorded in Europe. These facts, combined with the unique character of the Basque language (*q.v.*), has led to the supposition that the Basques descend from a different, and more ancient, European people.

The land that they inhabit has a mild and damp climate and is largely hilly and wooded. It contains mines of iron ore which from early times favoured the development of industry, particularly shipbuilding. They farm small holdings of bottom land, carefully tended slopes of grass, which is cut by hand and fed to stabled cows, and apple orchards and mountain sheep pastures which are still communal in many instances. The farmhouses are grouped loosely into villages or are scattered over the lower slopes. The household is a physical and social entity of great permanence, in regard to the buildings, the farm and the family, and this permanence was formerly defended by a traditional law of inheritance that ensured the descent of the property, intact, to a single heir or heiress and condemned surplus children to celibacy or emigration.

The Basques are known for their honesty, energy and fidelity, for their agility in dancing and their fine voices, for their strong Catholicism and for their belief in witches—a reputation established and perhaps exaggerated by the famous campaign of the magistrate Pierre de Lancre against the sorceresses of Labourd in the early 17th century. Their ethnic solidarity and their position astride the Franco-Spanish frontier make smuggling one of their traditional occupations.

Not all the inhabitants of the Basque territories are typical. In the larger industrial towns, not only rural customs but the Basque language tend to be lost. It had already disappeared from the valley of the Ebro and southern Navarre by the end of the 18th century. Today it is barely spoken anywhere to the south or east of Pamplona, in most of Álava or in parts of Biscay. The areas where it is still spoken have best preserved their customs and are limited, roughly, to the zones of coastal humidity. Today, virtually all Basques speak French or Spanish.

An enterprising, seafaring people with a traditionally high birth rate, they have, from the beginning, played a leading part in the colonization of the new world. Communities of Basques are found in all the countries of Central and South America and in the western states of the United States, particularly Nevada and California, where their skill in pastoral farming and in the restaurant business has brought prosperity to many. An estimate of their numbers in the new world is not possible but there are probably 500,000 persons who are conscious of their Basque descent.

The early history of the Basques remains a subject for speculation, but Roman authors record the presence of the tribe of Vascones in lands corresponding somewhat to the province of Navarre. They appear to have resisted the Visigoths, the Franks, the Normans and, on occasions, the Moors who occupied the valley of the Ebro. It was the Basques, not the Moors as the *Chanson de Roland* relates, who cut the rear guard of Charlemagne's army to pieces at Roncesvalles in A.D. 778.

At the end of the political turmoil of the middle ages the provinces of Álava, Biscay and Guipúzcoa are found united with Castile. The kingdom of Navarre was annexed by Ferdinand II of Aragon in 1513. However the Basques retained, in France as well as in Spain, a degree of local autonomy and privileges in matters of trade, taxation and military service. These were incorporated

in bodies of traditional law known as the *fueros* (*q.v.*) or *fors*, which determined the rights of the popular assemblies and the rules of inheritance. To these laws, the framework of their political and social organization, the Basques showed themselves much attached. Those of the French Basques were abolished by the Revolution. Recently, a more favourable attitude toward regional culture has been taken, and since the *Loi Daixonne* (1951) the Basque language, formerly outlawed in any official context, is admitted to state schools. In Spain the attempts of the state to encroach upon local privileges during the 19th century moved the Basques to support the cause of Don Carlos, with disastrous results. In the following period the ambition of political independence in the form of a Basque national state was formulated by Sabino de Arana Goiri, who founded the Partido Nacionalista Vasco in 1894 with the motto: "God and traditional law." Retention of their *fueros* was, for the Basques, a more important feature of Carlism than either the dynastic issue or the political preeminence of the Church, but once the Carlist wars were over, the unity of *fuero*, faith and dynasty disintegrated.

The advent of the republic in 1930 divided the political aspirations of the Basques: Guipúzcoa, Biscay and to a certain extent Álava were prepared to work for a status of relative autonomy within the republic, and for this reason they remained loyal to it in spite of its anti-Catholic policy; Navarre, on the other hand, was eager to see the republic overthrown and furnished one of the strong points of the rebellion in 1936 and, in its Carlist "Requetés," some of its best troops. The city of Bilbao, which had been a stronghold of liberalism against the Carlists, became at the same time the centre of republican government and also of Basque nationalism. The fighting lasted until Sept. 1937 and is chiefly remembered outside Spain for the bombing and burning, supposedly by German aircraft, of Guernica, the traditional assembly place of the province of Biscay and a symbol of the Basque nation in nationalist eyes. After the war, many Basques went into exile in the new world and a Basque national government continues to reside in Paris.

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BASQUE LANGUAGE. The Basques (*q.v.*) call their language Euskara, Eskuara or Úskara, according to the dialect. It is spoken today in the north of Spain (in the province of Guipúzcoa, part of the provinces of Biscay [Viscaya] and Navarre [Navarra] and a few districts in the province of Álava) by between 500,000 and 600,000 persons, and in the southwestern corner of France (western part of the *département* of Basses-Pyrénées) by about 90,000. Basque has never been the official language of a country. It has given way before the Romance languages. It comprises a large number of varieties of speech, which are grouped into eight dialects. Viscayan differs considerably from all the others, which are: Guipúzcoan, northern and southern upper Navarrese, spoken only in Spain; Labourdin, western and eastern lower Navarrese and Souletin, spoken mainly in France but each having a subdialect spoken in Spain. Nevertheless, the essential features of the structure of the language are everywhere the same.

Origins of the Basque Language.—Basque is the only living language in western Europe which does not belong to the Indo-European family. In the past the most varied hypotheses were advanced about its origin and relationship, but it can now be affirmed that it is a continuation of the language of the Aquitani (who in the time of Julius Caesar inhabited the region lying between the Garonne, the Pyrenees and the Atlantic ocean) and that of the Vascones (who occupied the greater part of the Spanish Navarre and some districts of other provinces), and that it does not come from the old Iberian. The Aquitani and the Vascones spoke languages close to each other or dialects of the same language. The Vascones still lived south of the Pyrenees in the time of Ausonius (4th century A.D.) and invaded Aquitania in the 6th century. There are good grounds for thinking that Basque is related to the Caucasian languages (*q.v.*), which, although varied, form a family. The most likely hypothesis is that the ancestral language of Basque was introduced by immigrants coming from Asia Minor at the beginning of the Bronze Age (*c.* 2000 B.C.).

Basque words have been known since the 8th century, but the oldest dated and printed texts are 16th century. Basque is written with characters belonging to the French and Spanish alphabets.

Phonology.—Basque has five vowels, *i*, *e*, *a*, *o* and *u*, analogous to those of Spanish, and a few diphthongs; there is in Souletin a sixth vowel, *ü*, similar to the French *u*. Basque has palatalized consonants; a soft *r* and a hard *r* (*hari* "thread," *harri* "stone"); a consonant notated as *s*, intermediate between the initial consonant of the English *sun* (notated in Basque as *z*) and the initial consonant of *shake* (notated in Basque as *ch* or *x*); and the three corresponding affricates (*tz*, *ts*, *tch* or *tx*). The fricative and affricated consonants are voiceless. There are voiced and unvoiced occlusives. Only the dialects in France have aspirated occlusives (*ph*, *th*, *kh*), as well as the consonant *h*; the aspirated occlusives are only phonetic variants of *p*, *t* and *k*. No Basque word begins with an *r*. The Latin *rege(m)* ("king") has become *errege* in Basque.

Vocabulary.—Basque words are formed principally by means of suffixes and by a process of composition, rarely by means of prefixes. The notation of numerals is vigesimal: *(h)ogoi* "20," *berrogoi* "40" (the prefix *berr-* means "twice," "again"). Basque has borrowed many words from Latin, Spanish, French and Gascon. But its morphology, which makes great use of agglutination, and its syntax are peculiar to Basque.

Declension.—All the nouns and adjectives follow the same declension, which makes no distinction between grammatical genders and comprises three varieties of form: the indefinite, without distinction of numbers; the definite singular and the definite plural may be distinguished. The nominative indefinite is identical to the stem: *harri* "stone(s)"; the nominative singular *harria* contains the postponed definite article *-a*, which is based on the third person demonstrative; the nominative plural is *harriak*. Certain case suffixes can be added to one another. Thus, a Basque noun in the genitive may be declined like an ordinary noun: *gizon* "man," *gizona* "the man," *gizonaren* "of the man," *gizonari* "to the man," *gizonarena* "that of the man," *gizonarenari* "to that of the man." There exists a so-called active case contrasted with the nominative, the subject or "passive" case: *gizona* (nominative) *dago* "the man stays"; *gizonak* (active) *badaki* "the man knows it"; *gizonak* (active) *dakusa haurra* (nominative) "the man sees the child"; *haurrak* (active) *dakusa gizona* (nominative) "the child sees the man."

In the personal pronouns and the conjugation, in the second person singular, Basque distinguishes between familiar and polite forms. The latter are old plural forms. New plural forms have been created by adding a plural suffix to the old ones. The personal pronouns are *ni* "I," *gu* "we," *hi* second singular familiar, *zu* second singular polite, *zuek* "you" (plural). There is no personal pronoun for the third person, but there are three demonstratives with the value of personal pronouns: *hau* (Latin *hic*), *hori* (*iste*) and *hura* (*ille*).

Conjugation.—The Basque conjugation is much more complex than the declension. Most verbs are conjugated by means of auxiliaries. These are four in number: "to be," "to become," "to have" and "to do." The personal forms are very numerous and may contain several indications of persons (a prefix and one or two suffixes): *nago* "I stay," *nagozu aldean* "I stay near you" (*aldean* means "near"); *nauzu* "you have me," *eman dautzut* "I have given it to you." The roots of these verbs are *go-* "stay" and *u-* "have." The signs of the persons are: *n-* "I" (subject or "passive"); *-zu* "to you" (polite), "you" (polite, active); *d-* "he," "him," "she," "her," "it," (subject or "passive"); *-tzu* "to you" (polite). When the second person familiar of the singular is expressed by a suffix, Basque differentiates the masculine (suffix *-k*) from the feminine

(suffix *-n*). To express "you have it," Basque has four forms: *duk* (familiar masculine, when speaking to a man, a boy, or an animal), *dun* (familiar feminine, when a woman or a girl is addressed), *duzu* (polite, when one person of either sex is addressed), *duzue* (plural, when speaking to several persons or animals). Finally, when the speaker is on familiar terms with someone and uses the pronoun *hi* in addressing him, in independent or main clauses special forms of address must be used, which contain the supplementary suffix *-k* or *-n* and show the sex of the person who is being spoken to. Thus, instead of saying *nago* "I stay," *du* "he (she, it) has it," the speaker must say *niagok* or *niagon, dik* or *din*.

Syntax.—The most important feature of the syntax of Basque is the fact that subordination is expressed by suffixes or prefixes joined to the personal verbal forms: *dugu* "we have him (her, it)," *dugun* "whom (which) we have"; *ikusi dugu herria, ederra da,* "we have seen the country, it is beautiful"; *ikusi dugun herria ederra da* "the country which we have seen is beautiful"; *ikusi badugu* "if we have seen it" (*ba-* means "if"); *baitugu* (for *bait-dugu*) "because (that) we have it." The relative verbal forms can be declined: *duguna* "he whom (she whom, that which) we have"; *ikusi dugunaren* "of that which we have seen." Sometimes pronouns and interrogative adverbs are used as relatives, in imitation of the Romance languages; but the verb in the relative clause then has the prefix *bait-*, which shows dependence: *non* "where?"; *non ikusi dugu?* "where have we seen him?"; *herria non ikusi baitugu* "the country where we have seen him." Two verses of the priest-poet Bernard Dechepare, published in 1545, run as follows: *Suyak bano gaizkiago erra diro gizona; Itchasoak ez iraungi eratcheki dadina* "(Love) more cruelly than fire can burn the man; the sea cannot extinguish what takes fire"; *suyak* "the fire" (active); *bano* "than"; *gaizki* "cruelly"; suffix *-ago* "more"; *erra diro* "it can burn him"; *gizona* "the man" (nominative); *itchasoak* "the sea" (active); *ez* "not"; *iraungi* "extinguish"; *eratcheki dadina* "he who (she who, what) takes fire."

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BASRA (Al Basrah), the port of Iraq, capital of a *liwa* (province) and largest town of the south, is situated on the western bank of the Shatt al Arab, formed by the union of the Tigris and Euphrates, at the exit from Lake Hammar, 70 mi. by water above Fao (Al Faw) on the open Persian gulf. Pop. (1957) 164,623. The adjacent terrain is low-lying and deeply intersected by creeks and watercourses. The city is an agglomeration of three small towns and several villages clustered around Ashar creek (Nahr al 'Ashshar), which enters the Shatt al Arab from the southwest. At the head of the creek, two miles from its confluence, lies Basra proper; at the confluence lies Al 'Ashar; and Al Ma'qil is four miles farther up the Shatt. The villages are Jubaylah, Manawi and Ribat al Saghir. Around these settlements are extensive palm groves intersected by drainage channels and minor inlets, to a depth of about three miles from the Shatt; and with the rise of the tide, river water is ponded back twice daily to give largely natural irrigation of the date palms.

Basra city proper is a closely settled Arab town of narrow streets; Al 'Ashar extends about one mile along the river and contains most of the larger modern public and commercial buildings; Al Ma'qil has a "western" residential quarter. Most of the inhabitants gain a living either from commerce and port activities or from date packing. At harvest time large numbers of tribesmen arrive as casual labourers.

The original city, Bassorah of the *Thousand and One Nights,* was founded by Caliph Omar I in A.D. 636 at Az Zubayr, about 8 mi. from the modern town. It was famous in the time of Harun al-Rashid but declined in importance with the decay of the Abbasid caliphs. The canals were neglected and, as the silt accumulated, communication with the Persian gulf was much reduced. The town was taken by the Turks in 1668 and later underwent many changes of fortune. Between 1720 and 1752 the East India company established itself, and Basra developed considerably during the 19th century as a transshipment point for river traffic to Baghdad. During World War I, Basra once more came into its own as the port whereby communication was maintained between Mesopotamia and India. Many improvements were effected, and both town and port grew in importance. In 1914 construction of a modern harbour began at Al Ma'qil (previously Basra had no wharves) where there is a deep channel offshore. In 1930 the port installations were transferred to Iraqi ownership and between 1918 and 1939 the Rooka channel was dredged through the outer bar of the Shatt al Arab to allow vessels of 30 ft. draft to reach Basra. Air and rail communications were also established. In World War II port installations were developed at Tannumah on the eastern bank of the river, which is there 300 to 400 yd. wide. Basra is now the focus of southern Iraq and sole port for the entire country.

The *liwa* (pop. 1957, 502,884; area 4,747 sq.mi.) extends from the frontier with Kuwait as far as Iranian territory. Besides its riverine section, which is by far the most important, there are expanses of desert. It is a highly productive region growing dates, rice, corn and millet. (W. B. Fr.)

BAS-RHIN, a *département* on the eastern frontier of France, comprises the northern part of the plain of Alsace and the flanking highlands that lie to the west. It extends along the left bank of the Rhine between the upper plain of Alsace (Haut Rhin) and the Rhenish Palatinate in Germany. The area became part of France at the end of the 17th century, but as a part of Alsace-Lorraine (*q.v.*) was lost to Germany from 1871 to 1919. Pop. (1954) 707,934; area 1,848 sq.mi.

The southwest corner of the *département* includes the northern part of the Vosges and reaches 3,600 ft. in the Hochfeld massif. As the crystalline rocks of the High Vosges give way northward to sandstones, the uplands lose height, but they rise steeply from the floor of the Rhine rift valley, with its infilling of soft sediments that include young alluvium along the flood plains of the Rhine and its tributary the Ill, and flights of gravel terraces. The plain has a sheltered climate, with warm, sunny summers. Where covered with loess, the terraces are exceptionally fertile and are highly cultivated for corn, sugar beet, fodder crops and hops, but elsewhere are barren tracts left under forest, the largest being the Forest of Haguenau. The low-lying belts of damp alluvium are rich meadowlands. At the foot of the highlands is a rich zone of small towns and villages surrounded by vineyards and orchards. In the north of the plain is the Pechelbronn oil field.

Strasbourg, its old town sited originally on the Ill river just above its confluence with the Rhine, owes its importance to its expansion into a great river port on the Rhine and to its position at the crossing of the river by a major west-east route. This approaches from Lorraine by the Col de Saverne and is followed by canal and railway as well as by road. Strasbourg (*q.v.*), the capital of the *département,* with cathedral and university, is the largest town. Wissembourg, Haguenau, Saverne, Molsheim, Erstein and Sélestat are also centres of *arrondissements.* The court of appeal is at Colmar (Haut Rhin). (Ar. E. S.)

BASS, a name given several fishes of two different groups: the sea bass (Serranidae) and the sunfish families (Centrarchidae). Most of these fishes are carnivorous, attain a length of more than a foot and are important game fishes.

Sea Bass.—Most of the Serranidae inhabit the shallow waters of tropical oceans and many of these are known as groupers, hamlets, etc.; only an occasional species is known as a bass. One such group, *Paralabrax* (including kelp bass, sand bass, etc.), inhabits the Pacific ocean off Mexico and southern California, and are among the fishes commonly taken from there by sport fisher-

men. Most of the catch is by hook and line, with live bait; they are also speared by skin divers. *Paralabrax* are solitary or occur in small groups. They are not migratory and most individuals spend all of their life in the same area. Growth is rapid and many of these bass attain a length of a foot or more in their first year.

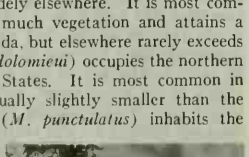
The giant sea bass (*Stereolepis gigas*) occupies a similar area. It may exceed a length of seven feet and a weight of 600 pounds. The genus *Centropristes* (including bank, rock and black sea basses) inhabit the Atlantic ocean off the United States. They attain a size of about two feet and are important game fishes. The floating eggs hatch in about five days. *Centropristes* are solitary or occur in small groups.

Another group of the sea bass family lives or spawns in fresh water. These fish can be distinguished from other fish called bass by the division of the dorsal fin into two separate units. Four species, the European bass (*Morone labrax*), the oriental spotted bass (*Lateolabrax japonicus*) and the striped bass (*Roccus saxatilis*) and its smaller relative the white perch (*Roccus americanus*) live in both salt and fresh water. The European bass is found along the Mediterranean and Atlantic coasts of Europe; the oriental spotted bass occurs along the Pacific coasts of Asia; the striped bass is native to the Atlantic coast of North America from New Brunswick to Florida and has been successfully introduced into several locations on the Pacific coast of North America between Oregon and the Colorado river; and the white perch is found along the Atlantic coast of North America between Nova Scotia and South Carolina, but seldom occurs in full sea water. The two North American forms can be distinguished by distinct striping.

The last four species mentioned have similar habits. The adults swim in large schools along the coasts, in estuaries or in landlocked lakes. During the spring they run up the rivers and spawn in running water. The spawning sites may be in brackish water or far upstream in fresh water. The northern populations tend toward the brackish-water spawning sites. Large females may produce more than 1,000,000 eggs that are slightly heavier than water. The eggs hatch in about two or three days. The larger fishes may exceed 100 lb. and 6 ft. These important game and food fishes are caught by nets or hook and line. Sport fishermen obtain them using a variety of lures or live bait fishing from boats or the shore. The use of surface baits is most successful.

Two other species, the white bass (*Roccus chrysops*) and yellow bass (*Morone interrupta*) are similar, but are restricted to the fresh waters of eastern North America. The yellow bass can be distinguished by the predominantly yellow colour and interrupted dark stripes. Similar to landlocked stocks of the other species, they live in lakes and move into the inlets to spawn.

Fresh-water Bass.—The fresh-water bass, or black bass, which are merely large and elongated sunfish, include six species of *Micropterus*. The native range is lakes and streams in eastern North America from southern Canada to northern Mexico. The largemouth bass (*M. salmoides*) occupies the entire range of the group and has been introduced widely elsewhere. It is most common in quiet waters, often with much vegetation and attains a weight of more than 20 lb. in Florida, but elsewhere rarely exceeds 10 lb. The smallmouth bass (*M. dolomieui*) occupies the northern two-thirds of the eastern United States. It is most common in clear running streams and is usually slightly smaller than the largemouth. The spotted bass (*M. punctulatus*) inhabits the southern two-thirds of eastern United States. It inhabits sluggish streams that often are moderately silty. Few spotted bass exceed 5 lb. Other *Micropterus* species are restricted to parts of the southeastern United States.



W. T. DAVIDSON FROM NATIONAL AUDUBON SOCIETY

LARGEMOUTH BASS (MICROPTERUS SALMOIDES)

The largemouth actually has the largest mouth, but because the relative mouth size changes with age, these fish are most easily recognized by the deep notch in the dorsal fin. Spotted and smallmouth bass can be distinguished by the longitudinal stripe of the spotted bass. In spring adult males of the black bass dig nests in gravel or around roots of aquatic plants; the females lay 1,000 to 25,000 eggs in one or more nests. The young, which hatch in 3 to 6 days, are protected by the father for several days after hatching. Although immature black bass may congregate in schools, adults are usually solitary. They are captured by use of a variety of lures and live baits. A spoon lure often obtains large bass. Fly casting may result in the best sport. *See* also FISHES. (C. HU.)

BASS, from Middle English *base* meaning low or deep, but influenced in spelling as a musical term by the Italian *basso,* French *basse* and German *Bass,* and used to describe the lowest male voice (*see* SINGING; VOICE), the lower part of a composition (*see* HARMONY). In compounds, the word denotes the member of an instrumental family with a low register (*e.g.,* bass clarinet), the lowest of all being called contra bass. The double bass is the lowest member of the violin family (*q.v.*).

BASSANO, JACOPO DA (JACOPO or GIACOMO DA PONTE) (1510–1592), Venetian painter, was one of the leading genre and landscape painters of the late Renaissance Venetian school. He was born at Bassano in 1510 and died there on Feb. 13, 1592. He was first a pupil of his father, Francesco da Ponte, then of Bonifazio Veneziano, a follower of the school of Titian, in Venice. His subjects were generally peasants and villages, cattle and landscapes, with some portraits and historical subjects. One of his earliest subjects was "Samson Slaying the Philistines"; the remains of this fresco can still be seen on the outside of the Casa Michieli, Venice; he painted portraits of Sebastiano Venerio Doge of Venice, Tasso, Ariosto, etc. His genuine works are somewhat rare and valuable, many of those which are called originals being copies either by his sons or by others. Bassano's style varied considerably during his lifetime; at first his style was modeled on his father's, and he was then strongly influenced by Titian before he developed his own characteristic manner. Although he painted few great pictures, his altarpiece of the Nativity at Bassano is estimated highly by the best judges, and in Lanzi's opinion is the finest work of its class.

One of his best pictures is the "Good Samaritan" in the National Gallery, London, where there are also "A Portrait of a Gentleman" and "Christ Driving the Money Changers out of the Temple." There are also pictures by him at Dublin, Florence, Milan, Naples, in the Louvre and at Venice. His four sons were all painters and assisted their father: Francesco (1543–91); Giambattista (1553–1613); Leandro (1558–1623); and Girolamo (1540–1622). Pictures by Leandro are at Dresden, Dublin, Madrid, Munich and Venice.

BASSANO DEL GRAPPA, a town in Vicenza province, Veneto, northern Italy, lies on the Brenta river at the foot of Monte Grappa, 27 mi. N. of Padua by road. Pop. (1957 est.) 28,753. Between 1036 and 1259 it became important under the Ezzelini family who built the castle, within whose walls is the old cathedral and near which is the great pottery. The town was the birthplace of the Da Ponte family of painters surnamed Bassano. It flourished as a dependency of Venice (1404–1796), trading in silk and wool, ceramics, jewelry and printing. Napoleon defeated the Austrians there on Sept. 8, 1796, and it was severely damaged during the fighting on Monte Grappa in 1917–18 and again in World War II. In the central Piazza della Libertà are the Remondini houses which held the famous printing and publishing works from 1650 to 1850. The 13th-century Torre di Ezzelino is now the civic tower. In the cloister of the old convent is the civic museum which contains, notably, paintings by Jacopo da Bassano (*q.v.*), drawings by Antonio Canova, Vittore Carpaccio (*qq.v.*) and others, ceramics, more than 1,000 *legni* (wood blocks) and a large collection of printed matter from the Remondini printing works.

Bassano is an agricultural and commercial centre. Its industries include metallurgy, ceramics, tanning, jewelry, printing, and the manufacture of automobiles and plastics. The famous *grappa* (a kind of brandy) has been made since the end of the 18th century in the distillery near the covered bridge.

BASS CLARINET: *see* CLARINET.

BASSEIN, the chief town of a district of the same name in the Irrawaddy division of the Union of Burma. It lies on the eastern bank of the Bassein river, the most westerly distributary of the Irrawaddy. Pop. (1953) 77,905. In spite of dangerous bends the Bassein river is navigable by ships of 10,000 tons up to Bassein, which is a port as well as an administrative centre. Vessels of the Inland Water Transport board ply between Rangoon and Bassein by inland waters. A railway runs northeast from Bassein to Henzada, where it is linked by ferry across the main Irrawaddy to a short line to Letpadan and so to Rangoon. Bassein is an important centre of the rice trade and has several rice mills and an expanding light industry including sawmills and machine shops. It has considerable mercantile potentialities.

Bassein district has a pop. (1941) of 664,727 and an area of 4,145 sq.mi. Its eastern half is a vast rice-growing alluvial plain in the Irrawaddy delta, interrupted only by undrained fresh-water swamps and cutoffs. The western half is formed by the forested southern portion of the Arakan Yomas and extends to the western or Arakan coast. (L. D. S.)

BASSELIN, OLIVIER (*c.* 1400–*c.* 1450), French poet, reputedly the author of French drinking songs which were popular in his native valley, the vau-de-Vire in Normandy. The songs were known as *vaux-de-vire,* from which originated the word "vaudeville." Little is known of Basselin, except that he was a fuller by trade, and that, from an anonymous poem lamenting his death, it would seem likely that he was killed at the battle of Formigny (1450). The songs were first published by a Norman lawyer, Jean le Houx, in a collection of drinking songs of which the first edition is lost, at the beginning of the 17th century. The language shows that le Houx at least revised them considerably. Their authenticity is discussed in V. Patard's *La Verité dans la question Olivier Basselin et Jean le Houx à propos du Vau-de-Vire* (1890). *Les Vaux de Vire de J. le Houx,* ed. by A. Gasté, was translated by J. P. Muirhead (1875).

BASSERMANN, ALBERT (1867–1952), German stage and screen actor, was born on Sept. 7, 1867, at Mannheim. He began his career in his native city in 1887. There followed short engagements in Cologne, Lüneburg, Hanover and Bern where the actor established himself in such character parts as King Philip II in Schiller's *Don Carlos,* Shylock, Iago, and Mephistopheles in Goethe's *Faust.* From 1890 to 1895 Bassermann acted on the stage of the Meiningen Court theatre. By the end of the century he gained a foothold in Berlin. From 1909 to 1915 he was a member of Max Reinhardt's company at the Deutsches Theater, Berlin, celebrating his greatest triumphs again as King Philip and Mephistopheles, but also as Lessing's Nathan, Schiller's Wallenstein and Shakespeare's Benedick, Othello and King Lear. Bassermann rejected routine characterizations and, with infinite care, studied the details and subtleties of his roles, putting on every one of them his inimitable artistic stamp, sometimes in defiance of tradition. After World War I he worked at the Berlin Staatstheater am Gendarmenmarkt in some of Leopold Jessner's expressionist productions of the classics. In 1933 Bassermann left Germany in protest against the Nazi regime, and the audiences of Zürich and Vienna benefited by this move. In 1938 he went to the United States where he worked in Hollywood playing sharply-profiled episodic parts in a score of films. In 1946 he returned to Europe touring the German-language area with his own company. Berlin saw him again as Pastor Manders in Henrik Ibsen's *Ghosts* and as Attinghausen in Schiller's *Wilhelm Tell.* Bassermann died in Zürich on May 15, 1952. (A. M. N.)

BASSES-ALPES (literally "Low Alps"), a *département* of southeastern France, formed in 1790 out of the northern part of Provence. It is bounded to the north by Hautes-Alpes, east by Italy and Alpes Maritimes, south by Var and west by Vaucluse and Drôme. Pop. (1954) 84,335. Area 2,698 sq.mi. The *département* is high and mountainous, and is one of the poorest and most thinly populated parts of France. Only in the Durance valley, as it opens out in the southwest toward the lowlands of Provence, is the altitude below 1,000 ft. and the mountains near the Italian frontier rise above 10,000 ft. There differential erosion of heavily folded and overthrust rocks of diverse lithology is responsible for a complex variety of mountain scenery, but most of the *département* farther west consists of the rugged but monotonous limestone *préalpes.* Their wall-like western edge overlooks an embayment of Miocene sediments that extends up the Durance basin as far as Digne. Between mountain-girt basins, where the valleys of the Durance and its tributaries open out, are almost impassable gorges, and the area is divided into separate compartments. Only with the 20th-century development of motor roads has their isolation been broken down. The Route Napoléon, traversing the *département* from north to south through Digne in the west, and the road from Briançon to Nice through Barcelonnette over high passes in the heart of the Alps are much frequented by summer tourists.

Basses-Alpes lacks the rich forests and verdance of the northern French Alps, and above its cultivated basins and valleys the mountains are largely covered with scrub and much bare rock is exposed. Cereals and vegetables, with fruit trees and vines, are cultivated, and there is extensive use of irrigated meadows for the production of fat lambs. Transhumance between the lowlands of Provence and the high Alps is in decline, however. Clustered villages and small towns, often perched on defensive sites, are characteristic of the settlement pattern. Above its spectacular gorges in the extreme south of the *département* the Verdon river has been impounded by the Castillon dam in a scheme to provide irrigation and hydroelectric power.

Digne (pop. [1954] 8,098) is the capital of the *département,* which forms the bishopric of Digne in the ecclesiastical province of Aix-en-Provence. The *département* is divided into four *arrondissements,* centred upon Digne, Barcelonnette, Castellane, and Forcalquier. It comes under the *académie* and court of appeal of Aix. (AR. E. S.)

BASSES-PYRÉNÉES, the extreme southwestern *département* of France, is at the western (lower) end of the Pyrenees. Consisting of the former province of Béarn and part of Gascony (*qq.v.*), it is bounded on the north by Landes and Gers, on the east by Hautes-Pyrénées, on the south by Spain and on the west by the Bay of Biscay. Pop. (1954) 420,019. Area 2,978 sq.mi. The crestline of the Pyrenees, forming the French frontier with Spain, falls westward from the Pic d'Anie, and the highest summits barely reach 6,000 ft. There are easy passes at about 3,000 ft., so that the Pyrenees are far less of a barrier than in the central and eastern parts of the range. In addition to the historic road route by the pass of Roncevaux, two railways cross the frontier, one by the coast from Bayonne to San Sebastian across the Bidassoa river, the other from Pau to Saragossa by the Somport tunnel.

The crystalline core of the Pyrenean system is not exposed in this western part of the range and the mountains are composed of a variety of sedimentary rocks, with a great fan of debris spread out to the north, drained by tributaries of the Adour river. The ancient Basque language still survives north of the Pyrenees in the districts on the approaches to Roncevaux and the Bidassoa. The Basques (*see* BASQUE) have distinctive customs, dances and rural traditions and the Basque countryside is also rendered distinctive by its farmhouses, with windows and frontage under the gable which has one side of the roof very long to cover barn and stable, the latter small because the very mild climate reduces the need for stabling.

In spite of the heavy precipitation, the western Pyrenees have no permanent snow. Their mild, wet climate is responsible for the exceptional verdance of the Basque country, and there is rich farming in the valleys, with corn (maize) and potatoes especially important crops. The vine is unimportant and vineyards are disease-ridden, but cider apples are extensively grown. Generally the farming is mixed, with emphasis upon cattle and poultry; unlike the areas farther east, little transhumance is practised. Market towns such as Pau are situated at the contact of mountain and plain. Others, such as Oloron and St. Jean-Pied-de-Port, serve the higher valleys. St. Jean-Pied-de-Port, on the Nive river, was the ancient capital of Navarre controlling the approach to the pass of Roncevaux. There are several spas in the *département,* notably at Eaux-Bonnes, Eaux-Chaudes, Cambo-les-Bains, St. Christau and Salies-de-Béarn. With the development of motor transport, the

tourist industry has become an increasingly important resource. Pau is an important centre inland, and the old fishing port of Biarritz has become one of the major seaside resorts of France. St. Jean-de-Luz, famous as a winter resort, retains some importance for fishing, chiefly for tunny. Salt is exploited near Bayonne, and iron pyrites on the frontier at Itxassou. In 1951 one of the world's major deposits of natural gas was discovered near Pau at Lacq. Large-scale exploitation has taken place since 1955, and gas is piped to Toulouse, Bordeaux, and farther to Nantes, Paris and Lyons. Much is used locally to drive a major electric-power station, aluminum plants, and other industrial works making fertilizers and plastics. The necessary purification of the gas yields great quantities of sulfur. As a result of this sudden industrial development, a new town, Mourenx la Neuve, has been established 3 mi. S. of Lacq.

Pau (*q.v.*), capital of the *département,* Bayonne (*q.v.*), the chief port, and Oloron give their names to the three *arrondissements* that constitute the *département,* which forms the bishopric of Bayonne. The court of appeal is at Pau, and the *académie* at Bordeaux. (AR. E. S.)

BASSET HORN, a clarinet (*q.v.*) pitched a fourth lower than the ordinary B flat clarinet, probably invented by A. and M. Mayrhofer of Passau, Bavaria, *c.* 1770. The name derives from its basset ("small bass") pitch and the arcuate, bugle-horn shape of the original design, which was soon supplanted by an angular form. It was employed notably by Mozart, in about 20 works from 1781 onward. By 1850 it had practically vanished until its revival by Victor Mahillon, which was followed by its reintroduction into the opera orchestra by Richard Strauss from *Elektra* (1909) onward. It is made to order by most makers, in straight form with upturned bell, and is regularly used in the works that demand it. It differs from the alto clarinet in having a narrower bore, in being pitched in F instead of (usually) E flat, and in having a downward extension of compass to sound the low F of the bass voice. For bibliography, *see* the article CLARINET. (A. C. BA.)

BASSETT, JOHN SPENCER (1867–1928), U.S. historian, was born at Tarboro, N.C., Sept. 10, 1867. He graduated from Trinity college (now Duke university) in 1888, and received the Ph.D. degree at Johns Hopkins university, Baltimore, Md., in 1894. From 1893 to 1906 he taught history at Trinity college and thereafter at Smith college, Northampton, Mass. He died at Washington, D.C., on Jan. 27, 1928.

Bassett was active in establishing the *South Atlantic Quarterly* as a critical organ for the postwar South (1902), and became its first editor. He wrote numerous works in American history and biography, including *The Federalist System* (1906), *Life of Andrew Jackson,* 2 vol., (1911), *The Plain Story of American History* (1915), *The Middle Group of American Historians* (1917) and *Expansion and Reform* (1926).

BASSETT, RICHARD (1745–1815), U.S. political leader, was born in Maryland, April 2, 1745. Entering politics in Delaware, he served in the legislature and represented that state in the constitutional convention of 1787. He signed the U.S. constitution and supported its ratification by Delaware. He served his state as U.S. senator (1789–93), as chief justice of the court of common pleas (1793–99) and was then elected governor. In 1801 Pres. John Adams, shortly before his retirement from the presidency, appointed him a judge of the U.S. circuit court. Bassett was thereafter known as one of the so-called "midnight judges." He died Sept. 15, 1815. (E. E. R.)

BASSI, AGOSTINO (1773–1856), an Italian lawyer who became a pioneer in bacteriology and one of the precursors of Louis Pasteur and Robert Koch in establishing the germ theory of disease. He was born near Lodi on Sept. 25, 1773. Although he was trained as a lawyer and was employed for a time as a civil servant he was unable to practice his profession because of poor eyesight and ill health. During his university years he had acquired a taste for science and so he retired to his farm, where he wrote on such subjects as the raising of potatoes (1817), vinification (1823) and cheese (1820). He also wrote on such diseases as pellagra (1846) and cholera (1849).

About 1815 he became interested in a disease of silkworms called by the French *muscardine* and by the Italians *mal de segno* which was producing serious economic losses in Lombardy. After 20 years of study Bassi was able to show that the disease was contagious and was caused by a microscopic, parasitic fungus that was transmitted from one silkworm to another by contact or through infected food. The organism is known as *Botrytis bassiana* in honour of its discoverer. In 1835 Bassi published his results in a classic monograph, *Del Mal del Segno, Calcinaccio o Moscardino* (*The Disease of the Sign, Calcinaccio or Muscardine*).

Although Bassi received many honours during his lifetime, his work was generally ignored by the medical profession; and it was not until 20 years after his death in Lodi on Feb. 8, 1856, that the germ theory of disease was firmly established through the labours of Pasteur, Koch and others.

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BASSOMPIERRE, FRANÇOIS DE (1579–1646), marshal of France, noted for the *Mémoires* written during his 11 years in captivity, was born on April 12, 1579, at Château d'Haroué in Lorraine, the son of Christophe de Bassompierre (a staunch supporter of the Holy League). His early travels took him through Bavaria to Trent, through Italy to Verona, Rome, Naples and Florence and back to Lorraine by way of the St. Gotthard pass. He was presented at court in 1598 and found favour with Henry IV, whom he accompanied in the campaign against Savoy (1602). He went to Vienna, served as a volunteer against the Turks (1603) and was presented at the imperial court (1604). Returning to France, he rose in royal favour, being appointed colonel-general of the Swiss guards (1614), grand master of the artillery (1617) and *chevalier des Ordres du Roi* (1619). He supported Louis XIII against the queen mother and took part in the defeat of her forces at Ponts-de-Cé (1620). He was sent to Madrid as ambassador extraordinary (Dec. 1620–May 1621) to settle the Valtellina (*q.v.*) dispute and was appointed marshal of France (1622) after the campaigns against the Huguenots under Benjamin de Rohan-Soubise. Again as ambassador extraordinary, he went to the Swiss cantons (Nov. 1625–Feb. 1626) and, to settle the question of the Catholic servants of Queen Henrietta Maria, to England (Sept. 1626). He was named one of the four presidents of the assembly of notables (Dec. 1626–Feb. 1627) and took part in the siege of La Rochelle (1628) and in the mission to Switzerland (1629–30). At this point, because of his relations with the queen mother's confidante, Louise Marguerite de Lorraine, princesse de Conti, to whom he was secretly married, Bassompierre came under suspicion of complicity in the conspiracy that the cardinal de Richelieu foiled on the "day of dupes" (Nov. 11, 1630). He was arrested on Feb. 25, 1631. After Richelieu's death (Dec. 1642) he was liberated from the Bastille (on Jan. 21, 1643), but he died, on Oct. 12, 1646, at Provins, without having regained his offices. Bassompierre's *Mémoires* (1665; ed. by the Société de l'Histoire de France, 4 vol., 1870–77) inspired the duc de Saint-Simon to write his own. He also wrote accounts of his embassies, 4 vol. (1668). (F. C. S.)

BASSOON (German *Fagott;* Italian *fagotto*), the normal tenor and bass instrument of the orchestral woodwind. Its narrow conical bore leads from the curved metal "crook," on to which the double reed is placed, downward through the wing joint (on which are the left-hand fingerholes) to the butt joint (on which are the right-hand holes). The bore then doubles back, ascending through the butt to the long joint and bell, where the holes are controlled by keywork for the left thumb. The bassoon is held on a sling aslant across the body, and thus, with the doubled-back bore, the tubing, which is 8 ft. long, too long to be controlled if in a straight line, is comfortably manageable. Its classical compass is three octaves upward from the B flat below the bass stave, the most-used melodic range coinciding with that of the tenor voice. Higher notes, up to treble E, have come into use since the mid-19th century, adding to the difficulty of what is in any case an exceptionally difficult instrument to play because the traditional placing of the fingerholes is scientifically irrational, yet essential to the production of a tone quality that has been one of the pri-

mary colours of the composer's orchestral palette from Handel's time. The reed is made by bending double a shaped strip of matured cane (*see* WIND INSTRUMENTS) and is placed between the lips retracted over the teeth.

The bassoon is a 17th-century development of the earlier *fagotto* or *Dulzian*, the English form of which was known as the "curtal." It was first mentioned *c.* 1540, in Italy, with the descending and ascending bores contained in a single piece of wood. Many examples survive in museums at Brussels, Berlin, Vienna, etc. The present construction in four separate joints is thought to have been developed in France after 1650, closely following the reconstruction of the shawm which produced the oboe (*q.v.*), to which the bassoon served as bass. During the 18th century the individuality of the bassoon became recognized not only in the orchestra (in which two have normally been since employed) but also as a solo instrument for concertos; yet well into Mozart's time no mechanism was required beyond four keys, most of the semitones outside the natural scale of C having been well obtained by cross-fingerings. Leisurely addition of keys from *c.* 1780 led to J. N. Savary's Paris models of *c.* 1840 which with further improvements in bore and mechanism have become the 20-keyed French bassoon made by the famous firm of Buffet-Crampon. This, built in rosewood, is used in France, Italy and Spain, and some British players still play it, or other similar models.

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BASSOON, WOODWIND INSTRUMENT BELONGING TO THE OBOE FAMILY

While it has preserved and developed the sympathetic vocal sonority of the classical instrument, the French bassoon remains a difficult instrument to control, owing to inherent unevenness in the quality and steadiness of many notes. A good player can overcome these defects, but alterations to minimize them were initiated in Germany in 1825 by Carl Almenraeder. A reformed model was developed by the firm of J. A. Heckel and perfected in the German bassoon now standard everywhere except in the Latin countries named above. It is of European maple, with its own positions and sizes of the holes to give a more even and positive response throughout the compass. It is quicker to learn, easier to choose reeds for, and in many respects more telling in a large orchestra. Research on old bassoons suggests that its tone quality, different from the French and by some considered to have sacrificed eloquence for expediency, may not represent as gross a deviation from classical tone as was hitherto believed.

The first useful contrabassoon or double bassoon, sounding an octave lower than the bassoon and much employed in large scores, was developed in Vienna and used occasionally by the classical composers. The modern contrabassoon follows Heckel's design of *c.* 1870, with the tubing doubled back four times and often a metal bell, pointing downward.

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BASSO-RILIEVO, the term applied to sculpture in which the design projects but slightly from the plane of the background. *See* RELIEF.

BASS ROCK, a small island in the Firth of Forth, about 3 mi. N.E. of North Berwick, East Lothian, Scot., circular in shape, a mile in circumference and 350 ft. high.

On three sides the cliffs are precipitous, but they shelve toward the southwest landing. Bass Rock, like North Berwick Law and Traprain Law, is the weathered plug of a volcano of the early Carboniferous period from which poured the lavas covering 50 sq.mi. of the mainland. It is composed of phonolitic trachyte, which differs from that of Traprain Law in being nonporphyritic. Sea birds, especially Solan geese, haunt the rock in vast numbers. A lighthouse with a six-flash lantern of 39,000 candlepower was opened in 1902. For a considerable distance east and west there runs through the rock a tunnel, about 15 ft. high, accessible at low water. St. Baldred, whose name has been given to several of the cliffs on the shore of the mainland, occupied a hermitage on the Bass, where he died in 756. In the 14th century the island became the property of the Lauders, called afterward the Lauders of the Bass, from whom it was purchased in 1671 by the government and a castle erected in which many Covenanters were imprisoned. At the Revolution four young Jacobites captured the rock, and, having been reinforced by others, held it for King James from June 1691 to April 1694, surrendering only when threatened by starvation. Thus it was the last place in Great Britain to submit to William III.

BASSVILLE (BASSEVILLE), **NICOLAS JEAN HUGOU DE** (1753–1793), French journalist and diplomat, whose death in Rome at the hands of a mob was exploited by the French Revolutionary governments as a grievance against the papacy, was born at Abbeville on Feb. 7, 1753. He was at first employed as a tutor and wrote two educational works. At the outbreak of the Revolution he became one of the editors of the *Mercure national.* In 1790 he published his *Mémoires historiques, critiques et politiques sur la Révolution de France.* Through the Girondin minister P. Lebrun-Tondu he entered the diplomatic service, went in 1792 as secretary of legation to Naples and was shortly afterward sent on a mission to Rome. His conduct in Rome, in particular his provocative display of the French tricolor, enraged the Roman populace. On Jan. 13, 1793, Bassville, who had been driving with his family to the Corso, was pursued by a hostile crowd and received an injury from which he died next day. The responsibility for the murder was laid by the Convention on the pope, and in 1797, by an article of the treaty of Tolentino, the Directory exacted damages of 300,000 livres for Bassville's family. The poet Vincenzo Monti, in his epic *Bassvilliana* (originally *In Morte di Ugo di Bassville,* 1793), described Bassville's soul looking down on the revolutionary scene as a penance before entering paradise.

See F. Masson, *Les Diplomates de la Révolution* (1880).

BASSWOOD: *see* LINDEN.

BASTAM (BUSTAM, also BISTAM and BOSTUM), a small town in Khurasan, Iran, lies at the southern foot of the Elburz mountains in a well-watered plain, about 4 mi. N. of Shahrud which now belongs to the province (*ostan*) of Mazanderan and Gorgan. Famous since Sassanian times and once thriving, it lost its position to the more modern Shahrud. Bastam has a group of remarkable buildings, some of great beauty, that cluster around the tomb of the famous Sufi poet and mystic Abu Yazid al-Bastami (d. 874). They include the mausoleum of the saint, a 12th-century minaret, a mosque wall of 1120, other tombs, a superb portal with faïences (1313) and a 15th-century college. A few hundred yards to the southwest are interesting ruins, including a Friday mosque and a charming little cloister with fine stucco. The greater part of these constructions is due to two Mongol monarchs, Ghazan Khan and Uljaitu. (H. BO.)

BASTAR, the southernmost district of Madhya Pradesh, India. Pop. (1961 census) 1,167,810. Area 15,124 sq.mi. The district headquarters town is Jagdalpur (13,793), on the main road running from southern Orissa onward into Maharashtra state. Bastar (Old Bastar), from which the district and one of the two petty principalities (Bastar and Kanker) absorbed into it in 1948 took their name, is a village 12 mi. N.W. of Jagdalpur.

The southern part of the district is divided by the Bailadila ("Bullock's Hump") range, running north-south. In this range rich deposits of iron ore (600,000,000 tons est.) are worked. West of it the country falls away into the Godavari valley and is the habitat of much big game. Much of the east of the district is a plateau at 1,500–2,000 ft. on which lies Jagdalpur; it has a fairly temperate climate. The Indravati river enters the eastern plateau from Koraput district (Orissa) and passes north of Jagdalpur; where it leaves the plateau at Chitrakot, about 60 mi. W. of Jagdalpur, there is a waterfall 94 ft. high in fine scenery. The Mahanadi (*q.v.*) crosses the district's northeastern corner. Less

than 10% of the district is cultivated, the villages being separated by broad forest tracts. But it has considerable undeveloped timber and mineral resources. The forests contain sal and teak. The chief crops are rice and small millets. There has been much shifting cultivation to the great damage of forest areas, but there are still about 5,000 sq.mi. of good forest. Most of the people are aborigines—Gonds (66%) and Halbis. (D. G. NA.)

BASTARD, a person born out of lawful wedlock. Commonly called illegitimate, he suffers a disadvantageous position at law. Among the Romans, bastards were classified as *nothi*, children born in concubinage, and *spurii*, those not so born. Both classes had a right of succession to their mother, and the *nothi* were entitled to support from their father but had no rights of inheritance from him. Both, however, had in other respects most of the rights of citizenship. The Germanic law was based upon an entirely different principle. It recognized as legitimate only those whose parents were of the same social rank. All others were regarded as bastards and took the status of the parent of inferior rank. The aim of all the Germanic codes was to preserve purity of race, not to improve morals, for incestuous unions were not censured. The influence of the Germanic law lasted throughout the early feudal period, and bastards were debarred rights of inheritance.

In the 13th century the influence of Roman law tended to modify this severity. An exception was probably made for those whose fathers were of royal blood, in which case it seems that no stigma was attached to the accident of their birth, nor did they suffer from the usual disabilities as to inheritance which attended those of illegitimate birth. Among the Franks, Theodoric I, a natural son of Clovis, shared the kingdom with the legitimate sons; Zwentibold, natural son of Arnulf, was created king of Lorraine by his father in 895; and William the Conqueror actually assumed the appellation of bastard.

England.—Under the common law of England a bastard was regarded as *filius nullius*, "son of no one," or *filius populi*, "son of the people," and the rights and duties appertaining to the parent-child relationship had no application to him. Yet, from early days in England the bastard was treated as a free man, whatever his parents' status, and he could acquire property and gain a surname by reputation. The practical import of illegitimacy related mainly to restrictions on inheritance of property.

Until the 16th century in England the maintenance of an illegitimate child was assumed by the parish in which he was born. The first effort to shift the burden was an act of 1576 which imposed obligations of support on the mother and putative father and called for imprisonment in default of payment. Re-enacted in the Poor law of 1601, the provision had extensive influence in the United States as well as in England. The sole purpose of the original legislation was to relieve the parish, but by 1844 the mother had an independent civil remedy against the putative father.

In mid-20th century England the support of an illegitimate child is primarily the mother's duty; she is usually the child's legal custodian. By statute she and the child have the right of intestate inheritance from each other, and the relationship resembles that of mother and legitimate child. The legal ties between child and putative father are few. He has a conditional right to custody and limited responsibility for the child's support. Contributions for its maintenance may be compelled on the basis of an enforceable agreement between the parents or a judgment in affiliation proceedings. To succeed in an affiliation proceeding the mother must meet certain crucial conditions: she must be unmarried, widowed or living separate from her husband; she must usually apply for an order within 12 months of the date of the child's birth; and she must introduce evidence corroborating her testimony on paternity. Support is limited to 30s. weekly, payable until the child is 16, or until 21 if needed for education and training. The putative father may also be required to contribute to maintenance of a child for whom the National Assistance board or a local authority is providing financial assistance.

United States.—With the exception of Connecticut the American colonies followed the common law on illegitimacy. Over the years the out-of-wedlock child's position, though improved, has remained inferior to the legitimate's. As in England, the mother is legal custodian. Mother and child may inherit from each other, and in a growing number of states the child may inherit from the mother's collateral, as well as lineal, ancestors and descendants. In the absence of acknowledgment of paternity or intermarriage of the parents, statutes do not usually permit intestate inheritance from the father. The states differ in answering the question whether the putative father has a custody claim superior to that of other relatives or interested parties in cases where the mother is unable to care for the child. In the state of Arizona, however, the law declares any child to be the legitimate child of its parents, whether married or not, with full rights of support and inheritance.

Legislation concerning support of illegitimate children still bears the imprint of the Elizabethan Poor law. Although state laws may afford several remedies for the support of these children, affiliation or "bastardy" proceedings are most commonly employed. These retain the traditional characteristics of proceedings quasi-criminal in nature; suit must be instituted within a limited time following the child's birth, and the terms of support are often less favourable than those applicable to legitimate children with respect to duration of the obligation and amount of support. A few states are notable for their protective approach to illegitimacy. In Minnesota, for example, the law provides that upon adjudication of paternity the father is subject to all the obligations for the care, education and maintenance of the child and to all the penalties for failure to discharge these obligations which would be imposed upon him were the child his legitimate offspring. The Minnesota statute further provides extensive administrative aids in enforcement of this law through state and county public-welfare machinery.

The widespread use of short-form birth certificates has eliminated one sore distinction between legitimate and illegitimate children. The tendency of modern legislation has been to enlarge the illegitimate child's rights and to impose upon the states a definite obligation to assist in their enforcement.

Continental Europe.—In certain European countries legislation on illegitimacy is integrated in the body of child-welfare laws. Norway led the way; the Castberg law of 1915 placed the illegitimate child on virtually the same basis as the legitimate. Swedish law requires appointment of a child-welfare officer in every case of illegitimate birth, and an illegitimate child whose parents have been formally betrothed may inherit from its father and bear his name. In Germany illegitimate births must be reported to the child-welfare board; it has legal responsibility for protecting the child and may supervise its care by the mother or arrange for its placement. In the Soviet Union the burden of support, which was placed upon the putative father by laws enacted prior to 1944, has been shifted to the state with respect to all out-of-wedlock children born since that time.

Experience on the continents of North America and Europe demonstrates that the most advantageous time to provide help for mother and child lies within the days immediately following birth. Thus discovery of cases of illegitimate birth is an indispensable prerequisite to the state's proper discharge of its responsibility.

See also LEGITIMACY; for the sociological aspects and statistics of illegitimacy, *see* ILLEGITIMACY.

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(M. K. R.)

BASTARNAE, a large tribe which in Hellenistic and Roman times was settled in Europe east of the Carpathian mountains (Alpes Bastarnicae) from the upper valley of the Dniester to the Danube delta. The name Peucini, sometimes applied to the tribe, belonged properly to a section of it living on the Peuke Island formed by the southernmost Danube mouths. According to Pliny the Bastarnae constituted one-fifth of the German race, and their Germanic origin was accepted by Tacitus and is confirmed by

archaeology and by headdresses represented on Trajan's column. The Bastarnae were used by the Macedonian kings Philip V and Perseus against their Thracian enemies and later by Mithradates of Pontus against the Romans. Subdued decisively by the Roman general M. Licinius Crassus in 29 B.C., they gave little trouble for the next two centuries. In the 3rd century A.D. they joined other tribes in raiding Roman territory and were transplanted south of the Danube by the Roman emperor Probus (A.D. 279–280).

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BASTI, a town and district in the Gorakhpur revenue division of Uttar Pradesh, India. The town, headquarters of the district, is on the Kuana river 38 mi. W. of Gorakhpur. Pop. (1951 census) 33,203. The town has three sections: (1) Old Basti, an elongated settlement extending east-west between the provincial road and the railway; (2) Pukka Bazar, a later suburb of official and professional residences, a mile to the southwest along the provincial road, and (3) the "civil station," an administrative quarter, on a higher site over the Kuana, half a mile west of Pukka Bazar. Basti is the seat of a college of Gorakhpur university. It is on the Delhi-Muzaffarpur national highway and the Northeastern railway between Lucknow and Gorakhpur. Agricultural produce from the district is exported through the town, and textiles, salt and building stone are imported for local use. Local manufactures are hand-loom cloths and wooden, earthen and glass articles.

Basti remained little more than a village until it was made the headquarters of the Basti district in 1865. Its growth as an administrative and commercial centre is shown by the population increase from about 5,000 in 1872 to more than 45,000 (1959 est.).

BASTI DISTRICT is part of the Saryupar plain, extending northward from the Gogra river. Pop. (1961) 2,621,937. Area 2,821 sq.mi. It is drained southeastward mainly by the Gogra tributaries Rapti, Kuana and Ami. From south to north it comprises three physiographical zones: the *tarhar* or plainland, often flooded during the rains; the *uparhar* or upland; and the *tarai* (*q.v.*). Drainage is defective causing swamps and jheels or marshy meres; of these Lake Chanda in the southwest and Lake Badhanchh in the east are quite extensive. There is some tube-well irrigation; the main crops are rice, barley, wheat, sugar cane, oilseeds and pulses. There are several sugar-processing factories. Considerable transit trade is carried on with Nepal. (R. L. SI.)

BASTIA, the biggest town in Corsica, the former capital of the island and still the military headquarters, lies on the east coast, 22 mi. S. of the tip of the Cap Corse peninsula, the northernmost point of the island. It is close to the mainland of Italy (117 km. or 72.6 mi. from Leghorn) and is an outlet for the fertile north valleys of Corsica. Pop. (1954) 42,729. Of the two very different parts of the town the older (*Terra Vecchia*), in the centre, is dominated by a Genoese keep, or *bastiglia*, which was built in 1383 and gives the town its name; an old fishing village and the old harbour are located there. The harbour is enclosed by the upper town (*Terra Nuova*) on the south and the modern town on the west and north, where the chief hotels and the railway station are situated. Farther to the south the densely populated old town is a network of alleys connected by dark, vaulted passages overlooked by the church of S. Giovanni Battista, with its classical façade, which is floridly decorated, as are the law court, the theatre and the *hôtel de ville*. Cap Corse is celebrated for its sweet wines; there are flourishing lime fruit trees and olives and some antimony mines near by. In Bastia itself cigarettes, cigars, *pâtés* and preserves are made. Exports include wine, timber, fish, chestnuts, tannin, early vegetables and fruits, crustaceans and asbestos.

Bastia was one of the first Corsican towns to welcome the union with France but, because of the strong Roman Catholic feeling of the inhabitants, it opposed the anticlericalism of the Revolution. The town was taken by the English in 1745 and again in 1794, was occupied by the Germans in 1942 and was heavily bombed in 1943. The damage has been repaired. From the Place St. Nicolas there is a fine view of the islands of Elba, Monte Cristo and Capraia. Vescovato, *c.* 20 km. (12 mi.) S., is the birthplace of the French naval hero Louis de Casabianca who with his 10-year-old son was immortalized by Felicia Dorothea Hemans in her poem about the Battle of the Nile beginning, "The boy stood on the burning deck."

BASTIAN, ADOLF (1826–1905), German ethnologist and traveler, was born June 26, 1826, in Bremen. After receiving a medical degree in 1850, he undertook the first of many journeys around the world as a ship's surgeon. After five years spent in the far east he began publication of his work on the peoples of eastern Asia. He made other trips to Africa, South America and India and published a long series of papers on Buddhism and on the psychological aspects of native superstitions. Bastian's observations were keen but unsystematized, and his influence was limited to his own day. He favoured independent invention rather than diffusion as an explanation of similar customs. When not on one of his journeys abroad, he lived in Berlin, where he was professor of ethnology at the university and curator of the museum, to which he contributed a notable collection. He also edited the *Zeitschrift für Ethnologie* from 1869, in conjunction with the pathologist, R. Virchow, and Robert von Hartmann. He died Feb. 2, 1905, in Port of Spain, Trinidad. Bastian's more important works were: *Der Mensch in der Geschichte* ("Man in History," 1860); *Die Völker des östlichen Asien*, 6 vol. (1866–71); *Ethnologische Forschungen* (1871–73); *Die Kulturländer des alten Amerika* (1878–79); *Der Buddhismus in seiner Psychologie* (1881).

For an appraisal of his work, *see* R. H. Lowie, *The History of Ethnological Theory* (1937).

BASTIAT, (CLAUDE) FRÉDÉRIC (1801–1850), French economist, was born June 29, 1801, at Mugron, near Bayonne. He became a lucid expositor of the policy implications of classical economics and was at his best in exposing the fallacies of protectionism. For example, in a well-known satirical parable he formulated a petition of the candlemakers for protection against the sun, suggesting how much the candlemakers and related industries could profit if only the sun were eliminated as a competitor in furnishing light (see *Sophismes économiques*, Eng. trans., 1922). Bastiat carried on vigorous propaganda for free trade and was the dominant personality in a short-lived French free-trade association.

During the revolutionary years 1848–49 Bastiat wrote effectively against the rising wave of socialism, which he attempted to identify with protectionism. The appeal of Bastiat's popularized economic science was enhanced by an extreme optimism concerning the future material welfare of society. He served in the constituent assembly of 1849 and in the subsequent legislative assembly of the same year.

Toward the end of his life Bastiat attempted a treatise on political economy, *Les Harmonies économiques* (1850). He was, however, unequal to the rigorous task of making an original contribution to fundamental economic theory. His important role was that of a brilliant economic journalist. He died on Christmas Eve, 1850, in Italy, where he had gone because of poor health.

See *Oeuvres complètes* (various editions) for an interesting *Memoir* of Bastiat. The English translation of *Les Harmonies économiques* contains a sketch of his life and writings. (D. Dn.)

BASTIDE (Provençal BASTIDA), an old military word for the fortified towns founded in southwestern France, chiefly between the second half of the 12th century and the beginning of the Hundred Years' War. The founders were the monarchy, the feudal nobility and some abbeys. Bastides were built on a geometrical plan—rectangular, square, circular or lozenge-shaped—with streets running at right angles or parallel to one another and, in the middle, a large square with arcades. Their function was not only military but also political and economic, and they were therefore endowed with important charters of privileges in order to attract inhabitants. A good example is the existing bastide of Libourne, founded by the English seneschal Roger de Leyburn (1270). Other types of bastides are represented by Sauveterre-de-Guyenne, Monségur, Montauban and Mont-de-Marsan.

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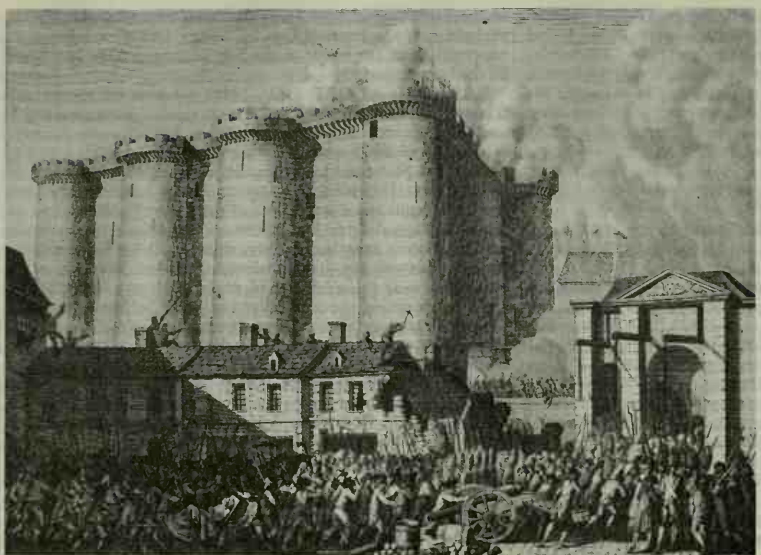

CULVER SERVICE

"TAKING THE BASTILLE, JULY 14, 1789," AN ENGRAVING AFTER A PAINTING BY PRIEURE IN THE LOUVRE MUSEUM, PARIS

1–2 (1950), and "La Frange orientale des bastides," *Annales du Midi,* no. 7–8 (1949); O. de Saint-Blanquat, "Comment se sont créées les bastides du sud-ouest de la France," *Annales: Economies, Sociétés, Civilisations,* no. 3 (1949). (R. Bo.)

BASTIEN-LEPAGE, JULES (1848–1884), French rustic genre painter and portraitist, was born of peasant stock in Damvillers, Meuse, Nov. 1, 1848. He was educated at Verdun, and in 1867 began studying under Alexandre Cabanel at the Ecole des Beaux-Arts, Paris. He first exhibited at the Salon of 1870 and after military service returned to Lorraine. He won a medal at the 1874 Salon for "Spring Song," which stylistically owes a little to Edouard Manet. "The Hayfield" (Luxembourg museum, Paris), popularly acclaimed at the 1878 Salon, follows in the tradition of J. F. Millet, and there is always an element of sentiment in his work alien to the Impressionists. "Joan of Arc listening to the Voices" (Metropolitan museum, New York) in which Joan is represented as a Lorraine peasant, typifies his subject pictures. Although not a pioneer of the *plein air* ("outdoor") school, he was much imitated in both France and England. His portraits include those of his biographer C. A. A. Theuriet, Henry Irving (National Portrait gallery, London) and Sarah Bernhardt (1879). He died in Paris, Dec. 10, 1884.

See C. A. A. Theuriet, *Bastien-Lepage* (1885; Eng. trans., 1892); Marie Bashkirtseff, *Journal Intime* (1890). (D. L. Fr.)

BASTILLE, a former fortress on the east side of Paris which became first a French state prison and then a place of detention for important persons charged with miscellaneous offenses. The storming of it by an armed mob of Parisians on July 14, 1789, owes its significance in the ideology of the French Revolution to the fact that the Bastille had become a symbol of despotism in the minds of those whom government policy had kept in ignorance of its real function.

With its eight towers 100 ft. high linked by walls of equal height and surrounded by a moat more than 80 ft. wide, the Bastille dominated Paris. The first stone was laid on April 22, 1370, on the orders of Charles V of France, who had it built as a *bastide* or fortification (the name Bastille is a corruption of *bastide*) to protect his wall around Paris against English attack. The Bastille, in fact, was originally a fortified gate, but Charles VI turned it into an independent stronghold by walling up the openings at the same time as the Porte Saint-Antoine was being built as a new gate a little way to the north. Finally its defensive system was completed on the eastern flank by the erection of a bastion in 1557, when Paris was threatened by the Spaniards after the battle of Saint-Quentin. Thenceforward entry into it was from the south side, between the two towers overlooking the Seine river. In the 17th century a transverse block was built, dividing the inner court into two unequal parts.

Cardinal Richelieu was the first to use the Bastille as a state prison; *i.e.*, as a prison for persons not guilty of common crimes or offenses but who had in some way endangered the security of the state, of the sovereign or of some group of citizens (sometimes even of a particular family). Whereas previously only persons of exalted rank in the kingdom had been appointed governors of the Bastille, Richelieu entrusted it to Charles Leclerc du Tremblay, a brother of the celebrated Father Joseph. The oldest known list of prisoners, 53 names of persons of every condition, belongs to the Richelieu period. From then onward the average yearly total of prisoners was about 40, interned on the king's orders, that is, by a *lettre de cachet* (*q.v.*): high-ranking foreigners, secret agents, journalists and political trouble-makers in general, but also gentlemen of vicious morals and young men held in restraint at the request of their own families.

Under Louis XIV a new class of prisoner came to be admitted; viz., sinister persons who were implicated in scandalous cases of witchcraft, poisoning or coining but whose trial was in the hands of regularly appointed judges. From being a state prison the Bastille thus became a place of judicial detention, in which the *lieutenant de police* (an officer first appointed in 1667, with his headquarters at the Châtelet) could hold prisoners. Under the regency of the duc d'Orléans, moreover, the practice began of detaining in the Bastille persons who were being tried by the *parlement.* Imprisonment by *lettre de cachet* remained, however, in force, and prohibited books, as in the case of the *Encyclopédie,* could also be placed in the Bastille. The treatment of the prisoners varied according to their status, but conditions were constantly improving. The cost of upkeep of the old building, however, was very high, and demolition was proposed in 1784.

There were only seven prisoners in the Bastille when the mob advanced on it on the morning of July 14, 1789—with the intention not of storming the Bastille but simply of asking the governor, the marquis de Launay (Bernard René Jourdan), to distribute the arms and munitions stored in it. Then enraged by his attitude and led by a determined band, the people forced their way in. Two days later, on July 16, the assembly of electors of Paris decided that the Bastille was to be razed to the ground. The task was entrusted to a master mason, "Patriot" P. F. Palloy, who had the idea of carving miniature Bastilles out of the stones and sending them to the municipalities. Demolition was expensive and was still incomplete in 1792. In 1840 a column was erected to the memory of the victims of the July revolution of 1830.

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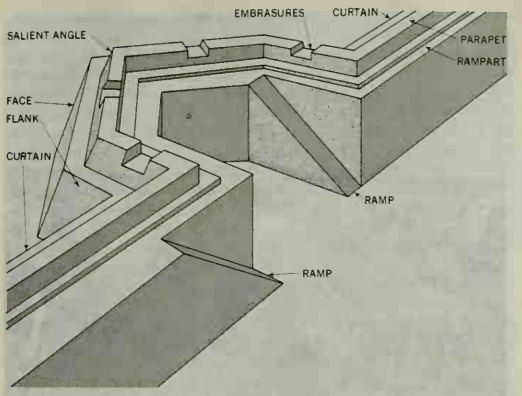
BASTION, an element of fortification that remained dominant



PLAN OF A TYPICAL BASTION

for about 300 years before becoming obsolete in the 19th century. A projecting work consisting of two flanks and two faces terminating in a salient angle, it was designed to permit defensive fire in front of neighbouring bastions and along the curtain connecting them.

Revolutionary changes took place in fortification (*q.v.*) during the 15th century after the fall of Constantinople in 1453 demonstrated that cannon could breach the stoutest masonry. Medieval walls and towers were gradually replaced by low, screened works as men dug into the earth for protection instead of building upward. Earth from the ditch was thrown up to form the rampart and parapet that provided cover for the musketeers and for the gunners of the artillery. And the bastion added to defensive firepower by eliminating the "dead space" just below the parapet.

The citadel at Antwerp, built in 1568 at the impressive cost of 1,400,000 florins, was for long Europe's most famous example of a fortification with a bastioned "trace," or general plan. By a historical coincidence, Antwerp took the lead three centuries later in the development of the "ring fortress" that replaced the bastion and similar works with detached underground strongholds protected by a crown of concrete. By 1889 the Belgian city was ringed by 24 such works, some of them at a distance of 12 mi., and the bastion had become a relic. (LN. MS.)

BASUTO: *see* SUTO.

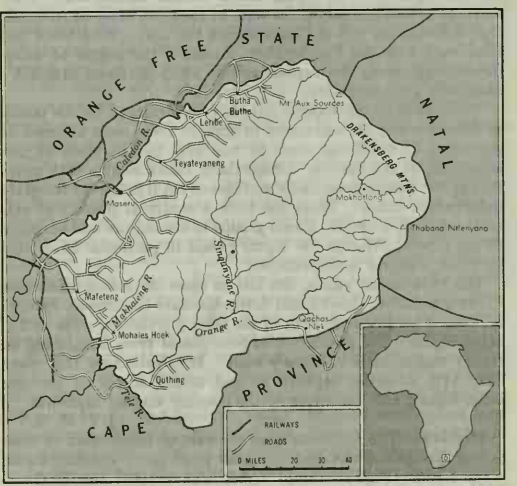
BASUTOLAND, a British colony, one of the three high commission territories in southern Africa, the other two being the protectorates of Swaziland and Bechuanaland. It is an enclave within the Republic of South Africa, but administered by Great Britain. Basutoland's independence is largely due to Moshesh who united scattered tribes to form the Basuto nation during the 19th century. Its area is 11,720 sq.mi. and it extends from latitude 28° 35′ to 30° 40′ S. and from longitude 27° to 29° 30′ E. Much of Basutoland is impoverished and heavily populated and its economy is entirely dependent on the export of agricultural products and labour, mainly to South Africa.

Physical Geography.—Basutoland consists mainly of the highest part of the great plateau of southern Africa. Nearly three-quarters of the country is between 6,000 and 11,000 ft. in height; this region is a highly dissected plateau of basaltic lavas overlying Stormberg rocks of the Karroo system, mainly shales and sandstones, which outcrop below about 6,500 ft. to the west and in the Orange River valley. These sedimentary rocks form the so-called lowlands and foothill regions of Basutoland.

The country can be divided into well-marked regions. The western lowlands form a long fringe, about a quarter the area of Basutoland, between the Caledon river and the Cave Sandstone foothills, and are situated at an altitude of about 5,000–6,000 ft. They consist of undulating basins and plains composed of softer sedimentaries with numerous, steepsided plateaus and conical hills of more resistant Cave Sandstone. The plateaus formed useful natural fortresses, the best known being Thaba Bosiu, which was Moshesh's headquarters (see *History* below). There are many caves and shelters at the base of the sandstone cliffs, used originally by the Bushmen (whose paintings can still be seen), while villages are now strung out along the slopes of the hills. Cultivation is carried on extensively in the basins and plains, the plateaus being reserved for grazing. The majority of the Basuto people live here, and the density of population is high, with more than 200 people per square mile in places. Most of the administrative centres are situated in the lowlands. Soil erosion is serious, particularly in the south, and this region has the highest proportion of migrant labour in Basutoland. A vigorous soil conservation campaign has been carried on for many years with considerable success.

The Cave Sandstone terrace is a long narrow zone between the highlands and the lowlands, with an average altitude of more than 6,000 ft. This region is one of the most productive in Basutoland and is better watered than the lowlands, with a more fertile soil and higher crop yields. The long barrier of the Maluti mountains, spurs of the main Drakensberg, over 10,000 ft. in places, marks the western edge of the highland region, a mature plateau deeply cut by river valleys and forming South Africa's main watershed. There rise the Orange river and its main tributaries, which drain west to the Atlantic and have cut the highlands into great blocks; and from there flow the Natal coastal rivers, such as the Tugela. Much of the eastern edge of the plateau is above 10,000 ft. high and descends in a spectacular escarpment thousands of feet to the terraces of Natal. The fingers of high plateaus above 8,000 ft. in height form the cattle post country; they are not permanently inhabited, except for herdboys, and are used as grazing for livestock. The deep valleys, such as the Senqunyane, have fertile soil, produce good crops and are well populated. The highlands are the most important economic region in Basutoland; large amounts of wool and mohair are produced; wheat and peas are the main crops. The long narrow subregion of the Upper Orange valley lies at a lower altitude, has less rainfall and more infertile soil and is more densely populated than the highlands. Maize (corn) and sorghum are the main crops as in the lowlands.

Climate.—Despite its subtropical latitude of about 30° S. the climate is equable with moderate annual temperatures due to the high altitude. Rainfall varies considerably in amount and seasonal periodicity. Three-quarters of Basutoland has more than 25 in. average annual rainfall, the highest totals occurring in the



ROADS, RAILWAYS AND PRINCIPAL PLACES OF BASUTOLAND. INSET SHOWS LOCATION OF THE PROTECTORATE IN AFRICA

highlands and the lowest in the western lowlands and Orange River valley. There is a marked summer maximum, with three-quarters of the total annual rainfall from October to April. Rainfall is generally convectional and associated with thunderstorms. Showers tend to be of short duration and heavy, sometimes over an inch falls in an hour. Hail often falls and may do much damage to crops. Snow may fall in considerable amounts at any time of the year in the mountains, while the lowlands occasionally have snow in winter. Mean annual temperatures are fairly low ranging from an average of about 45° F. for June and July to about 69°–70° F. for January in the lowlands, while it is estimated that in the highest part of the plateau the range of temperature is from about 10–60° F. Frosts occur widely in winter and occasionally during summer as well. The highlands usually have a growing season of less than six months.

Vegetation and Animal Life.—The vegetation of Basutoland consists mainly of temperate grasslands. Most of the country is treeless, except for the administrative and mission stations where willows, poplars and gums have been planted, and some of the warm sheltered valleys which have indigenous trees and shrubs. The highlands contain some of the finest natural grazing in southern Africa, particularly those areas with *Themeda triandra* or red grass. A bitter karroo bush, *Chrysocoma,* invaded large areas of highland which had been seriously overgrazed, but with controlled grazing this problem has been largely overcome.

A wide variety of wild life was once found in Basutoland, but it has been nearly all exterminated, except for a few small antelopes and hares. During the 19th century the Basuto traded otter and leopard skins, ostrich feathers and cranes wings with the Zulus for cattle, hoes, assegai blades, necklaces and copper rings.

(N. C. P.)

The People.—The people of Basutoland consist of a cluster of tribes which accept the authority of the paramount chief, the ruling member of the house of Moshesh (Moshoeshoe). Most of these tribes, collectively Basuto or Suto (*q.v.*), are of southern Sotho (*q.v.*) linguistic stock. Moshesh was originally the chief only of the Koena group (Molibeli, Monaheng, Hlakwana, Kxwakxwa and Fokeng tribes), which thus formed the nucleus of the nation. The nation absorbed members of other southern Sotho—but non-Koena—tribes, including the Phuting, Kxolokwe, Sia, Tlokwa, Taung and Rolong. There were also many Nguni-speaking tribes, some of which (Phetla and Phuthi) were original settlers in the area and others (Natal Nguni such as Tebele, Bhaca and Zulu and Cape Nguni such as Tembu) were offshoots of and fugitives from Nguni tribes outside Basutoland. They fled into Basutoland during the wars of 1818–30, between Africans, that followed the rise of Chaka among the Zulu. Both these and later wars with the *Voortrekkers* increased the degree of interdependence among the various groups which accepted Moshesh's leadership and protection.

The growth of the Basuto state has been marked by the policy of Moshesh and his successors to appoint their close kinsmen as governors of territorial areas to rule over groups often of different dialect and custom. Under them, chiefs include both members of the Basuto royal house and also of royal houses of formerly independent tribes. There has been a continual process of cultural adaptation by non-Koena groups to the culture and language of the Koena, although the Nguni groups in particular have tried to resist cultural amalgamation.

The 1936 census report, the last to show the ethnic affiliations of the population, showed that Sotho-speakers (commonly Sesuto) accounted for just over 85% of the total population, some 14.5% being Nguni. The proportion of men absent from Basutoland on labour migration is extremely high. It is estimated that more than 45% of males between 15 and 50 are absent at any one time, leaving half the wives of the country without husbands.

(J. F. M. M.)

History.—The Bushmen were the earliest inhabitants of what is now Basutoland but died out many years ago. The first Bantu were Nguni (Zulu-speaking) tribes who crossed the Drakensberg in the 18th century and settled along the banks of the Caledon river. Later they were joined by Sesuto-speaking tribes.

CONSTANCE STUART FROM BLACK STAR

BASUTOLAND GOAT-HERDER AND HIS FLOCK

They all lived at peace, disturbed only by intermittent cattle raids, until early in the 19th century, when that part of Africa was set in turmoil by the Zulu despot Chaka. Many tribes fled over the Drakensberg, pursued by his regiments, ravaging and plundering, until eventually the social fabric of the people was almost destroyed. Eventually a young chief, Moshesh, born about 1790, gathered the remnants of the tribes about him and, using impregnable mountain fortresses such as Thaba Bosiu as his bases, beat back the invaders.

No sooner was the Zulu menace from the east contained than the Basuto people had to face the Europeans who were trekking up from the south. With the unerring skill of a diplomat, Moshesh played off the rulers of the Boer states and the colonial government of the Cape Colony against each other. Moshesh welcomed missionaries and traders to Basutoland but with both he showed himself well able to hold his own. As tension increased between Basuto and Boers, who were passing through or settling in his country in increasing numbers, Moshesh's conviction grew that the only hope of "existence and peace" lay in British protection. He laboured incessantly to make this hope a reality. Protection was first granted in 1843. Then in 1848 British sovereignty was proclaimed over the Orange river country, and in 1849 the boundaries of Moshesh's territory were reduced. But in 1854 the British renounced sovereignty over the Boers north of the Orange, and Moshesh was left to battle on through repeated disappointments and almost continuous strife with his Bantu, Boer and British neighbours, until at last, in 1868, Basutoland was proclaimed British territory. The Boers, who had overrun practically the whole country up to the foothills, protested in vain against this interference and had to be content with a 30-mi. strip of "conquered territory" along the Caledon. Moshesh died two years later, happy that his people had at last become British subjects. The Basuto owe their existence as a nation to the genius of Moshesh who must be regarded as one of the dominating figures of South African history in the 19th century.

In 1871, without adequate consultation, Basutoland was annexed to the Cape Colony and a small administrative staff established. Then tactless attempts at direct rule, ignoring Basuto customs and loyalties, coupled with precipitate doubling of the hut tax, led to minor revolts and increasing restlessness. This finally flared into open revolt (the Gun War, 1880) when the government attempted to disarm the people. Peace was re-established in 1883, and the Cape Colony, weary of attempting to administer Basutoland, asked the British government to be relieved of the responsibility, while the Basuto chiefs for their part preferred British protection to the possibility of renewed encroachment from the Free State. In 1884 Basutoland became a crown colony. The new "governor's agent" was instructed

that "nothing more should be attempted at first than the protection of life and property and the maintenance of order on the border," and that the Basuto "were to be encouraged to establish internal self-government sufficient to suppress crimes and settle intertribal disputes." These instructions were faithfully obeyed. The chiefs were left to rule their people according to native law and custom, and the authority of Moshesh's senior son and of his son Lerotholi after him was supported. By 1898, after a few bloody affrays, Lerotholi enjoyed "undisputed supremacy." British control was peacefully accepted, and thenceforth (except for one incident during the South African War of 1899–1902) the Basuto remained loyal. Credit for this was due to the early resident commissioners, Sir Marshall Clarke (1884), Sir Godfrey Lagden (1893) and Sir Herbert Sloley (1902), and of Lerotholi, who was paramount chief from 1891 to 1905 during the difficult transitional period.

After 1884 the Basuto settled down rapidly and, with advice and help from missions and government, advanced in education and agriculture. But fears for their future were never entirely allayed. During the South African War, they were uneasily neutral. In 1906 the extension of the South African railway system to Maseru, indicative of the growing importance of the country's agriculture, trade and labour supplies, was strenuously opposed by the younger chiefs as a potential threat to their independence, although only one mile of the new line lay inside the border. These fears were revived again in 1909 by the unification of the four South African colonies and discussion about the transfer of the administration of the high commission territories, Basutoland, Bechuanaland Protectorate and Swaziland to the government of the new Union of South Africa. A deputation petitioned the king asking that the country should remain "outside (the Union) as far as possible, independent as it is now" and was reassured. Thereafter the matter remained quiescent until 1933, when informal discussions were opened between the Union and British governments. In 1935 an *aide-mémoire* recalled the pledges made by the British government both to the British parliament during the passage of the South Africa act (1909) and to the inhabitants of the territories, and recorded that the two governments now agreed that in the ensuing years their native policies "should be directed to bringing about a situation in which if transfer were to become a matter of practical politics it could be effected with the full acquiescence of the populations concerned." The Basuto determination to avoid incorporation was, however, strengthened at mid-20th century by the tide of African independence movements. Notwithstanding, South African prime ministers suggested that Basutoland was in more need of the Union than the Union was of Basutoland. In 1952 D. F. Malan spoke of the economic consequences of the Union treating Basutoland as a foreign state, while H. F. Verwoerd, in reviewing the proposed Basutoland constitutional changes (which probably put an end to the possibility of transfer; see *Administration and Social Conditions*, below) stated that the Union would not continue indefinitely to absorb the surplus inhabitants of the high commission territories. Assurances on future constitutional progress were given by British Prime Minister Harold Macmillan during his visit in Jan. 1960.

The uncertainty of the political future of Basutoland goes a long way to accounting for the *laissez-faire* policy which characterized the British administration in Basutoland in the 50 years that followed crown colony rule. Declining prices following the world-wide depression in the 1930s, accompanied as it was in Basutoland by a severe drought, forced the British government to pay greater attention to the territory's problems. A comprehensive financial and economic report of considerable consequence was drawn up by Sir Alan Pim. He referred to the government and native organization which worked practically independently of each other with no attempt being made "to combine them into a real system of government, or to make such modifications in the native system as would render it capable of dealing with the changing conditions of modern times and with the effects of the introduction of a money economy and of contact with European institutions." As a result of the Pim report some administrative reforms were initiated in 1938, and moneys were made available from the Colonial Development fund for soil conservation and agriculture.

The death of the paramount chief in 1940 gave rise to a series of disputes and aggravated conditions in a society that a report drafted for the Commonwealth Relations office (Cmd. 8209, H.M.S.O., 1951, the "Jones report") described as both "anachronistic and insecure." This feeling of insecurity found its most obvious expression in the intensification of Basuto belief in magical, supernatural aids usually referred to as "medicines." At least 133 cases of "medicine" murder, whose primary aim was to obtain human flesh for its supposed magical value, were recorded between 1940 and 1958. Yet the secondary causes, the Jones report suggested, were almost entirely political and stemmed from the rivalry and multiplication of chiefs and tribal authorities. (S. Tr.)

Population.—The 1956 census gives the African population of Basutoland as 638,857, an increase of 14.3% since 1946, of whom the great majority were Basuto. There were also 154,782 absentees in South Africa. Most Basuto are Christians because of sustained missionary activity. Europeans numbered 1,926 in 1956 comprising government officials, missionaries and traders, while there were 891 Asiatics and Eurafricans. The density of population decreases considerably from the lowlands to the highlands, the average density being 54.8 per square mile, while distribution is very uneven. The largest centre of population is Maseru (*q.v.*; pop. 5,739), the capital. (N. C. P.)

Administration and Social Conditions.—The territory is administered by a resident commissioner in Maseru, the capital, under the direction of the British high commissioner in whom the sole power to legislate reposed prior to 1960. An advisory body known as the Basutoland council was established in 1910 with the resident commissioner as president, the paramount chief as chief councilor, and 99 Basuto members. In Sept. 1955, following a resolution asking for legislative powers in all internal matters, the council set up two committees to formulate detailed proposals. Since then agreement has been reached with the British government with regard to constitutional changes for Basutoland. This constitution, which came into operation at the end of 1959, retains certain legislative and reserve powers for the high commissioner. A legislative council, called the Basutoland National council, was created. It has the power to legislate for all in Basutoland and the right to discuss those matters which remain in the high commissioner's legislative sphere. The council consists of 80 members of whom half are elected by the district councils. There is an executive council comprising four unofficial members and four official members, of whom one is the resident commissioner who presides and has both a deliberative and casting vote. There is a single voters' roll for Basuto and non-Basuto British subjects and British protected persons. The position of the paramount chief is specifically recognized in the new constitution and he will have the right to nominate 14 persons to the council.

The first modern political association was the *Lekhotla la Bafo* ("League of Commoners") which sought to end British influence in Basutoland. Later the Basutoland African congress became the major political organization urging self-government. With the impending elections this transformed itself into the Basutoland Congress party, while a new organization, the Basuto National party, also emerged. Both proclaim the right of the Basuto nation to rule themselves without constitutional limitations. There are two weekly and three monthly Sotho newspapers. Since 1951 there have been four registered trades unions.

For administrative and fiscal purposes the country is divided into nine districts under district commissioners—Maseru, Qachas Nek, Mokhotlong, Leribe, Butha Buthe, Teyateyaneng, Mafeteng, Mohales Hoek and Quthing. Under the 1959 constitution local government is in the hands of the district councils with the principal or ward chief as the titular presiding officer.

Justice.—Under the Native Courts proclamation Basuto courts are divided into two groups: those of class B (of which there are 47) function as courts of first instance; those of class A

(12) have first instance as well as appellate jurisdiction. In addition there are four higher Basuto courts of appeal which also have first instance as well as appellate jurisdiction; appeal from these is to the judicial commissioner's court. The Basuto courts deal with cases arising under Basuto law and custom, except (1) offences punishable by death or by life imprisonment; and (2) civil disputes where the amounts involved are more than £250 for B courts and more than £500 for A courts. They may also deal with laws over which the high commissioner may give them jurisdiction. The Basutoland judiciary is headed by a chief justice. Under him there are the judicial commissioner, registrar of the high court, magistrates, and the various presiding officers of the subordinate courts—that is, administrative officers in their judicial capacity. In addition, a puisne judge was appointed. The Basutoland police establishment consisted of about 12 European officers and more than 400 African subordinate officers and men. There were 10 jails.

Finance.—In 1946 a Basuto national treasury was established. Its main revenues are court fines and the proceeds of the sale of unclaimed stray stock. From these moneys chiefs' salaries and the expenses of local government are paid.

The government budget in the early 1960s allowed for an expenditure of just under £2,000,000 annually. The chief heads of expenditure were education, police and prisons, medical, native administration plus district administration. Colonial development and welfare grants accounted for about 10% of the total expenditure.

The main sources of ordinary revenue are customs and excise, local tax, income tax, and wool and mohair export duty. Basutoland currency is the same as in South Africa.

Medical Services.—Basutoland is not a tropical country and tropical diseases do not present serious problems. The principal diseases in the territory are venereal disease, chronic rheumatism, malnutrition, infections of the respiratory tract and dyspepsia. The heaviest toll of lives in children is due to tuberculosis, malnutrition, diphtheria, whooping cough and gastroenteritis. The incidence of nutritional and deficiency diseases is comparatively high and is allied to a staple diet of maize. There are a number of government and subsidized mission hospitals, child welfare centres, venereal disease clinics and health centres, including the mountain dispensaries. Mass diphtheria, whooping cough (with the assistance of UNICEF) and smallpox immunizations have taken place. WHO has co-operated in nutritional and tuberculosis surveys.

Education.—Basutoland has a higher proportion of the African population attending school than any country in Africa. This is possible because a substantial part of public funds is allocated to education, and because the missions bear the entire or partial cost of more than 90% of the schools. In the early 1960s there were more than 1,000 schools and institutions in the territory; only about 1% were not under mission control, and approximately 18% were unaided. The first schools were started by the Paris Evangelical Missionary society shortly after its arrival in Basutoland in 1833. The Roman Catholic mission founded its first school in 1864 and the Anglican Church mission followed in 1870. From 1871 onward the administration of Basutoland began to give financial support to the mission schools, and a government high school was established in Maseru in 1939. There were in the early 1960s about 20 secondary schools, several teachers' training centres, the Lerotholi technical school and other technical training centres, but these have not been eagerly attended by the Basuto. In 1945 the paramount chief alienated land for the Pius XII college where there are faculties of arts, science, commerce and education. The college caters mainly to the education of African Catholics. A number of Sotho are studying in South Africa and in the United Kingdom on government bursaries.

The Economy.—Basutoland has no industries and its internal economy rests on a peasant agriculture. Land is theoretically common property, administered in trust for the people by the paramount chief through the hierarchy of chiefs, subchiefs and headmen. Arable land is allocated as far as possible to each household (average four persons) but thousands of households remain without land holdings. The system of land tenure "does not permit of real development or of much improvement, either in crop production or in agricultural methods" (Colonial reports, *Basutoland*, 1957). Soil erosion and primitive farming have decreased the area of arable land to 12.4% (930,000 ac.) of the total land area. The population was estimated to reach 1,000,000 by 1963. Soil conservation is of vital importance, and as a result of a campaign launched in 1936, following the Pim report, most of the territory's arable land is now protected. Much has been done to encourage improved farming methods. A pilot project to demonstrate mixed farming on a co-operative basis has been undertaken in the 62-sq.mi. Tebetebeng valley. A slow but steady improvement in farming practice and living conditions is claimed for the scheme.

BY COURTESY OF SOUTH AFRICAN TOURIST CORP.

LARGE HAND-WOVEN BASKETS IN BASUTOLAND WHICH ARE USED FOR STORING GRAIN

The principal crops are maize, sorghum, beans and winter wheat in the lowlands, and maize, spring wheat, peas and barley, with some sorghum in the valley, in the highlands. The villages are encouraged to grow vegetables. In 1936 there were more than 800 vegetable gardens under the supervision of field demonstrators. By the early 1960s there were about 30,000 such gardens. Livestock numbered more than 360,000 cattle, 80,000 horses, 3,500 mules, 49,000 donkeys, 1,200,000 sheep and 500,000 goats. Very little livestock are kept in the lowlands except where tablelands have been reserved for grazing, and are mostly kept at mountain cattle posts practically the year round. Bovine and equine improvement is taking place.

Most of the retail trade in the territory is conducted by Europeans, there being, however, a few Indian traders in the northern districts. Europeans and Indians will not be granted further licences to establish new trading stations, as an increasing number of Sotho have engaged in trading activities since World War II. Approximately 2,700 Sotho hold trading licences of one sort or another, principally for bakeries, cafés, livestock trading, milling, general trading (subject to certain restrictions) and road transport. Another feature of postwar commercial activity has been the development, particularly in the field of wool and mohair marketing, of co-operative societies, which buy, grade and market produce. Basutoland has to import all the consumer and capital items it needs (principally foodstuffs, clothing, blankets and tin ware) as well as a certain amount of agricultural commodities (*e.g.*, plows) and livestock, the main exports being wool and mohair followed by wheat, sorghum and cattle. The value of imports usually exceeds the value of exports, often by a considerable figure, but the adverse balance is offset by the export of labour to the mines, industries and farms of South Africa resulting in a flow of income to Basutoland in the form of remittances to relatives, deferred wages paid locally, savings brought back from South Africa and payments to recruiting agents in the territory. The number of Sotho working in South Africa is not fully known. In 1958, 93,695 passes for South

Africa were issued to workers for the mines, agriculture and other work; this, however, was an emigration figure and is not an exact measure of migrant workers in that country. The Basutoland Co-operative Banking union was formed in Dec. 1957; it is a multipurpose organization which embraces banking, advances to co-operative societies, production and marketing. The possibility of mineral deposits in Basutoland is remote; there is, however, a diamond prospect on the Kau river.

Communications.—The territory is linked with the railway system of South Africa by a short line from Maseru to Marseilles on the Bloemfontein-Natal main line. The main road system totaling approximately 560 mi. is principally confined to the western lowlands. From Maseru a main road extends to the north to Butha Buthe and to the south to Quthing, with several short branch main roads eastward to the foothills of the mountains and a few westward to join South Africa's road system. Progress has been made in the building of a main road from Maseru into the mountainous area to the east. Qachas Nek on the southeastern border is connected by a main road with South Africa. Main roads are maintained by the public works department but the standard is generally low, the roads in many cases following the line of the original sunken wagon tracks formed by early missionaries and traders. Motor services of the South African railways operate between the government stations of Butha Buthe, Mohales Hoek and Quthing and the railroads in the Orange Free State. There are approximately 1,600 mi. of bridle paths in the territory, which are now constructed and maintained by the administration. The territory's main air strips, which can be used only by light planes but are being improved, are at Maseru, Mokhotlong, Sehonghong, Semonkong, and Qachas Nek, although there are others, used principally by traders, for transporting merchandise to their stores. Air transport includes regular mail services. A telegraph system covers much the same area as the main roads and a government radio links Maseru to Mokhotlong and Qachas Nek. (S. Tr.)

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BAT, the common name for flying mammals belonging to the order Chiroptera (from the Greek meaning "hand wings"). The general body form is similar to that of other small mammals such as mice or shrews. For instance, the skin is covered by fine fur; the mouth is equipped with teeth; a four-chambered heart pumps blood separately to the lungs and to the rest of the body; and mother bats have mammary glands to nurse their young. Most bats feed on insects, and the teeth, the skeleton, and the proportions of the brain show bats to be more closely related to mammals of the order Insectivora (shrews, moles and their relatives) than to those of the order Rodentia (gnawing mammals, mice, rats, squirrels, etc.). In fact, bats differ from shrews principally in having modifications for flight. These modifications include not only the wings and associated membranes that are usually attached to the hind legs and tail, but also the relatively large breast muscles that operate the wings, special modifications of the hind feet for clinging, and sensory adaptations for flying in the dark.

Even more than other small mammals, bats restrict their activities to twilight and nighttime. They are perhaps the only vertebrate animals that commonly live in the deeper and totally dark parts of caves, where they hang upside down. The hind feet are modified for clinging; usually the toes bend inward or ventrally, and the claws are so sharply curved that once a bat is hanging from a twig or the rough surface of a rock no further muscular contraction is required and it hangs securely in deep sleep, hibernation, or even after death.

BY COURTESY OF DON DAVIS

FIG. 1.—ROUSETTE FRUIT BATS (ROUSETTUS LEACHI) HANGING FROM CEILING OF A CAVE

Bats, in their mythological and artistic role, are famous as symbols of darkness and eerie mystery, and they are known by many people as haunters of churchyards and tombs or as squalid invaders of attics. In European and many other cultures bats are coupled with the nether regions; demons are pictured with the wings of bats, while feathered wings adorn the angels. Bats are victims of many more mundane superstitions, such as the belief that they tangle themselves in women's hair. While this may have happened on rare occasions, probably with a weak or semitorpid bat (*see* below under *Body Temperature and Hibernation*), a bat in normal possession of its faculties can easily avoid collision with a person. In Chinese and other far eastern cultures the bat is a symbol of good fortune, happiness and longevity. Stylized representations of bats are found in designs in oriental jade, china, metalwork and paintings. Two bats sketched on a Chinese greeting card that accompanied a gift symbolized the good wishes of the giver.

ORIGIN AND RELATIONSHIPS OF BATS

Bats, birds and insects are the only animals that can sustain themselves in the air for extended periods; of these only the bats are entirely a flying group. There are no bats that cannot fly, and many species are quite clumsy on the ground. Bats evolved the power of flight quite independently of the birds—and long after the appearance of the first flying insects. While the oldest fossil birds date from sometime during the Jurassic period (extending roughly from 130,000,000 to 160,000,000 years ago), the earliest bat fossils are from the early part of the Eocene, about 60,000,000 years ago. The shorter geological history of bats, being less than half as long as that of birds, accounts in some measure for the fact that bats are closer, anatomically speaking, to their nonflying ancestors than are birds. Birds evolved feathers, a unique and radical departure from the scaly skins of the reptilelike ancestors of both birds and mammals; feathers serve as insulation and provide aerodynamically efficient contours for wings and body.

Bats, on the other hand, have a body covering like that of other mammals; their wings, likened to exaggerated webbed feet, are composed of a thin layer of skin stretched between spars formed from extremely thin and elongated finger bones. The "thumb," however, is not involved in the wing, and usually bears a small claw useful for clinging.

Internally, too, zoologists have found the structure of birds to be more highly specialized for flight. For example, most of a bird's bones are penetrated by air spaces connected to the larger air sacs and lungs; bat bones, however, are of the same basic structure as those of other mammals.

It is possible that bats, from their evolutionary beginnings, have been auditory animals which listened in the darkness even when they were tree-climbing forms that jumped and glided before their descendants took to the air. Birds on the other hand may well have evolved from ancestors that used their eyes far more than their ears.

DONALD R. GRIFFIN, "LISTENING IN THE DARK," © YALE UNIVERSITY PRESS

FIG. 2.—AMERICAN LEAF-NOSED BAT (PHYLLOSTOMUS)

According to this interpretation the Megachiroptera (see *Classification* below) have deviated from the ancestral pattern. While this hypothesis has not been accepted by all students of mammalian evolution, it is supported by the fact that the oldest known fossil bats are typical Microchiroptera with relatively large auditory portions of the brain.

NATURAL HISTORY

For millions of years bats have been accustomed to roost by day in caves, crevices among rocks, hollow trees, cracks behind loose bark and similar natural hiding places. They do not construct nests nor do they dig or gnaw out holes as shelters. The only exception is one species (*Uroderma bilobatum*) belonging to the family Phyllostomidae—the leaf-nosed bats of the American tropics which feed largely on fruit. These bats cut the central vein of large palm leaves so that the leaf bends down to form a tentlike shelter under which the bats roost singly or in small groups.

When men began to build houses and other types of buildings, and to dig artificial tunnels as mines and tombs, bats began to use these retreats as substitutes for natural hiding places. This habit becomes particularly conspicuous in the many species that tend to be colonial. The females of many species congregate in early summer in roosting places that they find suitable as nursery colonies. There the young are born and cared for until they are well grown, and few if any adult males are present. Toward the end of summer these colonies are gradually deserted. (See *Annoyance* below for a discussion of bats in buildings.)

Body Temperature and Hibernation.—Bats differ from most other mammals in the ease and rapidity with which their body temperature and metabolism fluctuate. This is especially pronounced in colder climates, although even tropical bats show similar tendencies. When fully awake and active, bats have body temperatures between 100° and 105° F., and this is the case whether they are flying in cold winter air or in the stifling heat of an attic on a sunny day in summer. Under these conditions of wakefulness and activity bats regulate their body temperature just as other mammals do. The large surface area of the wing membranes greatly facilitates heat loss; when the blood vessels in the wings are dilated, a relatively large amount of blood flows out from the body and back again. In the cold these blood vessels are constricted, allowing the wing membranes themselves to cool almost to the air temperature but conserving the heat of the body as a whole.

When bats are at rest, however, the body temperature often falls rapidly to that of the air around them, and when they sleep this seems always to occur. Thus in summer a resting bat may have a body temperature of 80° or even 90°, but the same bat resting in the same spot on a cold day may allow its body to cool as low as 35° or 40° if the air temperature falls that low. The responsiveness and activity of the animal is roughly proportional to the body temperature, and bats cannot fly with normal strength or agility unless their tissues are warmer than about 80° F. On colder days they must warm themselves to this level before they can fly at all. Their heart rate, respiration, food utilization and bodily energy consumption (usually measured by the rate of intake of oxygen) all fall rapidly with lowered body temperature. This is why bats are often found in various degrees of lethargy and often fail to respond vigorously or to fly off for some minutes after they are first disturbed.

The bats of northern climates are mainly insectivorous, and during the lean winter months many species of them hibernate. Usually they lay on fat in the late summer and early fall, and they may reach double their minimum body weight of the previous spring. In the fall they seek out hiding places where they can pass the winter relatively undisturbed at a lowered body temperature and a greatly reduced metabolic rate. This in turn enables them to survive all winter on their stores of body fat. Such hibernation is apparently an adaptation for tiding themselves over the colder months when their insect food is not available in adequate quantity. An alternative solution adopted by some species is to migrate south to warmer climates, as many birds do (*see* below). Even these migratory bats undergo on cold days varying degrees of torpor that merge indistinguishably into hibernation.

One danger facing a hibernating mammal is that its winter retreat may fall below the freezing point of the water in its tissues, and this is usually fatal if prolonged more than a few hours or days. Bats sometimes increase their metabolic heat production at body temperatures within a degree or two of freezing and thus generate a small but sufficient amount of extra heat to tide them over brief cold spells. In other cases they respond by waking up completely and moving to other, more sheltered roosting places. In many cases bats move several times during the winter, seeking out retreats that are close to but not actually at freezing temperatures in order to conserve their stores of body fat.

Longevity.—Bats are unusually long-lived for animals of their size. This longevity is associated with the large proportion of their life spent in hibernation or varying degrees of lethargy and with lowered body temperature. It is a general rule that the smaller a bird or mammal the shorter the average life span of the species. Mice and shrews seldom live more than one year, and three or four years is an unusually long life span even for a pampered laboratory rat or mouse. But many small ($\frac{1}{4}$ oz.) insectivorous bats, which had been marked with numbered bands to study their migrations and homing (*see* below), have been recaptured as long as 10–15 years after banding. Occasionally such bats have been recovered after 21 years. Larger fruit bats (Megachiroptera) have lived up to 19 years in captivity.

Breeding Habits.—Bats reproduce like other mammals in all basic respects. The male introduces sperm into the female reproductive tract by copulation and the developing embryo implants itself in the wall of the uterus. As the embryo grows the maternal tissue forms a placenta to nourish the embryo by bringing an abundant supply of the mother's and the embryo's blood into close proximity across a very thin and permeable membrane.

Most bats have only one young at a time, and reproduce only once a year, but there are a few exceptions. Females of the American red bat (*Lasiurus borealis*) have been found carrying three or even four newborn young whose combined weight exceeded that of their mother. At birth the young are poorly developed except for the claws. The milk teeth are also specialized for holding on tightly to the mother's fur or nipple (fig. 3).

JOHN N. GERARD FROM NATIONAL AUDUBON SOCIETY

FIG. 3.—AMERICAN RED BAT (LASIURUS BOREALIS) NURSING TWO YOUNG

Baby bats are usually carried only for the first few nights, and after that are left in the daytime roost. Some observations indicate that mother bats occasionally nurse young other than their own and that nursing may to some extent be communal. The young develop rapidly; little brown bats (*Myotis*) fly before they are a month old. Nothing is known about how they learn to catch flying insects.

LYNWOOD M. CHACE FROM NATIONAL AUDUBON SOCIETY

FIG. 4.—LITTLE BROWN BAT (MYOTIS LUCIFUGUS) RESTING ON BRACKET FUNGUS

The bats that hibernate in the winter have a specialized feature of reproduction that is unique among mammals, although there are similar cases among reptiles and insects. The sperm often survive for some months in the female reproductive tract before their union with an ovum, or egg cell, occurs and fertilization is actually accomplished. This is especially likely to occur over the winter, when the females are spending most of their time in hibernation, for during this period the ova have not yet matured and been released from the ovary into the uterus; this latter process (ovulation) ordinarily occurs shortly after the final awakening from hibernation. While mating may occur during the fall, winter or spring, the sperm stored from fall and winter matings assure that all or almost all the females in reproductive conditions will become pregnant.

Migration.—Some bats that live in colder climates migrate to warmer regions in search of insect food during the winter, and even those that hibernate in caves may be obliged to fly many miles from their summer range to find suitable places for hibernation. The occurrence of migrations was suspected long ago because of seasonal fluctuations in bat populations and the finding of bats during the fall on ships as far as 500 mi. from land and around lighthouses or radio towers during nights when large numbers of migrating birds collide with these obstructions.

Many of the thousands of bats marked with numbered metal bands have been retaken after migratory flights of as long as 800 mi. Little brown bats (*Myotis*) have been retaken in caves up to 168 mi. from their summer roosts; a bat banded at Dresden, Ger., during the winter was caught again the following summer in Lithuania, 475 mi. to the north; and a free-tailed bat banded at Carlsbad caverns, New Mexico, was taken near Jalisco, Mex., 810 mi. to the south. Nothing is yet known about the methods of navigation employed by bats during these long migratory flights.

Homing Ability.—Coupled with the ability to perform long migrations are impressive powers of homing. If banded and carried to some distance before being set free, many bats succeed in finding their way home. In some such experiments a few little brown bats have returned so rapidly that they must have flown directly home from as far as 60 mi. during a single night. In other experiments bats have homed from as far as 180 mi., but these extreme cases may not be typical. The vision of these small insectivorous bats is known to be quite poor, and in certain experiments blindfolded bats homed from several miles in a single night; hence vision is not required for long-distance navigation.

Orientation.—Bats are almost completely nocturnal, and while many are active in the twilight of evening or early morning, only one or two species occasionally hunt by day. Even the fruit-eating Megachiroptera, which have prominent eyes, are nevertheless nocturnal animals. Furthermore most of the Microchiroptera are able to fly successfully into the totally dark reaches of underground caverns, and many species do so habitually—either using caves as daytime roosts or as places of hibernation. Flight in total darkness requires some means of avoiding collisions with all sorts of obstacles such as stalactites of caves or branches of trees. Many of the insectivorous Microchiroptera catch insects in the dark, usually flying insects that must be individually located and pursued.

The blind-flying abilities of bats were first studied by Lazzaro Spallanzani (1729-1799), one of the outstanding natural scientists of the 18th century. Thinking at first that bats could see in what to us would be darkness, he was forced by the results of his experiments (1793) to conclude that they did not need their eyes at all. He even surgically removed the eyeballs from several bats in order to be certain that some residual vision did not explain their continuing skill at avoiding small threads and their rapid and accurate selection of suitable landing places. A Swiss physician and zoologist, Charles Jurine, repeated Spallanzani's experiments and found that if the ear canals were tightly plugged, a bat became disoriented and helpless.

Spallanzani extended these experiments in many ways, eliminating all sense organs other than the ear, and convinced himself that hearing took the place of vision in guiding flying bats through darkness. These experiments, however, were largely forgotten until the 20th century, when biologists, using electronic instruments, discovered that bats orient themselves by emitting high-frequency orientation sounds and receiving the echoes as they bounce off objects. While these sounds have a very weak low-frequency component that can sometimes be heard under quiet conditions as a faint ticking, the great bulk of the acoustic energy lies in a frequency range above that to which human ears are sensitive. Interference either with the emission of these high-frequency sounds (by covering the mouth or, in some bats, the nostrils) or with hearing produce equally drastic disorientation. Bats have been using the equivalent of "sonar" for millions of years. This natural sonar is useful not only for simple flight patterns but also for the maneuverings needed in flying through tortuous caves and for catching flying insects.

The orientation sounds consist of short clicks, or sound pulses, lasting from 0.0002 to 0.1 second in various species under varying conditions. Since sound travels through air at a speed of about 1.2 ft. in 1,000th of a second (or 1.2 ft. per millisecond), bats' sonar pulses extend over distances of a few inches to about 100 ft. Most kinds of bats use pulses that last only a few milliseconds and that are effective to a distance of only a few feet. The horseshoe bats (family Rhinolophidae), however, employ pulses lasting as long as $\frac{1}{10}$ of a second. The short pulses of all other bats produce echoes that return from objects located a few feet distant only after the outgoing sound has ended; this timing probably facilitates the discrimination of an echo from the outgoing signal.

In many of the bats most specialized for feeding on flying insects (especially the families Vespertilionidae and Molossidae) the pulses, emitted in a rather broad beam, do not have a single frequency but rather a frequency that drops by about one octave from beginning to end of each very short pulse of sound. For example, the common little brown bat of the United States (*Myotis lucifugus*) usually emits pulses which begin at about 100,000 cycles per second (c.p.s.) and drop to 40,000 c.p.s. by the end of a pulse of sound that lasts only about 2 milliseconds. This very rapid frequency sweep is roughly comparable to frequency modulated radar or sonar, but the rate of frequency change is very much greater (in proportion to the actual frequencies involved), and the bat's sound system appears to combine the advantages of FM and pulsed sonar.

The horseshoe bats, on the other hand, employ a narrow beam of nearly constant frequency in their long pulses; they sweep this beam back and forth to scan their surroundings. It is important to note that the wave lengths of the orientation sounds used by various bats range from 0.1 to 1.0 in., and that these dimensions are roughly the sizes of the insects and other small objects that bats must detect.

The hearing of bats extends to frequencies approximately as high as those of their own emitted sounds, and the large external ears undoubtedly improve sensitivity to or discrimination of echoes of other sounds. The brain of a microchiropteran has large areas that are concerned with hearing, while the visual portions are reduced. The cerebral cortex is relatively small and simple in structure, with few if any folds in its surface. But the auditory nerve, the auditory areas of the medulla oblongata and the midbrain, and the auditory areas of the diencephalon are all relatively large. For example, the upper (dorsal) surface of the midbrain of most animals has four small lobes, two on each side, known as anterior and posterior colliculi. The anterior pair are composed of nerve fibres and cells concerned with vision, the posterior two with hearing. In most mammals they are roughly equal in size, but in bats (and in whales, which also use sonar) they are very much larger. In many species of bats the colliculi protrude dorsally so that they form a third pair of obvious lobes

when the brain is viewed from above, rising between the cerebral cortex and the cerebellum. These unusually large auditory lobes have also been found in the brain casts of fossil bats from the Eocene period (about 60,000,000 years ago), showing that then as now bats depended heavily on hearing. Probably even these remote ancestors of present-day bats possessed efficient sonar systems.

The individual pulses of orientation sound are emitted at different rates depending on the type of flight and the problems of navigation. Straight flight many feet above the ground and far removed from obstacles is usually accompanied by the emission of only a few pulses per second. But when a bat approaches a small or difficult obstacle such as a wire it speeds up the repetition rate of these sounds, until the rate may rise to more than 100 pulses per second. When flying insects are pursued on the wing, a similar but more extreme change in tempo often occurs. A bat that cruises while emitting 5 pulses per second may speed up its pulse repetition rate to 200 per second when closing in on a flying insect.

Vision can be eliminated from consideration because of an experiment performed by Spallanzani. He released several blinded bats and recaptured a few of them some days later early in the morning as they returned to their roost in the bell tower at Pavia. On killing the bats and examining their stomachs he found that they had caught just as many insects as the normal bats taken at the same time.

In experiments imitation insects are also pursued with the same increase of pulses, a fact that strongly suggests that bats detect insects chiefly by hearing echoes from the insects' bodies. In the early 1960s it was found that the little brown bat can catch small insects even when it is being bombarded with a loud noise covering most of the range of human hearing and far exceeding the faint sounds made by the beating of the wings of the insects; a much weaker noise, in the range of the bat's orientation sounds, causes the bat to stop trying to catch insects.

Echolocation is perhaps the chief method of hunting insects; however, sounds generated by the flying insects themselves often attract a bat's attention, and some insects are located and pursued by bats "homing" on the sounds arising from the insect's wingbeats or those made as the insect crawls on the ground or vegetation. The fact that so many moths have evolved elaborate auditory organs to warn them of approaching bats indicates that bats hunt mainly by echolocation rather than by silently heading toward sounds originating from their prey (see *Control of Insects* below).

Bats commonly fly together in large groups, especially when leaving caves for the evening, and apparently the presence of many other bats' orientation sounds and echoes does not prevent the sonar of a given animal from operating efficiently. When hunting insects in wooded areas, and in the rain, bats must discriminate the faint echoes bouncing off insects from those bouncing off the ground, treetrunks, branches, twigs and raindrops. Most bats drink at times by skimming just above the surface of a pond or stream and delicately dipping the very tip of the lower jaw into the water. Some of these bats catch aquatic insects emerging from the water, and other species catch fish.

A bat's brain is well adapted for rapid handling of complex patterns of sound and echo, discriminating and interpreting auditory signals with a skill and speed that impresses even those familiar with the latest advances in radar and computing machines.

IMPORTANCE TO MAN

In some parts of the world bats are used as human food, the large flying foxes that weigh two or three pounds being especially sought after in parts of Africa and Australia. The accumulated guano under bat roosts is used in the American southwest and elsewhere as fertilizer, and the bat guano of Carlsbad caverns is said to have been used during the Civil War as a source of nitrates for gunpowder.

Control of Insects.—The most important service to mankind performed by bats is undoubtedly the destruction of billions of insects every night throughout the world. It is difficult to assess the aid to agriculture from this wholesale process of insect destruction. Many of the species eaten are small gnats or flies which do not affect man directly, and in many regions the numbers of such insects are so astronomical that predation by bats and birds may not be a serious limiting factor, but there is evidence that bats are important predators which over the years do exert a real pressure on the population of many species of moths.

RUSSELL F. PETERSON IN "NATURAL HISTORY," OCT. 1958

FIG. 5.—FLYING FOX (PTEROPUS)

The caterpillars of moths are among the most destructive insect pests that cause widespread damage to agricultural crops. As explained above under *Orientation,* all of the insect-catching bats guide their flight in the dark by emitting high-frequency sounds, and these sounds are particularly numerous when insects are being hunted. Most moths, including many species whose caterpillars are agricultural pests, have highly specialized organs of hearing especially sensitive to the ultrasonic sounds of bats. These "ears" are not located on the head but on the thorax, or middle portion of the body, and they serve to warn the moth of an approaching bat so that the moth tries to escape—and often succeeds—by dodging or dropping to the ground.

These auditory organs are so specialized and occupy a large enough part of the moth's body that they must serve some useful function and have what biologists call survival value. That is, the moths and their ancestors over long periods of time must have tended to survive and reproduce their kind more successfully because of these acoustic warning devices. These organs of hearing are especially sensitive to bat sounds and to few other naturally occurring noises; there appears to be no other function for them. It therefore follows that bats must indeed have been important predators on moths over long periods of time in order for the evolution of these highly refined sense organs to have taken place. This means that bats are important limiting factors in the ecological pressures limiting the numbers of destructive moths.

Guano Production.—Since bats catch and digest a good fraction of their weight in insects every night their droppings (guano) can accumulate rapidly, and in a few years a colony of a few hundred bats can produce a pile of guano several inches deep. In heavily populated roosts and especially in caves such as Carlsbad caverns, New Mexico, which shelters millions of bats in the summer, the guano accumulates to the point where it is of commercial value as fertilizer. Many carloads have been taken from Carlsbad and other caves in the southwestern United States.

Charles Campbell set up bat roosts in and near San Antonio, Tex., in the early 1930s to attract the free-tailed bats; one such roost was actually used by a large colony that produced salable quantities of guano. Almost every other attempt at artificial colonization, however, has been a failure.

Pest Species.—The larger fruit bats, especially the flying foxes, of the suborder Megachiroptera, are serious pests in fruit orchards, particularly in Australia. Their importation alive into the United States has therefore been prohibited by law.

Of far greater importance, however, is the ability of various bats to transmit certain diseases of man and livestock. In many areas of tropical America the presence of vampire bats seems to limit the success of stock raising. It is doubtful whether the mere loss of blood from bat bites is of any consequence; but of significance is the fact that blood parasites such as trypanosomes (protozoans) and viruses are often transmitted from the bat to its victim, or from one animal to another via the bat acting as a vector of the disease. An even more serious problem is posed by the transmission of rabies.

Transmission of Rabies.—Epidemics of rabies in cattle have occurred sporadically for years in South and Central America, and at such times vampire bats occasionally fly out in broad daylight and attempt to bite larger animals. They may also bite other

kinds of bats such as the common fruit-eating bats of the genus *Artibeus* (family Phyllostomidae), and these in turn, when in the terminal "furious" stage of the disease, may make unprovoked attacks on larger animals and men. In Trinidad there have been especially serious outbreaks of human and animal rabies in which vampire and to a lesser extent other bats have been implicated as the vectors.

Until about 1953 it was thought that rabies was transmitted by bats only in tropical areas, but in that year and subsequently rabies has been found in many species of insectivorous bats in the United States. Most of the few human cases of rabies contracted from bats in the U.S. have occurred in the southwestern states and in Florida, but rabid bats have been found as far north as Pennsylvania, Michigan and Montana. In a few cases the rabid bat has flown out in daylight and attempted to bite without provocation. Although there have been a few human deaths from bat rabies, the great majority of bats in the United States are so small that their bites fail to break a person's skin under ordinary circumstances; in fact, only with difficulty has it been possible in laboratory experiments to cause infected bats to transmit the disease by biting other animals caged with them. Hence the hazard of widespread transmission of rabies from bats to dogs, foxes, skunks or human beings does not appear to be a major one. It is obviously prudent, however, to avoid being bitten by any bat that is unusually aggressive. It is important to recall, in this connection, that bats often become lethargic in daytime, even when completely normal and healthy, and will revive in a short time when disturbed. There is some evidence of transmission of rabies by aerosols in caves inhabited by bats.

On the other hand there is some evidence that bats, including some of the insectivorous species found in the United States, may survive an infection with rabies virus and appear to be in normal health; these bats may serve as carriers, which, at some later date, are able (at least under laboratory conditions) to infect other animals with the disease. It is of the utmost importance in any case where a person is bitten by a bat or other animal suspected of being rabid to secure the animal and to have it tested promptly by a public health laboratory. (*See* also RABIES).

Annoyance.—When bats select a house as a nursery colony, they often cause annoyance to the human occupants—particularly in view of the widespread superstitions and fears that bats arouse. The most common roosting places seem to be crevices in the outside trim of buildings or under loose shingles.

It is important to realize the small size of most of the common bats of the United States or western Europe; hardly any weigh as much as one ounce, and weights of $\frac{1}{8}$ to $\frac{1}{2}$ oz. are much more usual, even for fully grown bats. The smaller bats are more abundant, and they can easily enter elongated cracks as narrow as $\frac{3}{8}$ or even $\frac{1}{4}$ in.

Many types of frame houses have boxed-in spaces along the ends of the roof or under the eaves, and when the boards become slightly warped, cracks of this size can easily open up. Hundreds of bats occasionally use such a space for a nursery colony, and their presence may go unnoticed for many years.

While various poisons can be used to kill the bats, time-honoured remedies such as burning sulfur candles or sprinkling moth flakes in the attic have little if any permanent effect, and many poisons merely drive away the bats rather than kill them, so that they can return within a few months. The best method, where it is practicable, is to close all cracks and openings by which bats enter the building, preferably during the winter or at other times when they are absent. This may require a very thorough chinking and sealing of all exposed cracks; and even then, once bats are established in a building, they may re-enter through other cracks after their original pathways are blocked.

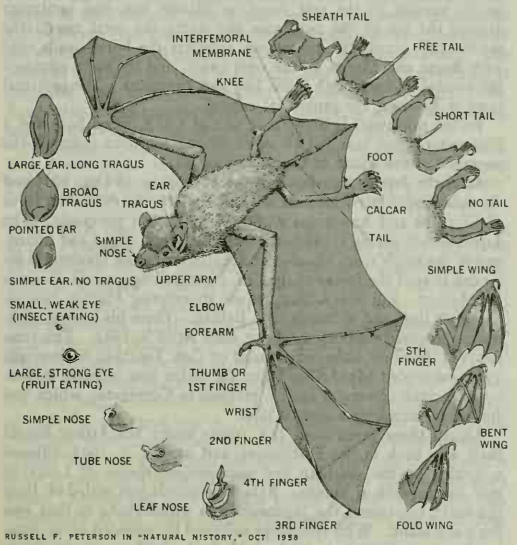

FIG. 6.—ANATOMY OF A BAT AND COMMON STRUCTURAL VARIATIONS

CLASSIFICATION

CHARACTERISTICS

The several hundred species of bats are clearly divided into two major groups (suborders), usually designated as the large fruit-eating bats (Megachiroptera) and the small, insect-eating bats (Microchiroptera). Distinct suborders they certainly are, but some of the Microchiroptera are larger than the smaller species of the Megachiroptera, and one family of the Microchiroptera feed mostly on fruit rather than insects. A more fundamental distinction lies in the relative size of the eyes and ears and the corresponding roles of vision and hearing.

Megachiroptera.—The Megachiroptera, consisting of one family, Pteropidae, are visual animals; all of them have large and prominent eyes, and they orient themselves as man does, largely by eyesight. The flying foxes (*q.v.*; genus *Pteropus*) are the largest of bats, with a wingspread up to 5 or 6 ft.; the likeness to a dog or fox is suggested in large part by the familiar proportions of eyes and ears.

Microchiroptera.—The Microchiroptera are far more diversified; about 15 families of these bats are recognizable, although only 3 are common in temperate latitudes. Several families, containing only small insectivorous species, differ from one another in the degree of specialization of the skeleton for flight (especially the shoulder joint), and in the size and shape of the ears and nose leaf. The latter is a fleshy structure surrounding the mouth or nostrils; in many bats it serves as an acoustic horn to form the sounds emitted by the bat into a narrower or broader beam.

The Microchiroptera have smaller eyes and larger ears than do the Megachiroptera, and to varying degrees they all rely far more on hearing and far less on vision than do the Megachiroptera, the birds or any of the larger mammals. Fig. 2 shows the face of a typical member of the Microchiroptera. While these bats are by no means blind they have very poor pattern vision, and their eyes cannot resolve fine details. Several families of special interest are included in the suborder (*see* below).

SPECIALIZATION AMONG VARIOUS GROUPS

Pteropidae (True Fruit Bats).—The Pteropidae (comprising the Megachiroptera) all feed on various kinds of fruit, and the only major specialization is found in those species that gather the nectar of flowers (for example, *Macroglossus* of the East Indies and the Philippines).

Macroglossus species are small bats that have elongated snouts and tongues, and they hover in front of flowers gathering nectar and pollen much as hummingbirds do. Another genus of the family, *Rousettus*, is exceptional in being able to fly in totally dark parts of caves, and it guides itself by emitting sharp, audible clicks and receiving their echoes reflected from obstacles.

BY COURTESY OF ANTNONY, "NATURAL HISTORY"

FIG. 7.—VAMPIRE BAT (DESMODUS)

Phyllostomidae (American Leaf-Nosed Bats).—(This family and those below are Microchiroptera.) These bats (fig. 2) are confined to the new world tropics; they usually have a simple spear-shaped nose leaf, and feed for the most part on fruit, although some species also eat insects and the larger Phyllostomidae prey upon smaller birds and bats. Several species of this family are highly specialized as nectar feeders; they have long snouts and tongues, and on their visits to certain flowers that bloom at night these bats incidentally facilitate cross-pollination.

Desmodontidae (Vampire Bats).—Vampire bats (fig. 7) feed solely on the blood of mammals and possibly also large birds. They too are found only in the tropical regions of South and Central America. Their teeth, stomach, and indeed the whole digestive apparatus is specialized for feeding on blood. The wounds inflicted on their victims are often so slight as not to awaken a sleeping man or horse. The bat's tongue is rolled into a tubular shape, and blood is drawn into the mouth by a peculiar action apparently intermediate between lapping and sucking. Vampire bats have been maintained in the laboratory for as long as 13 years on a diet of blood obtained from slaughter houses and fed to the bats in small dishes. Unlike most other bats, which lie almost flat on a horizontal surface and crawl along, the vampires stand on their hind legs, prop themselves with their folded wings and jump and scuttle rapidly.

Noctilionidae (Bulldog Bats).—This is a small family also confined to the American tropics and characterized by rather large, pendulous lips. One species *Noctilio leporinus* often feeds on small fish which it catches by flying low over the surface of fresh or salt water and gaffing them with long, highly curved claws on its specialized hind feet. The fish are then lifted to the mouth as the bat flies on.

Thyropteridae and Myzopodidae.—These are two other tropical families, the former of tropical America and the latter of Madagascar. They both have sucking disks on the wrists and on the hind feet to assist in holding on to smooth surfaces.

Rhinolophidae (Horseshoe Bats).—This family is widely distributed in temperate climates of the old world. The common name refers to a most elaborate type of nose leaf, usually two concentric rosettes that surround the nostrils and resemble a horseshoe when viewed from in front (fig. 8). These bats emit inaudible, high-frequency sounds through their nostrils, and the nose leaves serve as a horn to concentrate the sound into a narrow beam. Horseshoe bats tend to rotate their bodies through a complete circle as they hang from one or both hind legs, pivoting around extremely flexible hip joints. When an insect flies past they quickly dart out to catch it. Like other insectivorous bats, they also engage in direct pursuit of insects on the wing.

Vespertilionidae and Molossidae.—These are the most common bats of temperate latitudes throughout the world. They have simple muzzles. The Vespertilionidae includes most of the common bats of North America and Europe, and the Molossidae (free-tailed bats) are represented in the United States by the bats that inhabit Carlsbad caverns, New Mexico, and many other caves in the southwest. The common name for the Molossidae refers to the tail, which extends for part of its length beyond the interfemoral membrane that is attached to the two hind legs. By contrast the tail of the vespertilionids and many other bats is largely attached to this membrane.

G. RONALD AUSTING FROM NATIONAL AUDUBON SOCIETY

FIG. 9.—RAFINESQUE BAT (PLECOTUS RAFINESQUII), OF THE FAMILY VESPERTILIONDAE, IN FLIGHT

These two families are exclusively insectivorous except for three species of the Vespertilionidae that feed on fish, much as does *Noctilio leporinus* described above. They do most of their hunting on the wing, pursuing and seizing flying insects. But some species also eat nonflying insects which they take from the ground or from vegetation. Enormous quantities of insects are devoured nightly by each bat; under some conditions a little brown bat (*Myotis lucifugus*) weighing about $\frac{1}{4}$ oz. may catch more than 1,000 mosquito- or gnat-sized insects in a single summer night. Their methods of locating and intercepting flying insects were described above in *Orientation.*

See also Index references under "Bat" in the Index volume.

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(D. R. G.)

DONALD R. GRIFFIN, "LISTENING IN THE DARK." © YALE UNIVERSITY PRESS

FIG. 8.—HORSESHOE BAT (RHINOLOPHUS FERRUM-EQUINUM)

BATAAN, a province and peninsula on the island of Luzon, Republic of the Philippines, is across the bay west of Manila. Pop. (1960) 145,922; area 517 sq.mi. It is approximately 30 mi. long and averages about 15 mi. in width. Traversing the peninsula from north to south are steep mountains of volcanic origin culminating in two major peaks, Mt. Natib (4,224 ft.) to the north and Mariveles mountain (4,444 ft.) in the south. There are few roads except the three principal highways, one of which runs north and south, parallel to the east coast on Manila bay, and continues around the tip of the peninsula and along the west coast; the second cuts across the mountains, connects the north-south road with Bagac and Moron on the west coast; and the third connects the coastal highway with Subic bay and Zambales. The principal town is Balanga, the provincial capital.

To the northwest is Subic bay, site of a U.S. naval base and a Philippine naval base. Two miles off the southern point of the peninsula is the island of Corregidor (*q.v.*).

After the Japanese invasion of the Philippines in Dec. 1941 and the subsequent fall of Manila on Jan. 2, 1942, the defending force of Filipinos and Americans withdrew to Bataan peninsula. The Japanese, advancing in the north from Lingayen, Vigan and Aparri, and in the south from Mauban and Antimonan, had apparently intended to split the forces of the U.S. commanding general, Douglas MacArthur. But MacArthur, before abandoning Manila, consolidated his lines and withdrew into Bataan. There his troops, without replenished supplies, held out until April 9, 1942. The remnants of the army, then commanded by Gen. Jonathan Wainwright (who succeeded MacArthur when the latter was ordered to Australia to take command there), escaped to Corregidor, which was forced to surrender a month later.

Almost three years later, U.S. forces under MacArthur fought their way back to the Philippines, and on Jan. 9, 1945, effected a landing on the southern and southeastern shores of Lingayen gulf, to the north of Manila. Bataan peninsula was sealed off from the north to prevent the Japanese from withdrawing to that area for a last stand. With resistance softened by repeated aerial bombardment, landings were made at Mariveles harbour on the south-

ern tip of Bataan and on Corregidor, securing for the U.S. navy the use of Manila bay. (*See* also WORLD WAR II: *The War in the Pacific.*)

Agriculture is the principal industry in the province and rice the principal product; the narrow coastal plain along the Manila bay side of the peninsula is the principal producing district. Lesser crops are corn, sugar cane and fruit, primarily mangoes. The Bataan National shipyards are at Mariveles. (AN. C.)

BATAILLE, GABRIEL (1574 or 1575–1630), French lutenist and composer, master of the queen's music at the court of Louis XIII. On his marriage in 1600, he stated his occupation as clerk to a nobleman, but he later devoted himself to music and in 1617 acquired the court position that he held until his death. He shared with Pierre Guédron, Jacques Mauduit and Antoine Boësset the responsibility for the composition of the *ballets de cour.* His music appeared in contemporary collections, and the first of six volumes of *Airs de différents autheurs mis en tablature de luth par Gabriel Bataille,* in which Bataille provided lute accompaniments for songs by other composers, was published by Ballard in 1608. Bataille died in Paris, Dec. 17, 1630.

(C. A. L.)

BATAILLE, (FÉLIX) HENRY (1872–1922), French dramatist, who enjoyed a great success at the beginning of the 20th century, was born at Nîmes on April 4, 1872. Passionate love and its baleful effects provided the themes of most of his plays, including *Maman Colibri* (1904); *La Marche nuptiale* (1905); *Poliche* (1906); *La Femme nue* (1908), considered by many his best play; and *La Vierge folle* (1910). After 1911 Bataille's art evolved toward the play of ideas and finally he wrote a trilogy of social dramas, ending with *La Chair humaine* (1922), his last work.

Both his early training as a painter and his poetic talent are clearly revealed in his dramatic work. His lush style cruelly dated his plays, but his theory (largely unapplied in his own work) of what he called an "indirect language," capable of betraying (or concealing) a character's subconscious desires, made him a forerunner of Jean Jacques Bernard (*q.v.*) and the so-called "school of silence." Bataille died at Rueil on March 2, 1922.

See J. B. Besançon, *Essai sur le théâtre d'Henry Bataille* (1928).

(D. Ks.)

BATAK (not to be confused with the Batak [*q.v.*] or Battak of Sumatra), a small ethnic group occupying a heavily forested area on the east side of Palawan Island, Phil. Short statured and brown to dark-skinned they appear to be a composite of Negrito and Malayan type elements. Possessing a distinctive dialect, they are scattered in small hamlets with several families to a hut. The blowgun and bow are used in hunting, and minor dry gardening is practised; kin elders are leaders; garments are of bark cloth. Trade goods and mission work, with schooling and other government activities, are changing their traditional ways.

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(F. M. KG.)

BATAK (not to be confused with the Batak [*q.v.*] of Palawan in the Philippines), a powerful Proto-Malayan people who until 1825 lived in relative isolation in the highlands surrounding Lake Toba in Sumatra. Known as powerful magicians and cannibals who considered all strangers as enemies, they were shunned by their neighbours. Early in the 19th century missionaries appeared. Some met with disaster but the Rhenish Lutheran mission, which stressed schools, was singularly successful.

The Batak had felt Indian influences by the 2nd or 3rd century A.D. and had borrowed ideas of government, writing, elements of religion, arts and crafts. They failed, however, to develop a unified state and today are found in six cultural divisions. Within these are exogamous patrilineal clans known as *marga.* A price is paid for a bride who then is a member of her husband's group. Among the Toba Batak a village consists of several clan houses but in the Karo division all dwell in one or more long houses.

Human beings, plants, animals and inanimate objects are considered to possess souls or spirits which can be coerced or enticed. There lies the power of the magicians. Armed with secret formulas written on bark books and with staffs and images animated by the indwelling spirits of sacrificial victims, they are able to deal with the major life crises. They are aided by mediums who, in trance, communicate with the dead. Cannibalism was practised but victims were confined to prisoners and lawbreakers.

Today most of the Toba Batak are literate, as is the case of many in the other groups. Many are Christians who occupy places of importance in trade and in the Indonesian government. Moslem missionaries have been active in regions to the north and south of the Toba. The estimated population of Batak lands is in excess of 1,500,000, of which about one-third is Christian, one-third Moslem and the balance still pagan.

After World War II there was a mass movement of Toba squatters into the rich plantation lands of the east coast, formerly owned by foreign investors. Their adjustment to humid lowland jungle environment raised many complex problems. *See* SUMATRA.

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BATALA, a municipal town of Gurdaspur district, Punjab state, India, lies nearly 20 mi. S. of Gurdaspur on the Amritsar-Pathankot railway. Pop. (1951) 55,850. During the reign of Buhlul Lodi a Bhatti Rajput by the name of Rai Ram Deo founded the town in about 1465. A noteworthy agricultural machinery industry has developed in response to local demand, and Batala is a centre for the manufacture of lathe machines, precision tools and rolling mills. Baring Christian college is connected with Punjab university. (S. S. BH.)

BATALHA (*i.e.,* "battle"), a town of Portugal, 8 mi. S. of Leiria, is chiefly interesting for its great Dominican abbey of Santa Maria da Vitória ("St. Mary of the Victory"), also known as Batalha. Pop. (1960) 14,029 (municipal). In the battle fought on the plain between Canoeira and Aljubarrota, 9 mi. S.W., John I of Portugal (*q.v.*) defeated John I of Castile in 1385 and secured the independence of his kingdom. The abbey, probably founded 1388, is built of golden-brown limestone and richly sculptured. It is roughly a parallelogram, about 500 ft. from north to south, and 445 ft. from east to west. The Founder's chapel contains the tomb of John I (d. 1433) and Philippa of Lancaster (d. 1415), his queen (*see* LANCASTER, JOHN OF GAUNT), with the tomb of Prince Henry the Navigator (d. 1460; *q.v.*). Several later monarchs are buried in the royal mausoleum. Plans and masons were procured from England by Queen Philippa, and the work was entrusted to Affonso Domingues, a native architect, and Huet or Houguet, probably an Irishman. Only the royal cloister, church and Founder's chapel were included in the original design; and all three show signs of British influence. The Capellas Imperfeitas ("Unfinished Chapels") are one of the most marvelous examples of Manueline architecture. The earthquake of 1755 damaged the monastery and the French sacked it in 1810. It was secularized in 1834, declared a national monument in 1840 and gradually restored.

BATANES, northernmost, smallest (76 sq.mi.), and most remote province of the Republic of the Philippines, is coextensive with the Batan Islands (formerly Bashi Islands) that lie between Luzon and Formosa. The islands are rocky, windswept and subject to frequent destructive typhoons. Estimated area under cultivation is only about five square miles. Fishing is more important than agriculture. Despite its small population (1960) 10,335, the province is a food deficit area. Basco is the capital and only significant community. (AN. C.)

BATANG (PA-AN), an important frontier town of Szechwan province, China, and at one time the capital of the Chinese province of Sikang. It was one of the chief depots for caravan travel between Ch'eng-tu and Lhasa, and its inhabitants are mainly Tibetans. For years the Tibetans tried to wrest its control from the Chinese, and Batang was the scene of many local conflicts. In 1950, after the military occupation of Tibet by Communist

China, Batang was incorporated in the Tibetan Autonomous district under the Szechwan provincial government. It is connected with Kan-tzu (Kantse) with a highway, and thus is linked with the principal communication line between Tibet and China. The elevation of Batang is around 8,000 ft. and the climate is mild. Rice is grown in the valley. Before 1950 there were both Roman Catholic and Protestant missions in Batang. The missionaries established modern schools and hospitals and also planted apples, pears, peaches, walnuts and grapes on the hillsides.

(T.-L. S.)

BATANGAS, a province in southern Luzon, Philippines, that includes nearby Maricaban and Verde islands. It lies across Verde Island passage from the island of Mindoro and surrounds famous Lake Taal. Less than 10 ft. above sea level, the lake is a volcanic crater about 14 mi. across at its maximum width. Volcano Island (Taal Island) rises within the lake and contains another small crater (Yellow Lake) upon it. Volcano Island, the modern Taal volcano, was last active in 1912.

The province has been noted for the fertility of its soil, sometimes compared to the fertile volcanic soils of Java. It is an agricultural province with rice; coconuts, sugar, coffee, corn and fruit among the principal products. It has also been known for its livestock industry, especially horses, and fishing is important, both in the lake and along the coast. The principal manufacturing industries are the sugar central at Nasugbu and a petroleum refinery at Bauan on Batangas bay. The population of the province (1960) 682,855.

The capital, also named Batangas, is a municipality with an administrative centre (población) and 50 barrios. It is connected with Manila, about 70 mi. N., by good roads and by coastwise shipping and is the northern terminus of regular ferry service to Calapan, Mindoro. The town site is on a small plain on the west bank of the Calumpang river about a mile from the coast. Pop. (1960) 82,627. Other important settlements are Lipa, a chartered city with an estimated population of 69,342 in 1960 and the site of a military air base and a citrus experiment station; Taal, an old Spanish settlement with a historic cathedral and many buildings of Spanish architecture; Lemery and Balayan, both commercial centres on Balayan bay.

In World War II the shores of Batangas bay and Balayan bay were the scene of an Allied landing (Jan. 31 to Feb. 3, 1945) to aid in the attack on Manila from the south. (AN. C.)

BATAVIA, Indonesia: *see* JAKARTA.

BATAVIA, a city in western New York, U.S., midway between Buffalo and Rochester, and the seat of Genesee county. Pop. (1960) 18,210. (For comparative population figures *see* table in NEW YORK: *Population.*) Batavia's history dates from 1801 when a settlement was made at a junction of Indian trails. The same year the place was platted by Joseph Ellicott, agent and surveyor-general of the Holland Land company, which consisted of residents of the city of Amsterdam in what was then the Dutch republic of Batavia (meaning "better land"). Between 1792 and 1797 the company of Dutch capitalists acquired an immense tract of approximately 3,600,000 ac. in western New York known as the Holland Purchase. In 1801 Ellicott opened an office in the new settlement from which purchasers of most of the lands of the state lying west of the Genesee river obtained their titles.

Batavia was identified with the Antimasonic party (*q.v.*) because William Morgan lived there before his mysterious disappearance in 1826. Batavia was incorporated as a village in 1823 and as a city in 1915. A council-manager form of government became effective in 1958.

Batavia is the trade centre of a farming region producing milk, eggs, vegetable products, small grain and alfalfa. Important manufactures include electronic products, television and radio sets, die castings, paper products, women's shoes, heat exchangers, sprayers and fire extinguishers. A U.S. veterans' hospital and a New York state school for the blind (opened 1868) are there. The Tonawanda Indian reservation of the Seneca Indians is 13 mi. N.W. of Batavia. Horse races at Batavia Downs attract huge crowds from the surrounding area. (C. C. MA.)

BATE (BATES), **JOHN,** an English merchant who was condemned in the court of exchequer in Nov. 1606 for refusing to pay an extra duty of 5*s.* 6*d.* per hundredweight imposed by the crown on imported currants, in addition to the 2*s.* 6*d.* allowed by the statute of tonnage and poundage. The new duty was an extension to all importers of a similar levy previously made by the Levant company on importers who were not members of the company. The crown had extended this to all importers to recoup the £4,000 per annum which it lost when the company, because of the outcry against monopolies, surrendered its charter and the trade was thrown open. Bate's claim, that the new imposition was illegal without the sanction of parliament, had little basis in law. The interest of his case lies in the arguments advanced by the judges. Sir Thomas Fleming, chief baron of the exchequer, for example, asserted that, as such impositions were imposed by the king's "absolute" power rather than by his "ordinary" power, the king could fix what rates he pleased, a doctrine capable of making the crown financially independent of parliament. (R. B. WM.)

BATEMAN, HEZEKIAH LINTHICUM (1812–1875), U.S. actor and theatrical manager, was born in Baltimore, Md., on Dec. 6, 1812. He made his debut in 1832 and acted in various repertory companies until his two eldest daughters, KATE JOSEPHINE (1843–1917) and ELLEN DOUGLAS (1844–1936), were aged six and four respectively, when he, his wife and the two prodigies toured widely as stars. Ellen played Richard III, Shylock and Macbeth to Kate's Richmond, Portia and Lady Macbeth. In 1855 he managed a St. Louis (Mo.) theatre. As Kate's manager he later moved to New York city, where she was a hit in *Leah the Forsaken* (1863), Augustin Daly's version of Salomon Mosenthal's *Deborah.* The French company Bateman presented in New York (1867–69) began a craze for Jacques Offenbach *opéra bouffe* in the United States. In 1871 he leased the Lyceum theatre, London, engaged Henry Irving (*q.v.*), and presented him in *The Bells,* which made Irving a star. Bateman died March 22, 1875.

His wife, SIDNEY FRANCES (1823–1881), daughter of the English comedian Joseph Cowell and half-sister of the comic singer Sam Cowell, wrote plays, of which the most popular was *Self* (1857). After her husband's death, she managed the Lyceum and later Sadler's Wells theatre until her death on Jan. 13, 1881.

Ellen Bateman married early and gave up the stage, but Kate continued a long career of acting. She retired briefly in 1866 when she married George Crowe but returned in 1868, later playing Lady Macbeth and other roles with Irving. After 1892 she conducted a school of acting. Her daughter, Sidney Crowe, became an actress. Her younger sisters, Virginia and Isabel (Mrs. Edward Compton) also appeared on the London stage. (B. HT.)

BATES, EDWARD (1793–1869), U.S. lawyer, was born at "Belmont," the family home in Goochland county, Va., Sept. 4, 1793. He began to practise law in the territory of Missouri, and after its admission as a state in 1821 was elected (1826) representative in congress, where he served only one term. Bates was known as a conservative and as a southerner who had freed his own slaves. From 1830 to 1834 he served in the state legislature and after some years as a leader of the Whig party, he became identified with the newly organized Republican party. In the national convention of that party in Chicago in 1860 he received 48 votes for the presidential nomination. Appointed attorney general by Pres. Abraham Lincoln, Bates frequently dissented from the president's military policies. His service in the cabinet was not outstanding, and he differed frequently with his colleagues, Stanton, Seward and Chase. He served until 1864, when he returned to the private practice of law in St. Louis. He died there on March 25, 1869. (E. E. R.)

BATES, HENRY WALTER (1825–1892), English naturalist, explorer and author of *The Naturalist on the River Amazons,* was born at Leicester. In 1844 he met Alfred Russel Wallace (*q.v.*) and in April 1848 sailed with him for Brazil. Their object was to solve the problem of the origin of species and they hoped to meet their expenses by the sale of duplicate specimens. Bates, after spending seven and a half years exploring in detail the whole valley of the Amazon, sailed for England in 1859. He had collected 14,712 species of insects of which 8,000 were new to science. His paper, "Contributions to an Insect Fauna of the Amazon

Valley," read before the Linnean society in 1861, in which he stated and solved the problem of mimicry (*q.v.*), brought him enthusiastic letters from Charles Darwin and Sir Joseph Hooker. He moved to London in 1863 to try and find more remunerative scientific work. The same year his great and only book, *The Naturalist on the River Amazons,* with an introduction by Darwin, was published by John Murray, who also helped him to get the job of assistant secretary to the Royal Geographical society in 1864, a post which freed him from financial cares and which he kept until his death. "Bates," wrote Darwin to Sir Charles Lyell, "is second only to Humboldt in describing a tropical forest." Bates revised and edited many books and wrote several papers. In 1881 he was made a fellow of the Royal society. He sold his collection of butterflies after his appointment to the Royal Geographical society and concentrated on beetles, and after his death this collection was bought by René Oberthur of Rennes.

BATES, KATHARINE LEE (1859–1929), U.S. author and educator, who wrote the national hymn, "America the Beautiful," was born in Falmouth, Mass., on Aug. 12, 1859. Following her graduation at Wellesley college, Wellesley, Mass., in 1880 (M.A., 1881), she engaged in teaching. In 1885 she became instructor and in 1891 professor of English literature in Wellesley college, serving in this post until 1925 when she was made professor emeritus. She was the author of numerous works in prose and verse, including stories and plays for children.

With Cornelia F. Bates, she translated Gustavo Bécquer's *Romantic Legends of Spain* (1909). Among her writings are, *The College Beautiful and Other Poems* (1887); *Rose and Thorn* (1888); *Hermit Island* (1891); *English Religious Drama* (1893); *American Literature* (1898); *Spanish Highways and Byways* (1900); *From Gretna Green to Land's End* (1907); *The Story of Chaucer's Canterbury Tales Re-told for Children* (1909); *In Sunny Spain* (1913); *Fairy Gold,* for children (1916); *Sigurd* (1919); and *The Pilgrim Ship* (1926); *America the Beautiful and Other Poems* appeared in 1911. She died in Wellesley, on March 28, 1929.

BATES, SIR PERCY ELLY, 4TH BART. (1879–1946), English shipowner, who was responsible in 1931 for outlining the policy which led to the construction of the two largest passenger ships in the world, the "Queen Mary" and "Queen Elizabeth," was born in Derby on May 12, 1879. Educated at Winchester, he entered a Liverpool shipping office in 1899, moved to the family shipping business on the death of his father in 1900, and succeeded to the baronetcy when his brother died in 1903. He was appointed deputy chairman of the Cunard line in 1922 and chairman in 1930. Bates maintained that two large and fast ships could operate the North Atlantic express passenger services better than three smaller ones. He negotiated the amalgamation of certain White Star liners with Cunard line in the combined Cunard White Star line in the 1930s. He filled many of the most important posts in the British shipping industry and served the government in both World Wars I and II. He died at Neston, Cheshire, on Oct. 16, 1946. (P. Dr.)

BATES, WILLIAM (1625–1699), English nonconformist minister, one of those ejected under the Act of Uniformity (1662), was born in London in Nov. 1625. After taking his B.A. at Cambridge (1644), he became vicar of Tottenham and in 1654 of St. Dunstan's-in-the-West, London. At the Restoration (1660), he was made a royal chaplain, and was a commissioner at the Savoy conference (1661). He refused the deanery of Lichfield (1661) and in 1662 was ejected. Bates supported two attempts (1668, 1674) to reach agreement with the bishops, and in the cause of charity he occasionally received Anglican communion. He was licensed as a Presbyterian teacher (1672) and in his last years founded a Presbyterian congregation at Hackney, where he died on July 14, 1699.

BATESON, MARY (1865–1906), English historian of medieval social institutions, was born at Robin Hood's bay, Yorkshire, on Sept. 12, 1865, the daughter of W. H. Bateson, master of St. John's college, Cambridge. Educated in Germany, at the Perse school for girls and at Newnham college, Cambridge, she became an associate of Newnham college and a member of the council. She lectured there, with intervals, all her life, and furthered the interests of the college in numerous ways. She died at Cambridge on Nov. 30, 1906, leaving her library and property to Newnham.

Mary Bateson's reputation was established and has been maintained by her studies in monastic and municipal history. Her first major publication was *The Register of Crabhouse Nunnery* (1892), undertaken for the Norfolk and Norwich Archaeological society; perhaps her most important work was *Borough Customs* (1904–06), which she edited with introductions for the Selden society. She was responsible for the discovery (*English Historical Review,* xv, xvi) of the Norman origin of many Welsh and west midland towns. She also carried out extensive research in the municipal history of Leicester and Cambridge. Her more popular works include *Medieval England* (1903), and the chapter on "The French in America (1608–1744)" in the *Cambridge Modern History.* She was to have been one of the three editors of the *Cambridge Medieval History* but died shortly after accepting the appointment.

BATESON (BATSON, BETSON), **THOMAS** (*c.* 1570–1630), English composer, notable for his madrigals. Bateson is first heard of as organist of Chester cathedral, where he was appointed in 1599. From this it may be assumed that he was born in the early 1570s. In 1608 he moved to Dublin cathedral as organist and master of the choristers. He retained this post until his death, in Dublin, in 1630.

Although Bateson's career was that of a church musician, only one piece of church music by him survives, and that is the distinctly conventional seven-part anthem "Holy Lord God Almighty," probably written as a degree exercise for his Mus.B. in 1612. His reputation as a composer rests upon two sets of madrigals (1604 and 1618), one dating from his period at Chester, the other from that at Dublin, and each dedicated to a local dignitary. These two collections, each containing pieces for 3, 4, 5 and 6 voices, reveal him as a madrigalist of considerable range and invention, if not quite of the first rank. They have been republished by E. H. Fellowes as vol. xxi and xxii of *The English Madrigal School* (1922). A brief study of Bateson's work is contained in the same author's *The English Madrigal Composers* (1921).

(J. J. N.)

BATESON, WILLIAM (1861–1926), British biologist and founder of the science of genetics, was born at Whitby, Aug. 8, 1861, son of William Henry Bateson, master of St. John's college, Cambridge.

Bateson not only gave genetics its name and occupied the first university chair devoted to the new field at Cambridge university; he also recognized in 1900 the recently rediscovered work of Gregor Johann Mendel (*q.v.*), which he quickly confirmed, as the key to an understanding of heredity and variation and thereby of evolution.

Bateson introduced and defended Mendel's principles that heredity occurs by the transmission of particulate elements, genes (*q.v.*), against the view that it was continuous and nonparticulate.

Bateson was prepared for his research in genetics by a boyhood interest in natural history, which continued as a student at Cambridge and led him as zoologist and embryologist to study problems of variation in Asia and the United States. These studies culminated in his classical work *Materials for the Study of Variation* (1894), which stressed the discontinuous nature of variation.

His application of Mendel's method of experimental crossing of varieties of domesticated plants and animals (1900–10) extended the scope of the principle of segregation of genes, and he was one of the first to show its application to hereditary diseases in man (1902–06).

Bateson's work at this time revealed new principles of factor interaction (dependence of a variant character upon two or more different genes), and of coupling and repulsion, the tendency of certain genes to retain in the offspring the associations in which they occurred in the parents. This was later generalized and explained by T. H. Morgan (*q.v.*) in his principle of linkage, linked genes tending to remain together since located on the same chromo-

some (*see* GENETICS; CYTOLOGY). Although Bateson at first refused to accept this interpretation, and his later work suffered from this refusal, he eventually (1926) acknowledged its truth.

He was director of John Innes Horticultural institution from 1910 until his death and in 1914 was president of the British association. His books include *Mendel's Principles of Heredity* (1902) and *Problems of Genetics* (1913).

See Beatrice Bateson, *William Bateson, Naturalist* (1928), containing a memoir on his life and 14 of his essays on genetics; W. E. Castle, "The Beginnings of Mendelism in America," in L. C. Dunn (ed.), *Genetics in the 20th Century* (1951). (L. C. D.)

BATH, THOMAS THYNNE, 1ST MARQUESS OF (1734–1796), English politician, who, as a member of the connection led by the duke of Bedford, held important office during two critical periods of the reign of George III, was born on Sept. 13, 1734, the elder son of Thomas Thynne, 2nd Viscount Weymouth, to whose title he succeeded in 1751. He was secretary of state, first for the northern and then for the southern department from Jan. 1768 until Dec. 1770. As the minister responsible for public order during the riots in protest against the imprisonment of John Wilkes (*q.v.*), he became intensely unpopular. He was violently denounced, both by Wilkes and by "Junius" (*q.v.*), for encouraging the magistrates to use troops, which led to the St. George's Fields massacre. His resignation was probably due to personal inability to deal with the crisis in relations with Spain over the Falkland Islands. In Nov. 1775 he became secretary of state for the southern department again and held that office during the critical period of the American Revolution. In 1779, dissatisfied with Lord North's Irish policy and with the continuance of the American war, he followed Earl Gower, the lord president, into retirement. He was created marquess of Bath in 1789. He showed ability as a speaker but was prevented from becoming a statesman of distinction by his dissolute habits (especially in drinking and gambling) and by his indolence. He died in London on Nov. 19, 1796. (I. R. C.)

BATH, WILLIAM PULTENEY, 1ST EARL OF (1684–1764), English politician, who was prominent in opposition to Sir Robert Walpole, was born in London on March 22, 1684, a member of an old Leicestershire family. He was educated at Westminster school and at Christ Church, Oxford, and was member of parliament for Hedon, Yorkshire, from 1705 to 1734, and for Middlesex from 1734 to 1742. He was a prominent Whig during the reign of Queen Anne and was secretary at war (1714–17) in the first ministry of George I. When Walpole came to power in 1721 Pulteney failed to achieve high office. He was consoled for a time by the lucrative post of cofferer of the household but his failure to obtain the secretaryship of state in 1724 drove him into bitter and open opposition. Thenceforth he was a leader of the anti-Walpole Whigs and joined with Lord Bolingbroke in trying to form a united party of opposition. By his contributions from 1726 to the *Craftsman,* the paper which he and Bolingbroke had founded, and by his brilliant speeches in the house of commons, he helped to give coherence and direction to the Whig and Tory factions opposed to Walpole. The bitterness of his satire and the splendour of his rhetoric lowered the esteem in which Walpole and his ministry were held by the public and he was largely responsible for Walpole's failure over the Excise bill in 1733. His alliance with Bolingbroke and the Tories was never an easy one to maintain and it came to an end in 1735. Between 1735 and 1742 he was somewhat overshadowed by Lord Carteret, the earl of Chesterfield and William Pitt. When Walpole fell from power in 1742 Pulteney himself did not form a new government but accepted a cabinet post under Lord Wilmington and the earldom of Bath. He had already incurred considerable distrust, and his reluctance to shoulder responsibility ended his career in anticlimax. When Wilmington died (July 1743), Henry Pelham succeeded him and, apart from two days of office in Feb. 1746, Bath's political life was ended. He died on July 7, 1764. A man of many talents and scholarly tastes, his lack of clear purpose robbed him of the chance to become a notable statesman.

See J. H. Plumb, *Sir Robert Walpole,* 2 vol., with full bibliography (1956–60). (J. H. PL.)

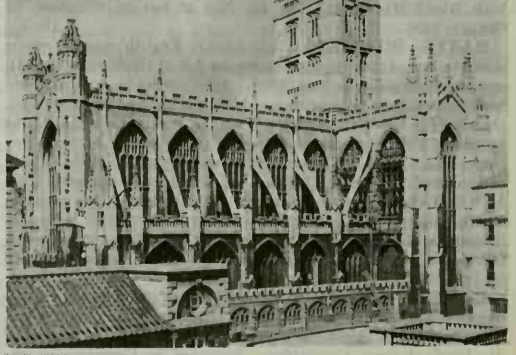
BATH, a city, parliamentary and county borough of Somerset, Eng., close to the borders of Gloucestershire and Wiltshire, is located 12 mi. E.S.E. of Bristol. Pop. (1961) 80,856. The city lies in a wide amphitheatre on a sharp bend in the river Avon, with steep hills rising several hundred feet on all sides. The racecourse on Lansdown (800 ft.) is the highest in England.

Bath is one of the most beautiful and architecturally distinguished of British cities, the only one with natural hot springs. The oldest parts of the city are on the north bank close to the river, but building has extended up the slopes on both sides. All buildings are constructed of, or faced with, Bath stone. The abbey church of St. Peter and St. Paul (16th century), a very fine and ornate example of late Perpendicular style, has been called "the Lantern of the West" from the many windows, particularly the great west window flanked by carved angels ascending and descending. Of the Georgian buildings, the North and South parades (1728) were conceived by John Wood as a sort of forum. The Pump room (1796), the third of a series of pump rooms on this site, affords a rendezvous for visitors as well as a fountain for "taking the waters."

Northwest of the original town wall, Gay street links Queen square (1735) with the Circus, laid out by the elder Wood and completed by his son, who added to this development the magnificent Royal crescent (1775) and also the assembly rooms (1771); Lansdown and Camden crescents were built as isolated features on the northern slopes. Milsom street (1761) soon became an unparallelled shopping centre; it contains the Octagon, originally a chapel designed by Thomas Lightoler in 1767. Prior Park (1742), now a school, was built in a vale with views northward over the city as a residence for Ralph Allen and also to demonstrate the qualities of Bath stone.

The group of municipal buildings includes the Guildhall (1776) with its magnificent Adam style banqueting room, and the Victoria Art gallery and Central library. Opposite these, Pulteney bridge with shops on either side of the carriage way leads to Great Pulteney street and the Holburne of Menstrie Art museum (china, plate, glass). Behind the museum lie Sydney gardens, formerly an 18th-century pleasure resort. King Edward VI Grammar school was founded in 1553.

Bath has retained its importance as a spa and tourist centre. The mineral springs, which are municipally owned and to which Bath owes its name, yield over 500,000 gal. of water daily at temperatures ranging from 114° to 120° F. The waters are drunk medicinally and used for hydrotherapy treatments. The Royal baths and treatment centre were entirely rebuilt behind the 18th-



A. W. KERR

ABBEY CHURCH OF SS. PETER AND PAUL, IN BATH, BUILT IN THE 16TH CENTURY

century colonnaded façade of Bath street. Other industries include general and electrical engineering, printing, bookbinding, joinery, and the manufacture of shoes and underclothes. After the dispersal from London of central government offices during World War II, Bath was selected as the secondary headquarters of the admiralty. The city lies on the Western region railway to south Wales, and to the south and west coasts. It is a centre of main roads.

History.—Pre-Roman sites on the neighbouring hills are evidence of very early settlement. The founding of Bath itself is attributed in legend to Bladud, son of Lud Hudibras and father of King Lear, who in 863 B.C. was cured of disease by immersion in the steaming swamps. Roman colonists had developed a considerable spa establishment well before the end of the 1st century A.D. The Roman baths were discovered in 1755, but full-scale excavations were begun only in the late 19th century and are still continuing. The Roman bathing establishment, with its Great bath, lined with lead mined in the Mendip hills, the Circular bath, and extensive heated rooms and plunge baths, was modified and extended throughout the 400 years of its popularity. The Roman name Aquae Sulis alludes to Sul, a local deity, identified by the Romans with Minerva.

Following the fall of Rome, Bath declined until its capture by the Saxons in 577 A.D., recorded in the *Anglo-Saxon Chronicle*. The desolate site of the sacked city is probably the subject of the Anglo-Saxon fragment "The Ruin." The Saxons renamed the city Akemanceaster, and later, Aet Bathum. They built the first abbey there, in which Edgar, first king of all England was crowned, in A.D. 973. Between 1088 and 1122 the Normans rebuilt the church, transferring there the diocese they had founded at Wells. The bishop's throne returned to Wells in 1206, but the bishop is still styled "of Bath and Wells." The Norman buildings were replaced by the present church in the 16th century.

The first civil charter was granted in 1189, and for about 500 years the city continued as a market town and cloth-weaving centre. Chaucer's Wife of Bath is said to excel even the weavers of Flanders, and Bath "beaver" was known throughout England. The royal visit of Queen Anne in 1702 inaugurated a golden age in which Bath re-emerged as a spa, and seasonal centre of fashion and elegance. This period is dominated by Beau Nash, master of ceremonies, the architect John Wood (*q.v.*) and his son, and their patron Ralph Allen who provided the stone with which the city was rebuilt, and encouraged the architects who swept away the Elizabethan town and designed the Palladian squares, crescents, and terraces. Bath olivers (a biscuit named after Dr. William Oliver, a Bath physician who founded what is now the Royal National Hospital for Rheumatic Diseases), Bath buns, Bath bricks, Bath chaps and Bath chairs, all take their name from the town. Many literary associations are found in the works of Smollett, Fielding, Jane Austen, Fanny Burney, Macaulay, Thackeray and Dickens. The Pump Room orchestra, founded by Nash in 1705, continued until well into the 20th century. To John Palmer, impresario, was granted the first patent in the provinces for a Theatre Royal.

Bath suffered air raids in 1942, in which the rebuilt assembly rooms were gutted, and some houses damaged. Most of these have been reconstructed, and there has been considerable cleaning and restoration of the weather-worn façades of famous buildings.

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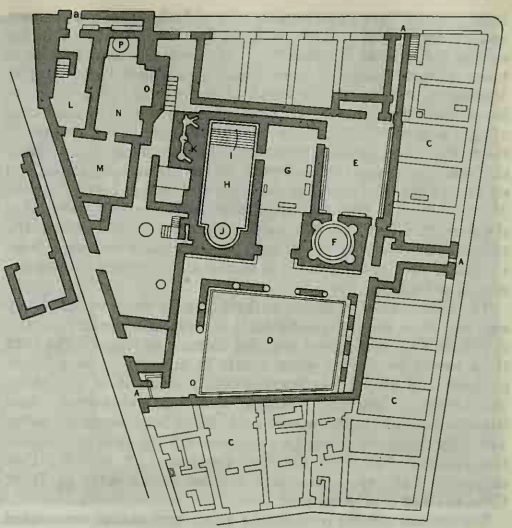
BATH, the process of immersing the body in some medium other than atmospheric air for the purpose of cleanliness or as a cure; and the building or room in which such immersion takes place.

Separate structures for baths existed at a very early date; they were probably similar to the types still to be found among primitive peoples. Although bathrooms occurred in early Egyptian palaces, remains are too fragmentary to permit complete analysis of Egyptian types. It is the palaces of the Aegean civilization that provide the earliest well-preserved examples of bathrooms. They are remarkable for both their careful structure and advanced



GROUND PLAN OF BATHS AT POMPEII

(A) Men's entrances, (B) women's entrance, (C) shops, (D) court, (E) apodyterium or dressing room, (F) frigidarium or cold bath, (G) tepidarium or warm bath, (H) caldarium or hot room, (I) alveus or warm bath, (J) laconicum with labrum or sprinkling vessel, (K) furnaces, (L) women's frigidarium, (M) women's tepidarium, (N) women's caldarium, (O) alveus, (P) labrum

system of water supply and drainage. Examples are in the palaces of Knossos and Phaistos (*c.* 1700–1400 B.C.) and on the mainland as in the palace of Tiryns (*c.* 1200 B.C.). Bathing occupied an important place in the life of the Greeks. Vase paintings show that there were showers, but even though in the later period there were public baths, they never received important and monumental architectural treatment. Eastern peoples seem to have had luxurious baths, which Alexander the Great is reported to have admired.

Roman Baths.—The Romans, with their customary organizing genius and love of luxury, developed not only the technique of bathing but also the planning of bath buildings to a degree before unknown. The bather undressed and left his clothes in the apodyterium. He was then anointed with oil in the elaeothesium or unctorium and, thus anointed, went to the room or court where he could indulge in violent exercise. After this he proceeded to the caldarium, or hot room, and the sudatorium or laconicum, a steam room. It was probably at this point that the body was scraped of its accumulation of oil and perspiration with curved metal strigiles. The bather then went to the warm room, or tepidarium, and then into the cold bath, or frigidarium, in which there was frequently a swimming pool. After the body was once more anointed, the process was completed. There is some question as to the exact order in which the hot and cold baths were taken and of the exact relationship of caldarium and laconicum, which were apparently often combined in one room.

To carry on this complicated process the Romans developed baths varying in size from those in the larger houses, in which each unit was merely a tiny room, to the enormous thermae of imperial Rome. The essential features that run through all types are: (1) an adequate system of furnishing hot, tepid and cold water; (2) the heating of the hot portions of the bath and sometimes also the tepidarium by the circulation of the smoke and heated air from a fire under the floor and through the hollow walls (*see* HYPOCAUST); and (3) adequate basins for warm and cold water in the hot bath.

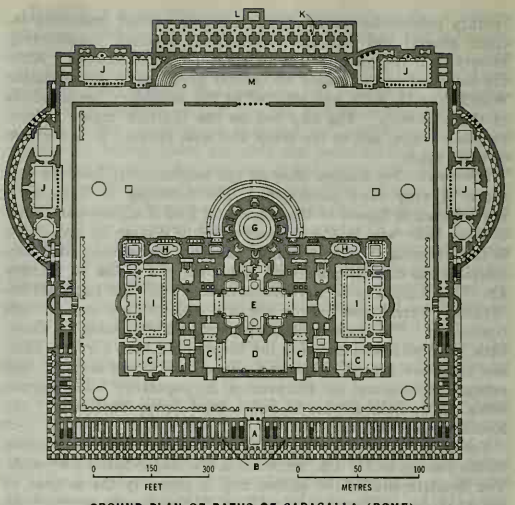
A good example of the private bath exists in the so-called Villa of Diomede in Pompeii. Also in Pompeii are the two oldest Roman public baths extant, the Stabian baths and those of the Forum,

both of which have two complete sets of bathrooms, one for men and one for women. These are of a type characteristic of all the smaller baths, ruins of which have been found in many provincial towns such as Trier in Germany and Timgad and Homs (Leptis Magna) in Africa. The general scheme consists of a range of barrel-vaulted apartments flanking an open court. The rooms are of approximately the same size and are usually three in number: the apodyterium, usually surrounded by niches to serve as lockers; the tepidarium; and the caldarium, which has an apse at one end containing the labrum and at the other end the hot bath or alveus. The cold bath in both the larger Pompeian establishments takes the form of a small circular room with a large round pool in the centre. The baths of Homs have as their main feature a large swimming pool, lavishly cased in marble and bordered by a monumental colonnade.

The arrangement of rooms in these smaller baths varied widely and was often quite asymmetrical; a codified architectural type developed first in the great imperial thermae of Rome. The bath there served as a great social centre in addition to its primary purpose, and the architectural problem involved in its design was thereby complicated. Gardens, a stadium and exedrae, where lectures were given and poems read, all became necessary parts. The fully developed examples are those of Titus (A.D. 81), Domitian (A.D. 95), Trajan (*c.* A.D. 100), Caracalla (A.D. 217) and Diocletian (*c.* A.D. 305). Extensive remains of the baths of Titus, Caracalla and Diocletian exist.

The general scheme comprised a great open garden surrounded by subsidiary club rooms, and a block of bath chambers either in the centre of the garden, as in the baths of Caracalla, or at its rear, as in the baths of Titus. The main block contained, in addition to the frigidarium, caldarium and tepidarium, courts and smaller bathrooms. Of the three great bathrooms in this block, the tepidarium was made much the most important and was used, apparently, as the great assembly hall or lounge. In addition to the frigidarium there were often enormous unroofed swimming pools, or piscinae, as in the baths of Caracalla. The caldarium on the other side of the tepidarium is treated in the baths of Diocletian and Caracalla as a domed circular hall. Service was furnished by means of underground passageways; slaves could move swiftly and simply without being seen. In order to light and roof the enormous rooms the Romans were forced to develop an ingenious system of buttressing, cross vaulting and clerestory windows. Their scheme of groined vaults carried on interior columns and buttressed by cross buttresses, which form the walls of recesses opening from the room, has since been an inspiration to designers of great halls (*e.g.*, St. George's hall, Liverpool, Eng.; Pennsylvania station, New York city). The remains of the baths of Diocletian, whose great hall, slightly altered by Michelangelo, forms the church of Sta. Maria degli Angeli, give an extraordinarily vivid impression of what the thermae must have been. The important pieces of sculpture found in Roman baths, such as the Laocoön group from the baths of Caracalla, indicate the richness of their furnishings. Floors were universally of marble or mosaic. Walls were apparently sheathed with marble to a considerable height and decorated above with stucco reliefs, colour and mosaic. Gilt bronze was used freely for doors, capitals and window screens. Although not usually on the same colossal scale as in Rome, this is essentially the type of imperial bathing establishment repeated throughout the Roman empire. Examples exist in Trier, Ger., where facilities for heating adapt the structure to the raw northern climate; in Arles, France; in Lambessa (Lambèse), Djemila and Cherchel in north Africa; and at Ephesus in Asia Minor.

As a rule the sexes bathed separately, usually at different times, as is still common in the near east, or in different establishments. Arrangements for division of the sexes under the same roof and utilizing a common fire also were common, and this may account for the symmetrical disposition of many baths. Mixed bathing is first mentioned by Pliny the Elder (*Natural History* xxxiii. 153). The practice seems to have been largely restricted to courtesans (Martial 3.51; 3.72; 3.93; 7.35) and bluestockings (Juvenal 6.447). It was condemned by respectable citizens (Quintilian *Institutio oratoria* V. 9.14) and prohibited by the emperors



GROUND PLAN OF BATHS OF CARACALLA (ROME)

(A) Main entrance, (B) shops and separate bathing rooms, (C) entrance halls and dressing rooms, (D) frigidarium, (E) great central hall, (F) tepidarium, (G) caldarium, (H) small bathrooms, (I) exercise courts, (J) lecture and reading rooms, (K) reservoir, (L) aqueduct, (M) stadium

Hadrian and Marcus Aurelius. There are many contemporary references to Roman baths and bathing scattered through the works of Pliny the Younger, Seneca, Juvenal, Suetonius and, in the later empire, Ausonius and Statius. (*See* also ROMAN ARCHITECTURE; ROME: *The Aventine, Quirinal, Esquiline, and Caelian Hills.*)

Medieval Baths.—The excessive luxury of the public baths of Rome were bound to produce a reaction, and the church Fathers generally agreed that bathing should be confined to the purposes of cleanliness and health. Moreover the destruction of the great aqueducts (*q.v.*) of Rome led to the closing of the baths. Baths and the public buildings for them must have remained as a luxury in Europe, for by the 12th century there are indications that public baths were common. By the 14th and 15th centuries they were notorious. Late Gothic tapestries and woodcuts indicate the existence of many outdoor garden pools for bathing and bathhouses with large pools or basins of warmed water. In both cases the bathing was quite promiscuous; the abuse of this custom is indicated by the colloquial use of the Italian word *bagno* ("bath") for a brothel. From the Renaissance until the 19th century there was little additional development of bathing, and the mechanical arrangements were of the crudest, as in the famous bath of Marie Antoinette at Versailles.

Islamic Baths.—Bath architecture, however, progressed in the countries under Islamic rule. There, either through the development of a primitive eastern bath tradition or through the adoption of the Roman system or, as is perhaps more likely, through a merging of the two, the complicated technique of bathing continued and with it the growth of adequate architectural forms. The Alhambra (*q.v.*) at Granada has a beautiful set of bathrooms, all rectangular, which show the Moorish form at the beginning of the 14th century. Farther east Roman or Byzantine forms were the bases of the baths. Constantinople baths, which are typical, and whose form seems to have varied little, consist universally of a series of square rooms, carrying domes on pendentives. Each series of rooms is composed of a warm, hot and steam room, corresponding roughly to the tepidarium, caldarium and laconicum. The place of the frigidarium is generally taken by a basin of cold water at one end of the warm room. In addition to these vaulted chambers there are dressing rooms and frequently a luxurious rest room.

Russian Baths.—In Russia a great love of hot and steam baths

Bathroom in the palace of Minos, Knossus, Crete; 1700–1400 B.C.

Apodyterium, or dressing room, Stabian baths, Pompeii, one of the oldest Roman baths extant; originally built 2nd century B.C.

Artist's reconstruction of the tepidarium of the baths of Caracalla, Rome; A.D. 217

Tepidarium of the baths of Diocletian (c. A.D. 305) as reconstructed, with alteration, by Michelangelo to form the church of Sta. Maria degli Angeli, Rome

ANCIENT BATHS

BY COURTESY OF (TOP LEFT) GREEK INFORMATION SERVICE; PHOTOGRAPHS, (TOP RIGHT) ALINARI, (BOTTOM LEFT) THE BETTMANN ARCHIVE, (BOTTOM RIGHT) FOTOTECA UNIONE, ROME

BATH

Tepidarium of a public bath at Pompeii. Probably 1st century B.C.

Bath in the Alhambra, Granada, Spain; 14th century

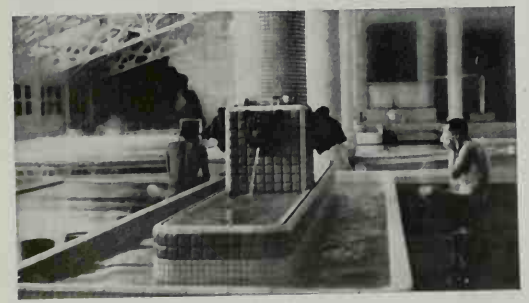
Ruins of the Great Bath, Bath, Eng.; 1st century A.D.

Public bathhouse at Spa, Belg., famous for its mineral springs and source of the common name "spa" for such resorts

Bathing in rough-hewn larch trunks in the mountains of Austria near Gmunden

Pool of the Yéni Kaplidja baths, Brusa, Turk.; 16th century

"Bath of the Princess" (*Baño de la Nusta*), Inca ruin at Ollantaitambo near Cuzco, Peru



Modern Japanese bathhouse at a hot springs

Interior of a Finnish sauna, a steam bath produced by pouring water on heated rocks

BATHS IN EUROPE, ASIA AND SOUTH AMERICA

BY COURTESY OF (BOTTOM RIGHT) FINNISH NATIONAL TRAVEL OFFICE; PHOTOGRAPHS, (TOP LEFT) ALINARI, (TOP RIGHT) FOTO MAS, (SECOND ROW LEFT) EWING GALLOWAY, (SECOND ROW RIGHT) AUTHENTICATED NEWS, (THIRD ROW LEFT) HERBERT PORN FROM BLACK STAR, (THIRD ROW RIGHT) MARTIN CHAMBI, (BOTTOM LEFT) HORACE BRISTOL

has resulted in a multitude of bathhouses. These are usually simple and consist only of a steam room and a cold bath; frequently even the cold bath is lacking and the bather plunges directly from the steam room into a river or outdoor pool or even snow. (H. Hn.)

Finnish Sauna.—The sauna, or Finnish vapour bath, is a traditional national institution. It is presumed to derive from the Scythian baths described by Livy, who tells that these inhabitants of southern Russia threw water and hempseed on heated stones to create an intoxicating steam. The modern Finns omit the hempseed, but their country bathhouses have impressed visitors from the 18th century onward because men and women took steam baths together, beat themselves with birch twigs to stimulate circulation and cleanse the skin and completed the process by plunging into a stream or rolling in snow. (X.)

Far Eastern Baths.—Although bathing has always been popular in both China and Japan, it reached its highest development in the latter. There baths, which traditionally consisted of wooden tubs, usually of considerable size, may be outdoors in the court or garden. Many families followed a custom of serving one filling of exceedingly hot water for the entire family. In the more luxurious houses and hotels, modern conveniences were introduced and tubs were often built indoors. Massage is often associated with bathing in Japan.

The Japanese have also built numerous bath establishments of great size near medicinal springs; a famous example is that near Matsuyama on the island of Shikoku. In these establishments the bath proper consists of a large shallow pool with steps on which the bather sits. Surrounding the pool are cubicles for dressing. The main bathroom is frequently of two stories with tearooms, restaurants, etc., above. In all Japanese baths, public and private, there is no attempt to achieve privacy. Public baths, for instance, frequently have large unprotected openings through which people in the streets can watch the bathers.

Modern Baths.—Contemporaneous with the Industrial Revolution a new feeling for personal cleanliness led quickly to the erection of public bathhouses to compensate for the universal lack of home plumbing. Three main types were constructed. The mid-19th century baths consisted of a range of small individual bathrooms and a control office. With the development of athletics, shower baths and swimming pools were added. The second type, approximating the Roman, is a large and complex structure containing a swimming bath with adjacent ranges of showers through which the bathers are compelled to pass before entering the pool, steam, massage and rest rooms, and occasionally restaurants. The third type was developed in connection with medicinal springs and contains all necessary bath and treatment rooms, plus restaurants, card rooms, concert and dance halls and extensive gardens. Modern western architecture has developed no distinctive forms for either Turkish or Russian baths, both of which have been very popular since the beginning of the 19th century.

The European municipal swimming baths are, in many cases, works of great architectural interest. There are usually first- and second-class establishments under the same roof. The swimming pools are frequently large and are often vaulted, and their resemblance to Roman prototypes is strong. Noteworthy among these are the Guentz bath at Dresden, the municipal bath at Hanover and the enormous and monumental Karl Mueller public baths at Munich. The Imre baths at Budapest are especially lavish in their appointments and show, in their use of domed rooms, strong Turkish influence.

Medicinal baths exist in all countries; among the best known are those of Baden-Baden, Ger., and Karlovy Vary (Carlsbad), Czech.; Vichy and Aix-les-Bains in France; Bath and Harrogate in England; Spa in Belgium; White Sulphur Springs, W.Va., and Hot Springs, Ark., in the United States.

The design of swimming pools has become a science. By means of disinfectants the same water can safely be used again and again, making a swimming pool possible even when the water supply is limited. The tank is usually of reinforced concrete lined with glazed or ceramic tile and furnished at water level with a gutter that automatically removes floating scum.

The medium of the baths hitherto described has been water, vapour or hot dry air. Other substances used are sand, peat, radioactive mud, aromatic herbs in great variety, especially pine oil, scented and soluble salts, and ammonia. (H. Hn.)

Bibliography.—Vitruvius, *De Architectura;* Lucian, *Hippias;* D. Krencker and E. Krüger, *Die Trierer Kaiserthermen,* with extensive bibliography and a survey of the most important Roman baths (1929); A. Mau, "Bäder," in Pauly-Wissowa, *Real-Encyclopädie der classischen Altertumswissenschaft* (1896); H. Glück, *Die Bäder Konstantinopels* (1927); W. P. Gerhard, *Modern Baths and Bath Houses,* with a full bibliography (1908); George Ryley Scott, *The Story of Baths and Bathing* (1939); P. Rowland James, *The Baths of Bath in the Sixteenth and Early Seventeenth Centuries* (1938); Kay Gilmour, *Finland* (1931). (H. Hn.; X.)

BATHOLITH, in geology, a huge body of igneous-appearing rock formed at great depth. The term was derived from the Greek *bathys,* "deep," and *lithos,* "stone." Batholiths are typically developed in the earth's great mountain belts and are composed predominantly of granitic rocks (*see* Granite). Beyond these qualifications, there is much diversity among geologists as to the meaning of the term. Since direct observations are limited to the upper parts of these masses, it is not surprising that a great diversity of opinion also exists as to how these large bodies were created. Various attempts to restrict the definition of batholith and to assign it a genetic meaning have led to much confusion. To satisfy the need for a more general and nongenetic term, these bodies may be referred to as large plutons (plutonic masses).

The large plutons or batholiths appear to fall into two somewhat gradational classes: those formed contemporaneously with the mountain-making epoch (synchronous plutons) and those formed subsequent to it. In general, synchronous plutons are composed of rather heterogeneous and gradational rock types; they are associated with folded and strongly metamorphosed rocks; and they have gentle to steep gradational contacts (*see* Metamorphism). Pluton boundaries roughly conform with structures (foliation and bedding) in adjacent rocks. A marked layering (foliation), displayed more or less throughout, parallels the borders of the pluton. Abundant slablike masses of the adjacent rock, oriented parallel to the foliation, may be enclosed within the pluton.

Subsequent plutons (those formed after the mountain-making) are composed of highly uniform but rather distinct rock types. They are not necessarily observed to be associated with regional metamorphism and folding. Pluton boundaries are steep and sharp, and they crosscut structural features of the enclosing rocks. A weak foliation, if at all developed, is generally confined and parallel to the border zones. Angular blocks of the adjacent rock, in diverse orientations, occur within the pluton.

No single theory adequately explains the origin of large plutons, and it is generally agreed that batholithic bodies may have arisen in a variety of ways. One theory assumes the existence of large masses of molten rock (magma) that rise from great depths and become cooled and crystallized before reaching the earth's surface. Several methods of ascension have been considered. The hot liquid may have melted its way upward, assimilating the solid rock above. It may have advanced upward by engulfing large blocks of the overlying rock, which sank or became digested in the magma. It may have been forcefully intruded from the depths; and, following zones of weakness (folds and faults), may have spread out horizontally and made room by crowding aside and lifting the adjacent rock.

Another theory supposes that large plutons developed, mainly in the solid state, in mountain-making regions (orogenic zones), where portions of the earth's crust were actively undergoing folding, crushing and metamorphism. Recrystallization transformed the original minerals of the sedimentary rocks into quartz and feldspars to form granitic material. According to the chemical replacement theory, it is supposed that during metamorphism great quantities of rock-making material migrated differentially in a more or less dissociated state. Alkalies and silicon were added to the original sedimentary rocks, while calcium, iron and magnesium were carried away. By such chemical substitution or replacement, old minerals were transformed to minerals comprising granitic

rocks (granitization process). So gradual and perfect was this change that only faint (or even no) traces of sedimentary bedding or other structures may have been retained in the pluton. *See* also GEOLOGY; GEOCHEMISTRY; GEODESY; PETROLOGY.

See M. P. Billings, *Structural Geology* (1954). (C. A. CN.)

BÁTHORY, ISTVÁN: *see* STEPHEN (ISTVÁN) BÁTHORY (king of Poland).

BÁTHORY, SIGISMUND (ZSIGMOND) (1572–1613), prince of Transylvania, was the son of the prince Christopher Báthory and Elizabeth Bocskay, and the nephew of the great Stephen Báthory, king of Poland. He was elected prince of Transylvania in his father's lifetime, but on Christopher's death (1581) the government was at first entrusted to a regency because of his youth. In 1588 Báthory took over the government and, on the advice of his foreign counselor Alfonso Carrillo, joined the league of Christian princes against the Turks, thus reversing the traditional policy of Transylvania. This change aroused strong opposition in Transylvania and led to lengthy strife, which was subdued only in 1595 by the execution of Báthory's opponents. The same year he conquered Walachia for his vassal Michael the Brave, after defeating Sinan Pasha at Giurgiu. The turning point of his career was his separation from his wife, the archduchess Christina of Austria, in 1599, followed by his abdication in the same year, so that he might take holy orders. He offered his throne to the Holy Roman emperor Rudolf II, the Habsburg king of Hungary, in exchange for the Silesian duchy of Oppeln (Opole). In 1600, however, on invitation by the Transylvanians, he returned at the head of an army of Poles and Cossacks in an attempt to recover his throne, but was defeated at Suceava by his former vassal Michael the Brave, who had himself become prince of Transylvania. The following year the diet at Kolozsvár (Cluj) recalled Báthory to the throne, but Michael drove him out of Transylvania again before he could occupy it. He died in obscurity at Prague in 1613. (T. K.)

BATHOS, the Greek word for "depth," the bottom or lowest part of anything, was made current in English to describe a descent "from the sublime to the ridiculous" by Pope's satire *Peri Bathous (Miscellanies,* 1727–28), "the art of sinking in poetry." The title was a travesty of Longinus' *On the Sublime. See* FIGURES OF SPEECH: *The Literature of Figures of Speech.* (G. W. A.)

BATHSHEBA (in the Douai version of the Bible, BETHSABEE), wife of Uriah the Hittite and later of David, and mother of King Solomon. Information about her is found in II Sam. xi and xii and in I Kings i and ii. Bathsheba was a very beautiful woman, probably nobly born, a daughter of Eliam, who may have been a son of Ahithophel the Gilonite (II Sam. xxiii, 34), the famed vizier who sided with Absalom when the latter sought to seize his father's throne. Her seduction by David resulted in a pregnancy that precipitated the plotting of Uriah's death by the king, apparently without any collusion on her part. The child of the illicit union died in infancy; but subsequently, as the legal wife of David, she bore Solomon. When David was dying Bathsheba entered into a successful conspiracy with the prophet Nathan to block Adonijah's succession to the throne and win it for her own son. She appears as a strong-willed and fearless personality. Later as queen mother she occupied a characteristically influential position. (J. C. RY.)

BATHURST, EARLS, came of a family said to have settled in Sussex before the Norman Conquest. ALLEN BATHURST, (1684–1775), 1st earl, was born at Westminster on Nov. 16, 1684, son of Sir Benjamin Bathurst. Educated at Trinity college, Oxford, he was member of parliament for Cirencester from 1705 to 1712, when he was one of 12 Tories raised to the peerage, becoming Baron Bathurst of Battlesden. He defended Francis Atterbury, bishop of Rochester, in 1722 and was a consistent opponent of Sir Robert Walpole in the house of lords. He became a privy councilor after Walpole's fall (1742). He was given a pension of £2,000 a year soon after the accession of George III, and was created Earl Bathurst in Aug. 1772. Pope, Swift, Congreve, Matthew Prior and Sterne were among his friends. He died near Cirencester on Sept. 16, 1775.

HENRY (1714–1794), 2nd earl, was born on May 20, 1714, the eldest surviving son of the 1st earl, whose title he inherited in 1775. Educated at Balliol college, Oxford, he was then called to the bar and became a king's counsel (1745). As member of parliament for Cirencester from 1735 to 1754, he was at first in opposition as a supporter of Frederick, prince of Wales, but after his death (1751) Bathurst joined the Pelham connection. He was appointed judge of the court of common pleas in 1754. His appointment as lord chancellor in 1771, when he was made Baron Apsley, was unexpected and he proved incompetent. Loyalty to Lord North led him to resign, somewhat unwillingly, in 1778 to make room for Lord Thurlow in North's cabinet. Thereafter he was lord president of the council (1779–82). He died near Cirencester on Aug. 6, 1794.

HENRY (1762–1834), 3rd earl, was born on May 22, 1762, the elder son of the 2nd earl. He was member of parliament for Cirencester from 1783 until he succeeded to the earldom in Aug. 1794. Mainly as a result of his friendship with William Pitt, he was a lord of the admiralty (1783–89), a lord of the treasury (1789–91) and commissioner of the board of control for India (1793–1802). Returning to office with Pitt in May 1804, he became master of the mint and was president of the board of trade and master of the mint during the ministries of the duke of Portland and Spencer Perceval, only vacating these posts in June 1812 to become secretary for war and the colonies under the earl of Liverpool. For two months during 1809 he was in charge of the foreign office. He was secretary for war and the colonies until Liverpool resigned in April 1827 and deserves some credit for improving the conduct of the Peninsular War. As secretary for the colonies Bathurst was closely concerned with the abolition of the slave trade. He was lord president of the council in the government of the duke of Wellington from 1828 to 1830, and favoured Roman Catholic emancipation, but he strongly opposed the Reform bill of 1832. He died on July 27, 1834. Bathurst was made a knight of the Garter in 1817.

The present holder of the title is HENRY ALLEN JOHN (1927–), 8th earl.

BATHURST, a city of New South Wales, Austr., 129 mi. W.N.W. of Sydney by road and 149 mi. by rail. It lies on the south bank of the Macquarie river at an elevation of 2,206 ft. on a fertile, undulating plain west of the Blue Mountains plateau. Pop. (1961) 16,938. The city has an Anglican and a Roman Catholic cathedral, two hospitals and a racing track for cars and motorcycles. A 100-ft. carillon tower, the only one of its kind in Australia, forms a war memorial. Bathurst is a tourist centre and is famed for its trout fishing. There are cement-pipe, brick and railway works, a flour mill and canning and clothing factories. The district is a sheep-grazing area and produces vegetables, apples, pears and peaches.

Bathurst was officially founded in 1815, being named after the 3rd Earl Bathurst, then secretary for war and the colonies, but its progress was slow until 1851, when gold was found in the area. It became a municipality in 1862 and a city in 1885.

BATHURST, capital of the former British colony and protectorate of Gambia, stands on the Island of St. Mary, a sandbank near the mouth of the Gambia river, west Africa. It is connected with the adjacent division of Kombo St. Mary, on the mainland to the west of Bathurst, by a bridge. Pop. (1963) 27,809. Commercial life is centred on the river front. The main streets have concrete drains on either side and concrete-block buildings now take the place of the former rectangular huts. A housing development has been built on Crab Island, a piece of land that has been reclaimed. A power station at Half-Die supplies electricity to Bathurst, Kombo St. Mary's area and Yundum airport. The new Victoria hospital completed in 1957 was built from the Colonial Development and Welfare funds. Education is provided by primary and infant schools, two secondary schools run by the Roman Catholic mission, a government-run secondary modern school (1958) and a Gambia high school (1959). There is a teachers' training college at Yundum.

Bathurst is the main port but, as the river is navigable, ocean-going steamers load peanuts at the ports of Kuntaur, Kaur and Balingho. There are irregular services of cargo and passenger

vessels to and from the United Kingdom. There are regular air services from Yundum airport, 18 mi. S.W. by road, to Europe and to the other west African territories. The marine department runs regular river steamer services as far as Basse in the upper river division. There are about 40 mi. of bituminous surface roads in the vicinity of Bathurst.

St. Mary's Island was occupied by a few fishermen at the end of the 18th century but was entirely unoccupied when Bathurst was founded by the British in 1816 as a military post to suppress slave-trading and as a trade outlet for merchants who were ousted from Senegal when it was restored to France. (C. I. J.)

BATHYCLES, a Greek sculptor of Magnesia in Ionia, was commissioned by the Spartans during the 6th century B.C. to make a marble "throne" for the statue of Apollo at Amyclae. Pausanias gives a detailed description of this monument, which was perhaps rather an altar built round a more ancient statue than it was a true throne. It was adorned with mythological reliefs and supporting figures in the round. Interesting architectural fragments have been recovered but virtually none of the sculpture. (C. M. RN.)

BATIK: *see* TEXTILES.

BATJAN, a mountainous island of the Moluccas, Indon., lies in the Molucca sea, close to the southwest coast of the island of Halmahera, and is in the Ternate division. It is 50 mi. long and 27 mi. wide. The greatest heights are in the south; Mt. Labuha, or Sibela, for example, reaches 6,922 ft. The centre is lower and the northern part is volcanic. There are no active volcanoes on the island, but sulfurous springs exist and in the south there are ancient and nonvolcanic rocks. West of Batjan are Great Tawali or Kasiruta, 19 mi. long and 15 mi. wide, Mandioli, 17 mi. by 9 mi., and several smaller islands. Gold, copper and coal exist in small quantities, but a company formed to exploit them later abandoned operations.

Batjan's animal life includes the crested Celebes black ape (*Cynopithecus nigrescens*), which exists elsewhere in the archipelago only in Celebes, Sulu and Buru; Batjan is the most easterly point on the globe inhabited by any of the apes. Other mammals are an eastern opossum (*Phalanger orientalis*), a pigmy flying phalanger (*Petaurus ariel*), the great Indian civet (*Viverra zibetha*) and several bats. Among the many birds is a bird of paradise, discovered by A. R. Wallace and named after him *Semioptera wallacei*, Wallace's standard wing. Other birds are a red lory (*Domicella garrula*); little lorikeet (*Charmosyna placentis*); green parrot, with red bill and head (*Geofroyus geofroyi cyanicollis*); golden-capped sunbird (*Hermotimia auriceps*); racquet-tailed kingfisher (*Tanysiptera galatea*); a rare goatsucker (*Aegotheles crinifrons*); and a large and handsome fruit pigeon with metallic green and rust plumage. Among butterflies, Batjan has the fine blue *Papilio ulysses* and the beautiful "bird-winged butterfly."

Wallace described Batjan as "an island that would perhaps repay the researches of a botanist better than any other in the whole archipelago." It has fine trees, a great variety of surface and soil and a number of small streams, a few of which are navigable for small boats for some distance. Its products include sago palm, coconut palm, clove, nutmeg and excellent Moluccas dammar (a resin used for making varnish).

The estimated population of Batjan in 1956 was 21,482, partly people from Ternate and Tidore engaged in collecting forest products, and Javanese and others, working on the plantations of the Batjan Exploitation company. The Batjanese are supposed to have come originally from Halmahera, with whose people they have strong affinities. They cultivate the land on a small scale, fish and make baskets. Other inhabitants include the Serani, or Christian descendants of the Portuguese, Macassarese, Malays, Halmahera men and a few Chinese and Arab traders. Labuha, at the foot of high mountains, is the capital and a port trading in dammar, spices, copra, timber and mother-of-pearl.

The little fort, Barneveld, was built by the Portuguese, and captured from them by the Dutch in 1609. Batjan, hitherto independent, was placed under the suzerainty of the sultan of Ternate, but when the Dutch superseded him in 1683 they made it subject to themselves. Japan occupied Batjan in 1942. The island is now part of Maluku Utara (North Moluccas).

(E. E. L.; J. O. M. B.)

BATLEY, a municipal borough in the Batley and Morley parliamentary division of the West Riding of Yorkshire, Eng., 8 mi. S.S.W. of Leeds. Pop. (1961) 39,390. Area 7 sq.mi. It lies at the junction of the east Pennines and the Yorkshire plain. Mentioned in the Domesday Book as *Bateleia*, by the mid-18th century it was an important wool and market town. Its situation on the southwest Yorkshire coal field led to its development as an industrial town and a centre of the heavy woolen trade as well as of the manufacture of shoddy (*q.v.*) and mungo. Other industries include the making of textile equipment and plastics, and engineering. The history of cloth manufacture is shown at the Bagshaw museum (opened 1911). Oakwell hall, Birstall, a typical Yorkshire manor house dating from the 15th century and described as "Fieldhead" in Charlotte Brontë's *Shirley*, now belongs to the corporation. In a nearby farmhouse Joseph Priestley was born; he was educated at the Batley Grammar school (founded 1612), where Sir Owen Richardson was also a pupil.

BATLLE Y ORDÓÑEZ, JOSÉ (1856–1929), Uruguayan statesman, journalist and anticlerical, was born in Montevideo on May 21, 1856, the son of Gen. Lorenzo Batlle, president of Uruguay from 1868 to 1872. His ancestry was Catalonian, and a grandfather, Josef Batlle, had emigrated to Uruguay at the beginning of the 19th century. José Batlle began but did not complete a law course. In the late 1870s he began a vigorous journalistic career, and on June 16, 1886, founded *El Día*, which became Uruguay's leading newspaper. Batlle fought strongly against a succession of late-19th-century dictators, even those who belonged to his own Colorado party and on various occasions he was the object of personal attacks, persecution and temporary imprisonment.

By 1887 Batlle was ready to launch a long campaign to revivify and purify the Colorado party. That party's chief strength lay in Montevideo, the capital, and the power of its opposition, the Blanco or Nationalist party, was in the rural areas; the two parties had an unofficial working agreement to divide offices between them. At about the same time Batlle held the first of many public offices, that of political chief (governor) of the department of Minas. A few years later he was elected national deputy and in 1898 a senator. In 1895 Batlle began his long prolabour fight, the chief ultimate objective of which was the establishment of an eight-hour day to replace that of 15 to 19 hours then prevailing. This goal was finally attained in Nov. 1915.

Batlle was first chosen president, by the congress, March 1, 1903. Almost immediately a Blanco revolt broke out that was not suppressed until a year and a half later after much bloodshed. In his first term, 1903–07, much of Batlle's energy was expended in improving the country's disastrous financial situation. He also supported bills legalizing divorce, abolishing income taxes for the lowest paid public officials, reorganizing the university curriculum, broadening popular education, etc.

Soon after the end of his first term, Batlle left with his family for Europe and remained there during most of the following four years. He was re-elected president in 1911 to serve until 1915. During his second term he sponsored bills providing for a state monopoly over insurance, encouraging immigration, nationalizing the Bank of the Republic, providing a minimum wage and workers' accident insurance, establishing vacations with pay, more extensive medical care and many other reforms.

His chief campaign during this period, however, was for creation of a plural bipartisan executive in order to prevent personal dictatorships which he felt were a blight on Latin American democracy. He probably received the inspiration for this idea during his residence in Switzerland. The threat that Batlle might be elected president for a third term, 1919–23, moved his opponents, who controlled a constitutional assembly in 1916–17, to compromise the issue and agree to a bifurcated executive with both a presidency and an independent national council of administration. Batlle served twice, in 1920 and 1926, as president of that council. He died in Montevideo, Oct. 20, 1929.

Throughout his life Batlle was a militant agnostic and foe of religious interference in government. He was one of Uruguay's

most controversial figures, arousing both fervent enthusiasm and violent opposition. In many respects, he was ahead of his times. He laboured indefatigably to better the lot of the lower income groups and to extend the powers and services of the state. His residence in Europe widened his views and converted him into one of the early advocates of a world political organization. *See* URUGUAY: *History.* (R. H. FI.)

BATON, from the French *bâton* ("a stick"), a word used in a musical connection to mean the stick used by the conductor of an orchestra to beat time. The practice dates from the 15th century when choirs were directed by a leader holding either a roll of paper or a short stick. In the 17th and 18th centuries conductors would sometimes beat time by tapping their batons on their desks, creating, according to Rousseau, an insufferable noise. A long baton with which the conductor marked the time by striking the floor was also used in the 17th century, notably by Lully. Ludwig Spohr, in 1820, and Mendelssohn, in 1829, were among the first conductors to use a baton to direct a symphony orchestra. Thereafter the baton, a lightweight wooden stick varying in length from 15 in. to 30 in., sometimes with a cork handle, became the instrument of the virtuoso conductor, who used it not only to beat time but to convey, by a great variety of personal gestures, the expression of the music. *See* also CONDUCTING.

BATONI (BATTONI), **POMPEO GIROLAMO** (1708–1787), Italian painter, who was ranked with Anton Raphael Mengs (*q.v.*) as a painter of historical subjects, was born at Lucca on Jan. 25, 1708. Probably his portraits are now better known, as he invented the type of "grand tourist" portrait, very popular among the English, which shows the sitter at his ease among the ruins of antiquity. He also painted three popes and many princes. Reynolds referred to him disparagingly in his 14th discourse, but as a competitor for English sitters he may not have been entirely disinterested. Most of Batoni's portraits are still in country houses, but there are examples at Cardiff and Dublin, at the National Portrait galleries of Edinburgh and London, and at Oxford. He died in Rome on Feb. 4, 1787. (P. J. MY.)

BATON ROUGE, the capital of Louisiana, U.S., and seat of East Baton Rouge parish, on the east bank of the Mississippi river, at the head of deep-water navigation, 80 mi. N.W. of New Orleans. It has a municipal airport and a well-equipped river port which accommodates ocean-going vessels.

Baton Rouge is located on the first bluff above the Gulf of Mexico and is free from overflow at all flood stages of the river. Surrounding the city is a fertile agricultural section adapted to stock raising and dairy farming. Across the river to the southwest are the great sugar plantations, known as the sugar bowl of the United States. Other staple crops raised in the area are rice, cotton, vegetables and fruits.

It is believed that the French named the town for a red cypress tree which marked a boundary between Indian tribes. The French established a fort on the site in 1719, and established a military force to subdue the Indians. The area was ceded to England in 1763 at the end of the French and Indian War. While England was at war with its American colonies, the Spanish overpowered the British garrison there in the first battle of Baton Rouge, Sept. 21, 1779, and controlled the area for the next 20 years. In 1800 Spain ceded Louisiana to France, and Napoleon sold the territory to the United States in 1803 (*see* LOUISIANA PURCHASE). Baton Rouge, however, was claimed by Spain along with the entire territory of West Florida. The inhabitants of Baton Rouge and the U.S.-born citizens of the surrounding parishes rebelled against Spanish rule in the second battle of Baton Rouge (Sept. 23, 1810), and established the West Florida republic (comprising that portion of West Florida east of the Pearl river, the present boundary between the states of Louisiana and Mississippi). The republic was annexed to the United States three months later. Baton Rouge was incorporated in 1817, and became the state capital in 1849. During the Civil War the capital was transferred to other towns; in 1882 it returned to Baton Rouge. Overshadowed by New Orleans down the river, Baton Rouge had a population of only 5,428 by 1860. Throughout the Civil War it was held by Union forces, except for a short period after the third battle of Baton Rouge. A Confederate force, under Gen. John C. Breckinridge, attacked the city on Aug. 5, 1862, and a bloody engagement followed. Although both sides claimed the victory, the Union forces withdrew two weeks later because of a temporary threat to New Orleans. Union forces reoccupied the city in Dec. 1862.

The city grew slowly through the remainder of the 19th century; its population was only 11,269 by 1900. Its growth as an industrial centre began with the building of the Standard Oil company's giant refinery in 1909. Subsequently, numerous chemical plants were established there, attracted by the proximity of the oil fields of the southwest, the economy of ocean and river transportation, and the abundance of natural gas and other natural resources. During World War II Baton Rouge became an important synthetic rubber centre. Refineries and dock facilities were expanded and many large industrial firms built local plants. The city's population increased by more than 300% in the decade 1940–50, from 34,719 to 125,629 (about one-third Negro).

In 1947 most of the suburbs were absorbed in the extension of the city's boundaries, accounting in part for the growth in population. And in the same year the city and parish governments were consolidated to meet the new demands of a rapidly growing urban area. The city continued to grow, and by 1960 the population numbered 152,419. The population of the standard metropolitan statistical area (East Baton Rouge parish) was 230,058 in 1960.

The Louisiana State university and Agricultural and Mechanical college occupies a 3,000-ac. tract along the river, bought in 1920, and occupied in 1925. The university dates to grants of land made by the United States to the state in 1806, 1811 and 1827 "for use of a seminary of learning." The seminary was opened in 1860, near Alexandria. In 1870 it became the Louisiana State university; and in 1877 the Louisiana State Agricultural and Mechanical college, which had been opened in New Orleans in 1874, was consolidated with it. Southern University and Agricultural and Mechanical college, a Negro institution, was founded in Baton Rouge in 1880. (G. M. CA.)

BATSWANA: *see* TSWANA.

BATTALION, a tactical military organization composed basically of a headquarters and two or more companies, batteries, or similar organizations. The term has been used in nearly every western army for centuries and has had a variety of meanings. In the 16th and 17th centuries it denoted a unit of infantry forming part of a line of battle, and was loosely applied to any large body of men. During the Napoleonic Wars the French developed an army organization in which the regiment was a unit of administration for its battalions serving as fighting units in the field. In this connection, the terms regiment and battalion often were used interchangeably, but in most modern armies the regiment is the higher unit.

In the armies of the British Commonwealth, infantry battalions, usually commanded by lieutenant colonels, are tactical units formed within regiments, which are not tactical but serve as administrative parent organizations. The equivalent tactical artillery and armoured units, however, are called regiments. In most military forces, the cavalry and aviation equivalent of the battalion is the squadron.

In the U.S. army of the early years of the 20th century a battalion usually numbered from 500 to 1,000 men, and normally was commanded by a lieutenant colonel. After World War I, the "square" infantry battalion of four companies was superseded by the "triangular" battalion of World War II and the Korean war, usually composed of three rifle companies, a heavy weapons company and a headquarters company. During World War II and in Korea, the infantry battalion often was used as the nucleus of a combat team in special operations, such as air-borne or amphibious assaults, requiring decentralization of tactical control by higher echelons. Battalion combat teams included such reinforcements for independent action as attached artillery, tanks, engineers and other special elements. In 1957 the U.S. army eliminated its infantry battalions and regiments, replacing them with "battle groups" (*see* REGIMENT). Battalion organization was retained,

however, in most noninfantry commands. A further reorganization, begun in 1961, called for the restoration of infantry battalions as administratively and tactically self-sufficient units of between 800 and 900 officers and men, normally divided into a headquarters company and three rifle companies. Armoured battalions were to be reorganized along similar lines. From two to five battalions were to form the combat maneuver elements attached to a tactical brigade (*q.v.*).

In the Soviet army the battalion was smaller than its U.S. counterpart. A typical rifle battalion of a rifle division consisted of 550 officers and men organized into three 100-man rifle companies plus machine gun, artillery, mortar and service units.

(H. C. T.)

BATTAMBANG, a town and province of Cambodia, southeast Asia. The province consists largely of a low-lying plain west of the lake Tonle Sap and physically continuous with the eastern Bangkok plain in Thailand. It is largely shielded by the Cardamom mountains from the rain-bearing southerly winds, and its annual rainfall averages only 50 in., with winter drought. Its agriculture, therefore, is mainly dependent on the regular floods caused by the rise and fall of the water level in Tonle Sap, which is related more to the Mekong river regime than to the local rains. These floods, from August to October, make possible rice cultivation without engineered irrigation. The lake also yields an abundant supply of fresh-water fish, the foundation of a trade in dried, salted and fermented fish.

The population of the province is 552,588 (1962) and of the town 46,762. The area of the province is 7,162 sq.mi. The town is sited roughly at the maximum limit of the lake floods and 25 mi. from the permanent water level. It is a market centre with a substantial Chinese trading community. It has rail and road links southeastward to Phnom Penh and a rail link to Thailand, and is a stop on the air route from Saigon to Bangkok. Part of the medieval Cambodian empire, in 1794 Battambang passed under Siamese suzerainty until 1907 when the French enforced the claim of the Cambodian kingdom. It reverted to Thailand in 1941 but was again ceded to Cambodia in 1946. (E. H. G. D.)

BATTANI, AL- (ABU- 'ABDULLAH MUHAMMAD IBN JABIR AL-BATTANI, called in Latin ALBATEGNIUS or ALBATENIUS) (*c.* 858–929), Arab astronomer described as "the greatest of Islam" (G. Sarton), was born about 858 in or near Harran and died near Samarra in 929. His remarkably accurate astronomical observations began in 877; he compiled a catalogue of the fixed stars for the years 880–881; he discovered the movement of the sun's apogee and assigned to annual precession the improved value of 54.5″ and to the inclination of the ecliptic that of 23° 35′; and he showed that annular eclipses of the sun were possible. His principal work, *De motu stellarum,* translated by Plato Tiburtinus (*c.* 1116) and annotated by Regiomontanus, was published at Nürnberg in 1537; the Arabic text from a manuscript in the Escorial library near Madrid, Spain, with a Latin translation by Nallino, was published in three volumes in Milan in 1899–1907.

See G. Sarton, *Introduction to the History of Science,* vol. i (1927).

(D. McK.)

BATTEN, in industry a term used in joinery for a board not more than 4 to 7 in. broad or 3 in. thick employed for various purposes, such as for strengthening or holding together laths and other woodwork. It is also applied to the strips of wood used in roofing for the fixing of slates or tiles; such battens are usually in sections about 2 by 1 in.

On board ship the name batten is applied to a strip of wood nailed to a mast to prevent rubbing or to fix down a tarpaulin over a hatchway in rough weather.

BATTENBERG, the name of a family of German counts, which died out about 1314, whose seat was the castle of Kellerburg, near Battenberg, in Hesse. The title was revived in 1851, when Alexander (1823–88), a younger son of Louis II, grand duke of Hesse, contracted a morganatic marriage with the Polish lady, Countess Julia Theresa von Hauke (1825–95), who was then created countess of Battenberg. In 1858 the countess and her children were raised to the rank of princes and princesses of Battenberg, with the title of *Durchlaucht,* or serene highness.

In 1917 the eldest son of this union, Louis Alexander (1854–1921), who had become an admiral in the British navy, was created marquess of Milford Haven (*see* MILFORD HAVEN, LOUIS ALEXANDER, 1ST MARQUESS OF), and, at the request of King George V, the members of the family who lived in England renounced, in 1917, the German title of prince of Battenberg and adopted the surname of Mountbatten. The second son, Alexander Joseph (1857–93), was elected Prince Alexander I of Bulgaria in 1879. (*See* ALEXANDER OF BATTENBERG.) Henry Maurice, the third son, married on July 23, 1885, Beatrice, youngest daughter of Victoria, queen of England, became a naturalized Englishman and was appointed captain general and governor of the Isle of Wight and governor of Carisbrooke. He died at sea on Jan. 20, 1896, of a fever contracted on active service with the British troops during the Ashanti War. The fourth son, Francis Joseph (1861–1924), married in 1897 Anna, daughter of Nicholas I, prince of Montenegro, and was the author of *Die volkswirtschaftliche Entwicklung Bulgariens von 1879 bis zur Gegenwart* (1891).

The only daughter of the princess of Battenberg, Marie Caroline (1852–1923), married in 1871 Gustavus Ernest, prince of Erbach-Schönberg. Princess Alice of Battenberg (b. 1885), daughter of Prince Louis Alexander, and Victoria Eugénie (Princess Ena of Battenberg; b. 1887), only daughter of Prince Henry Maurice, were both married before 1917, the former to Prince Andrew of Greece and the latter to Alphonso XIII, king of Spain. Prince Henry's youngest son, Maurice of Battenberg, was killed in action near Ypres on Oct. 27, 1914. For the descendants, with three exceptions, of princes Louis Alexander and Henry Maurice *see* MOUNTBATTEN.

BATTERING RAM: *see* ENGINES OF WAR.

BATTERSEA, a metropolitan borough of London, Eng., which under the London Government Act 1963 was amalgamated on April 1, 1965, with the greater part of Wandsworth to form the new London borough of Wandsworth (*see* LONDON). Battersea metropolitan borough was bounded north by the Thames, there crossed by the Chelsea, Albert, and Battersea bridges, and by Lambeth and Wandsworth. Pop. (1961) 105,870. Area 3.4 sq.mi.

At the Domesday survey it was called Patricesy and the manor belonged to the abbey of St. Peter, Westminster. Under Henry VIII it passed to the crown and later to the St. John family and to the earls of Spencer. York Road recalls the existence of a palace of the archbishops of York, occasionally occupied by them between the reigns of Edward IV and Mary. In the 17th and 18th centuries Battersea was celebrated for its enamelware, specimens of which are highly valued, and for its market gardens where grew the best and earliest celery in London.

On the riverbank are several large factories and the well-designed Battersea electric power station. Wandsworth common (175 ac.) and Clapham common (205 ac.) are partly within the borough. Battersea park (200 ac.), bordering the Thames between Albert and Chelsea bridges, was laid out in 1858 on the site of Battersea fields, a former resort which had become derelict. The park contains a lake, a subtropical garden and many handsome trees; in 1951 part of it was adapted as pleasure gardens in connection with the Festival of Britain. The Dog's and Cat's home (founded 1860) is on Battersea Park road.

Battersea has returned two members to parliament since 1918, one for Battersea North and one for Battersea South.

BATTERY. The term battery, as commonly used in electricity and electrochemistry, refers to a device for converting chemical energy directly to electrical energy. The mechanism of the process involves the arrangement of chemicals in such a manner that electrons are released in one part, or electrode, of the battery and caused to flow through an external circuit to the other part, or electrode. Such batteries are called voltaic cells.

The part of the battery at which the electrons are released to the external circuit is called the anode, or the negative electrode or pole; the part that receives the electrons from the external circuit is called the cathode or the positive electrode or pole. (The terms anode and cathode are used here in the accepted scientific sense in referring to components of a battery that produces elec-

tric current; in a device that consumes current—*e.g.*, an electroplating cell, an electron tube, etc.—the term anode is commonly applied to the positive electrode while the negative electrode is called the cathode.) Familiar examples of batteries are the so-called dry cells used in flashlights, lead-acid batteries used in automobiles and mercury batteries used in hearing aids.

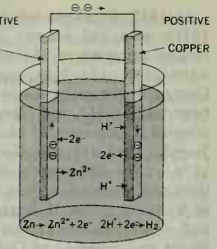


FIG. 1.—SIMPLE ZINC-COPPER CELL

Batteries that do not depend upon a chemical reaction have been developed to convert solar energy and nuclear energy directly to electrical energy. These are commonly called solar batteries, thermal batteries and nuclear batteries. The term battery, strictly used, means an assembly of two or more cells; but the term is now generally used to refer to one or more cells.

A Simple Cell.—One of the simplest batteries can be made from a zinc rod and a copper or carbon rod inserted in a solution of dilute acid (fig. 1). At the negative electrode the zinc atoms give up electrons to form zinc ions. This is indicated with the chemical equation $Zn \rightarrow Zn^{2+} + 2e^-$. The released electrons move through the external circuit to the copper (or carbon) electrode, from which they are picked up by the hydrogen ions of the acid solution to form hydrogen atoms, and, in turn, hydrogen molecules. This is indicated with the equation

$$2H^+ + 2e^- \rightarrow 2H \rightarrow H_2 \text{ (gas)}$$

The current is carried through the solution in the internal circuit between the two electrodes by the ions of the solution.

This battery will operate satisfactorily for a short time, but soon the hydrogen gas produced at the positive pole will cover the electrode and prevent further reaction. Such an electrode, coated with reaction products, is said to be polarized. In the early days of battery development a chemical called a depolarizer was added, presumably to react with and remove the hydrogen. It was recognized later, however, that any chemical with a strong enough affinity for electrons to remove them from the hydrogen would be the chemical to receive the electrons at the electrode in preference to the hydrogen. Hence, the chemical was not acting as a depolarizer but rather as the electron acceptor, called the cathodic material, at the positive electrode. An example of such a material is manganese dioxide in a dry cell.

Theory of Cell Operation.—A voltaic cell can be described as a device composed of two chemicals with different electron attracting powers immersed in an electrolyte and connected to each other through an external circuit. These two chemicals are called an electrochemical couple. In the zinc-acid cell described above, the electrochemical couple is the zinc-hydrogen ion couple. The reaction occurring between the electrochemical couple in the voltaic cell is an oxidation-reduction reaction and can be written as one over-all reaction; *e.g.*, in the cell above the over-all reaction is

$$Zn + 2H^+ \rightarrow Zn^{2+} + H_2$$

It is also customary to write the electron reaction occurring at each electrode. For example, in the above cell at the negative electrode $Zn \rightarrow Zn^{2+} + 2e^-$ (oxidation occurs at the anode); at the positive electrode $2H^+ + 2e^- \rightarrow H_2$ (reduction occurs at the cathode). These are called half reactions, or electrode reactions.

The electron releasing or attracting power of ions (or atoms) in solution is indicated by a table of electrode potentials of half reactions called the electromotive force series or standard electrode potentials (Table I). Since it is necessary to have two half reactions to give the over-all cell reaction it is not possible to measure the voltage of a half reaction alone. However, for purposes of comparison, the voltage of the hydrogen half reaction

$$H_2 \rightleftharpoons 2H^+ + 2e^-$$

has been arbitrarily set at zero and the voltage of a cell in which this reaction is one of the half reactions is taken as the voltage of the other half reaction; these are the values given in Table I. Furthermore, such a table is compiled by measuring the voltage of each metal in a molar solution of a salt of the metal (*i.e.*, in solutions whose activity is unity).

From such a table it is possible to select the chemicals usable for the two half reactions and to predict the probable voltage of such a cell. The voltage will vary from these values according to the temperature and the concentration of the electrolyte.

Voltage, Current and Capacity of a Cell.—Ohm's law gives the relationship between the voltage (E), the current (I) of the cell and the resistance (R) of the circuit.

$$E = IR$$

E is given in volts, I in amperes and R in ohms. An analogy frequently helpful in visualizing the meaning of this equation is a comparison of the flow of electrons with the flow of water molecules down through a vertical pipe. E, the electrical potential or electromotive force, corresponds to the height of the pipe; R corresponds to the resistance to flow; and I, the current, is the rate of flow.

TABLE I.—*Electromotive Force Series at 25°*

Element	Ion	Half reaction	Electrode potential (v.)*
Metals			
Lithium	Li^+	$Li = Li^+ + e^-$	−3.05
Potassium	K^+	$K = K^+ + e^-$	−2.93
Barium	Ba^{2+}	$Ba = Ba^{2+} + 2e^-$	−2.90
Calcium	Ca^{2+}	$Ca = Ca^{2+} + 2e^-$	−2.87
Sodium	Na^+	$Na = Na^+ + e^-$	−2.71
Magnesium	Mg^{2+}	$Mg = Mg^{2+} + 2e^-$	−2.37
Aluminum	Al^{3+}	$Al = Al^{3+} + 3e^-$	−1.66
Zinc	Zn^{2+}	$Zn = Zn^{2+} + 2e^-$	−0.76
Iron	Fe^{2+}	$Fe = Fe^{2+} + 2e^-$	−0.44
Cadmium	Cd^{2+}	$Cd = Cd^{2+} + 2e^-$	−0.40
Nickel	Ni^{2+}	$Ni = Ni^{2+} + 2e^-$	−0.25
Tin	Sn^{2+}	$Sn = Sn^{2+} + 2e^-$	−0.14
Lead	Pb^{2+}	$Pb = Pb^{2+} + 2e^-$	−0.13
[Hydrogen	H^+	$H_2 = 2H^+ + 2e^-$	0.00]
Copper	Cu^{2+}	$Cu = Cu^{2+} + 2e^-$	+0.34
Mercury	Hg_2^{2+}	$2Hg = Hg_2^{2+} + 2e^-$	+0.79
Silver	Ag^+	$Ag = Ag^+ + e^-$	+0.80
Platinum	Pt^{2+}	$Pt = Pt^{2+} + 2e^-$	+1.20
Gold	Au^{3+}	$Au = Au^{3+} + 3e^-$	+1.50
Nonmetals			
Sulfur	S^{2-}	$S^{2-} = S + 2e^-$	0.48
Iodine	I^-	$2I^- = I_2 + 2e^-$	+0.54
Bromine	Br^-	$2Br^- = Br_2 + 2e^-$	+1.07
Chlorine	Cl^-	$2Cl^- = Cl_2 + 2e^-$	+1.36
Fluorine	F^-	$2F^- = F_2 + 2e^-$	+2.65

*Oxidation potentials are same but of opposite sign.

Two other terms related to cells are the faraday and the coulomb. A flow of electrons is called an electric current. If 6.02×10^{23} electrons flow from one electrode to another, a faraday of electricity has passed. If 1/96,500 of a faraday is produced by the battery, a coulomb of electricity has passed. If the rate of flow of electrons is a coulomb per second, the strength of the current is one ampere.

The capacity of a cell is frequently given in terms of ampere-hours. Capacity is determined by the quantity of electrons that can be released at the anode and accepted at the cathode; this quantity in turn is determined by the amount of available reactive anodic and cathodic material on the electrodes. A 100 amp.hr. battery is one that will produce a current of 5 amp., for example, for 20 hours.

Types of Cells.—Voltaic cells can be classified as follows: (1) Primary batteries; (2) Secondary or storage batteries, or accumulators; and (3) Cells for scientific measurements.

Miscellaneous cells other than voltaic cells may be classified as: (1) Nuclear; (2) Solar; and (3) Thermal.

HISTORY

The two most commonly used types of batteries are the lead-acid battery employed in automobiles and the dry cell used in most flashlights. The lead-acid battery, which dates back to Gaston Planté's discovery of the lead-acid system in 1859, may be charged and discharged many times. The electric generator for

charging lead-acid batteries was not developed until 20 years later. The stimulus for the development of the generator was the invention of the electric light bulb by Thomas A. Edison in 1879. Prior to the invention of the generator, lead-acid batteries were recharged by batteries of the dry cell type, patented in 1868 by Georges Leclanché. Hence, the Leclanché cell, which is nonchargeable, became known as the primary battery and the chargeable type battery was designated the secondary battery, or storage battery, or accumulator.

The other batteries used industrially are the Edison battery, invented by Edison in 1908, and the nickel-cadmium battery, invented jointly by W. Jungner and K. L. Berg in 1893–1909.

Primary Cell.—The early history of primary cells and batteries goes back much before this time. The Parthians (250 B.C. to 224 B.C.) may have used batteries for gold-plating jewelry. Records describe the observations of Alessandro Volta (1792) on the difference in potential of metals in contact with an electrolyte; he developed the concept of the electrochemical series. In 1800 he described (*Philosophical Transactions of the Royal Society*, 90, 403–431) the first operating battery (called a Volta pile). It consisted of a disc of silver (cathode), a slightly smaller disc of paper or cloth or similar material soaked in a salt solution (electrolyte), a disc of zinc (anode), then a second silver disc in dry contact with the zinc, followed by an electrolyte layer and a second zinc, and so on until a battery of substantial voltage was produced. In another form of the same battery, the individual cells were assembled in separate vessels called a "crown of cups." In such a cell, when the circuit is closed, zinc dissolves in the electrolyte as zinc ions, liberating electrons,

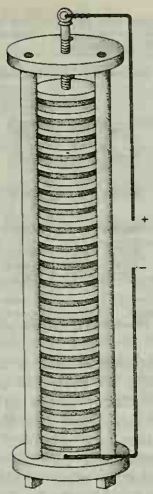
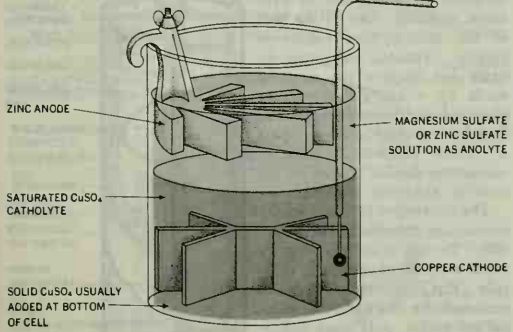


FIG. 2.—A VOLTA PILE

$$Zn \rightarrow Zn^{2+} + 2e^-$$

the latter giving the anode a negative charge. The electrons travel through the external connection from the anode to the cathode, where molecular hydrogen is liberated: $2H^+ + 2e^- \rightarrow H_2$, or, in terms of hydronium ions, $2H_3O^+ + 2e^- \rightarrow 2H_2O + H_2$. The cathode (silver or copper) is not electrochemically changed; it is an inert electrode.

Most of the early electrochemical discoveries were made with Volta's battery; among these were Sir Humphry Davy's electrolysis of molten salts that led to the isolation of the alkali metals, the carbon arc (1809) and the laws of electrolysis (Michael Faraday, 1833).



FROM W. A. KOEHLER, "PRINCIPLES AND APPLICATIONS OF ELECTROCHEMISTRY" (JOHN WILEY & SONS, INC.)

FIG. 3.—DANIELL CELL, GRAVITY TYPE

The Volta pile type of battery polarizes readily on continued use. In 1836, a cell was developed by John F. Daniell that effectively prevents polarization. This cell (fig. 3) consists of a zinc anode immersed in a solution of zinc sulfate, magnesium sulfate or dilute sulfuric acid, and a copper cathode in a saturated copper sulfate solution. The two liquids may be separated by a porous diaphragm or, as is more common in commercial practice, by gravity alone, the copper sulfate solution being the heavier and remaining at the bottom of the battery container.

The anode reaction, as in the Volta pile, involves the solution of zinc during discharge

$$Zn \rightarrow Zn^{2+} + 2e^-$$

and the formation of zinc sulfate; at the cathode, metallic copper is deposited from the copper sulfate solution:

$$Cu^{2+} + 2e^- \rightarrow Cu$$

The over-all chemical reaction may be expressed as

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$

To offset the resulting loss in dissolved copper, and so to ensure maximum capacity, an excess of copper sulfate crystals is usually placed in the bottom of the container when the cell is assembled.

The Daniell cell has an open-circuit voltage of about 1.08 v. and, since it shows no marked polarization at moderate current drains, it gives a steady operating voltage. However, internal resistance in the standard construction is relatively great, and large current drains cannot readily be obtained; zinc corrosion is high, even when the cell is idle. Consequently, the cell, formerly much used for telegraph and similar applications, was largely superseded by other types; *e.g.*, the Lalande and air-depolarized batteries.

As early as 1801 it was observed that amalgamating the electrodes (*i.e.*, coating them with mercury) helped reduce wasteful corrosion of electrodes when batteries were not in use and thus improved their shelf life.

Oxidizing agents, or "depolarizers," were first used in 1839; their purpose is to prevent polarization at the cathode due to accumulation of hydrogen. Sir William R. Grove (1839) developed a two-fluid cell consisting of amalgamated zinc immersed in dilute (8%) sulfuric acid, the latter separated by a porous pot from a strong nitric acid solution containing a platinum cathode. The substitution, generally credited to Robert Wilhelm Bunsen, of cheap retort carbon for platinum contributed in large measure to the general acceptance of this cell. The over-all reaction

$$Zn + 2HNO_3 + H_2SO_4 \rightarrow ZnSO_4 + 2NO_2 + 2H_2O$$

involved reduction of nitric acid and placing zinc into solution, the cathode remaining unaffected, as in the Volta pile. The cell had a high initial voltage of 1.8–1.95, depending on the acid strength, and it was capable of delivering heavy currents at sustained voltages.

Dichromate Cell.—Further advance was effected by substituting chromic acid for nitric acid in the Grove-Bunsen cell. The diaphragm was commonly omitted and only a single solution was employed; the solution consisted of potassium dichromate, or the less expensive sodium salt, dissolved in sulfuric acid. On discharge, zinc dissolved anodically while dichromate was reduced, the cell reaction proceeding in accordance with the equation:

$$3Zn + 7H_2SO_4 + Na_2Cr_2O_7 \rightarrow 3ZnSO_4 + Na_2SO_4 + Cr_2(SO_4)_3 + 7H_2O.$$

The cell had a voltage of 2; it showed exceptionally low operating cost; and although it lacked the steady-drain characteristics of the Grove-Bunsen element, it was well adapted to the delivery of comparatively high currents for limited periods of time.

The introduction at the cathode of solid cathodic materials, such as manganese dioxide (MnO_2) and lead dioxide (PbO_2), by August Arthur de la Rive in 1856 marked an important forward step in primary battery development. Such solid materials may be substantially insoluble in electrolyte, so that there is little of the tendency characteristic of liquid cathodic material to migrate toward the zinc anode and accelerate corrosion of the latter when

the cell is not in use. Consequently, the need for two-fluid and diaphragm cells was eliminated, construction was simplified and the modern cell of good keeping quality was made possible.

Storage Batteries.—The idea of using a chemical reaction to store electrical energy dates back to the early experiments with electricity. If two platinum plates were used to pass an electric current through sulfuric acid solution for a short time and the current was interrupted, it was found that the platinum plates could then supply a small electrical current. The current was thought to result from a chemical reaction occurring on the surface of the platinum and was described by the term "polarization." The current so available was too small to be of practical use, and the phenomenon was merely an electrochemical curiosity.

TABLE II.—*Chemical Composition and Performance Characteristics of Various Dry Cells*

Type	Cell components			Energy-producing reaction	Open circuit voltage (v.)	Average operating voltage* (v.)
	Anode	Electrolyte	Cathode			
Commercial cells						
Leclanché	Zn	$NH_4Cl - ZnCl_2$	MnO_2	$Zn + 2MnO_2 \rightarrow ZnO.Mn_2O_3$†	1.5–1.65	1.25
Zinc-mercuric oxide	Zn	KOH	HgO	$Zn + HgO \rightarrow Hg + ZnO$	1.34	1.30
Alkaline zinc-manganese dioxide	Zn	NaOH	MnO_2	$Zn + 2MnO_2 \rightarrow Mn_2O_3 + ZnO$	1.52	1.15
New cell developments						
Magnesium-manganese dioxide	Mg	$MgBr_2$	MnO_2	$Mg + H_2O + 2MnO_2 \rightarrow Mn_2O_3 + Mg(OH)_2$	1.8–2.0	1.4–1.5
Magnesium-bismuth oxide	Mg	$MgBr_2$	Bi_2O_3	$3Mg + 3H_2O + Bi_2O_3 \rightarrow 2Bi + 3Mg(OH)_2$	1.6	1.03
Air	Zn	NaOH	O_2(Air)	$Zn + \frac{1}{2}O_2 \rightarrow ZnO$	1.4–1.5	1.2–1.3
Indium	In	KOH	HgO	$2In + 3HgO \rightarrow 3Hg + In_2O_3$	1.15	1.05
Aluminum	Al	$AlCl_3 - (NH_4)_2Cr_2O_7$	MnO_2	$2Al + 3H_2O + 6MnO_2 \rightarrow 3Mn_2O_3 + 2Al(OH)_2$	1.7	1.3

*Approximate results for a light drain application. †Example of one of several reactions that can occur in a Leclanché dry cell.
Source: Morehouse, Glicksman and Lozier, *Proceedings of the IRE*, pp. 1462–83 (Aug. 1958).

It was observed that the electrical current resulting from polarization was much greater when lead plates were used for the electrolysis. This observation was put to a practical use in 1859 by Planté, who rolled up two long strips of sheet lead separated by pieces of flannel and immersed the assembly in dilute sulfuric acid. This cell, after a short charge, could produce a moderate amount of current. The current available was increased to a useful value by giving the cell alternate charge and discharge. A modification of this type of battery is still in use today. The method of separation was improved to obtain materials of greater resistance to acid, and the principle (namely, the use of metallic lead with a large area) was developed to provide batteries that are useful principally for stationary service.

In 1881 Camille Faure devised a battery that required less lead and is the basis for the modern automobile battery. Instead of a thick sheet of lead, a latticework, or grid, of lead is used; and, instead of producing the active material by corroding the lead support, a paste of lead oxide is applied to the grid and is converted by an electric current to a material of high activity and relatively low weight.

Both the Planté and the Faure batteries had one serious disadvantage. When the battery was charged and discharged frequently, small particles of the active material of the positive plate fell to the bottom of the cell. This loss of active material reduced the capacity of the battery, and sediment built up until the cell was no longer usable.

The search for methods of preventing this trouble resulted in two types of construction, the Ironclad and the Kathanode. Both these batteries feature a barrier that holds the positive active material in place and has thereby increased life of the batteries to a point where they are practical and economical sources of motive power.

An entirely different line of attack was used about 1900 by Edison, who made a survey of all possible chemical systems that might be used in a storage battery and concluded that the combination of an alkaline electrolyte, an iron negative plate and a nickel oxide positive plate had considerable merit. He developed a practical battery using this system.

The nickel-cadmium battery was developed about the same time. Jungner, working in Sweden, found that cadmium could be used in the negative plate. The construction of this battery was similar to Edison's, and it, too, was found to be useful for certain applications.

PRIMARY CELLS

A number of types of primary cells are now in use. These may be classified as (1) dry; (2) wet; (3) solid electrolyte; (4) reserve; (5) fuel; and (6) standard cells (to be discussed under *Cells for Measurement*).

Dry Cells.—These cells are not dry but contain an aqueous electrolyte that is unspillable or immobilized. Many of these cells are sealed to avoid seepage of the electrolyte or reaction products. In the early 1960s two types of dry cells were produced in large quantities, the Leclanché cells and the mercury cells. Another type produced in smaller quantities was the alkaline zinc-manganese dioxide cell. Much research has been done on developing more suitable systems. Among the proposed systems studied are the Leclanché type of cell in which magnesium anodes are used in place of zinc, and air-depolarized cells in which atmospheric oxygen is used as the electron acceptor material at the cathode.

The characteristics of several cell systems are given in Table II.

Leclanché Cells.—This type of cell was described in 1868, but the description came after several thousand of the cells had been in use in railroad signal systems and telegraph lines for several years. Approximately 90% of the dry cells produced annually in the United States are of this type.

The original type made by Leclanché contained a spillable electrolyte of ammonium chloride solution with zinc as the anode and manganese dioxide as the cathode. This same electrochemical couple was used later with an immobilized electrolyte. More than 2,000,000,000 of these cells were made each year in the early 1960s. Probably the best-known Leclanché dry cell is the cylindrical type commonly used in flashlights; a cross section of such a cell is shown in fig. 4. In this cell the amalgamate zinc can serve as both the container and the anode. The cathode is formed from a mixture of manganese dioxide and graphite to make a conductive medium. This mixture is packed around a graphite rod that serves as a chemically inert electrode and through which electrons can flow to the manganese dioxide which captures the electrons from the external circuit; as a result of the capture, manganese is reduced from a 4+ to a 3+ oxidation state.

The manganese dioxide may be naturally occurring ore or synthetic material. One of the best of the natural ores occurs in Ghana. Synthetic manganese dioxide for battery use may be made by either electrolytic or chemical oxidation of manganese. Usually a mixture of about 1 part of carbon black to 8 parts of manganese dioxide is used for the positive electrode material.

The electrolyte contains mainly ammonium chloride and zinc chloride. To this is usually added a small amount of mercuric chloride ($HgCl_2$), which amalgamates with the zinc and reduces local cell action; potassium dichromate ($K_2Cr_2O_7$) is often added to inhibit the corrosion of the zinc

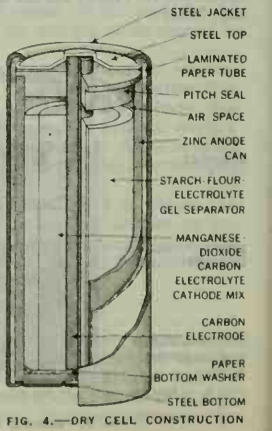


FIG. 4.—DRY CELL CONSTRUCTION

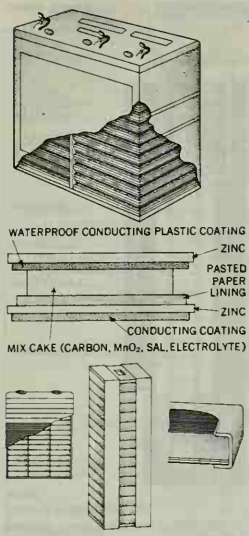


FIG. 5.—(ABOVE) CONSTRUCTION OF FLAT-TYPE B BATTERY; (BELOW) IMPROVED FLAT-TYPE B BATTERY CONSTRUCTION, "MINI-MAX"

and to give longer shelf life.

An "inside-out" cell is also constructed in which the zinc anode is at the centre of the cell. This type is claimed to give better utilization of the zinc.

A second type of construction is the flat cell type or the layer built type, which has been designed primarily for high voltage cells (fig. 5[a] and 5[b]).

The Zinc-Mercuric Oxide Cells.—This type of cell was suggested in 1884 but was not developed for practical commercial use until the early 1940s. This cell (fig. 6) contains an amalgamated zinc anode, a mixture of mercuric oxide with about 5% graphite as the cathode and an approximately 45% solution of potassium hydroxide as the electrolyte. The cell gives about 1.34 v.

An advantage of this cell is a more constant voltage during the life of the cell as compared with the Leclanché cell; a disadvantage is the cost of the mercuric oxide as compared with the cost of manganese dioxide, which is in the ratio of about 100 to 1.

Mercury batteries are used in both civilian and military applications, including hearing aids, portable radios, communication equipment and scientific apparatus.

The Zinc-Manganese Dioxide-Sodium Hydroxide Cell.—The cell is similar in construction to the mercury cell (fig. 6). Its capacity is not as high as the mercury cell, but the cost is less. It gives an open circuit voltage of 1.52 v.

Miscellaneous Dry Cells.—Air dry cells, sometimes called air-depolarized cells, use molecular oxygen of the air absorbed on porous carbon as the cathode material to accept electrons. The anode is zinc and the electrolyte is sodium hydroxide. The disadvantage of these cells is that they dry out after long periods of operation. However, the wet type of air cell is quite satisfactory.

Magnesium dry cells have been investigated as replacements for the present Leclanché cells and appear very promising. Cells using magnesium anodes and manganese dioxide cathodes give 2 v. and in many cases have better capacity characteristics than Leclanché cells. Other research in the early 1960s also indicated it might be possible to replace manganese dioxide in magnesium cells with organic cathodic materials.

Other dry cells using aluminum-manganese dioxide and indium-mercuric oxide showed some promise in the early 1960s.

Wet Cells.—Primary cells containing free and mobile electrolyte are used when service requirements include a large capacity, moderately high currents and long life. Examples of uses with such requirements are telephone and telegraph circuits, and signal systems for marine, mine, highway and railway use. Examples of these cells are the Lalande cell of zinc-copper oxide-sodium hydroxide devised by Felix Lalande about 1880 and the zinc-air-sodium hydroxide cell.

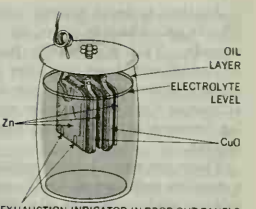


FIG. 7.—LALANDE (COPPER-OXIDE) CELL, AGGLOMERATED PLATE TYPE

Lalande cells (fig. 7) are designed in general to meet the following specifications:

Capacity	500–1,000 amp.hr.
Voltage and current	0.5–0.7 v. up to 15 amp.

The air cells can be used to replace Lalande cells; they differ from the Lalande cells in that a porous carbon electrode to absorb air-oxygen replaces the carbon electrode inserted in a mass of copper oxide. They are designed to give continuous current as high as 2 amp. and 1.1 to 1.2 v. The type used for railroad signal systems is shown in fig. 8.

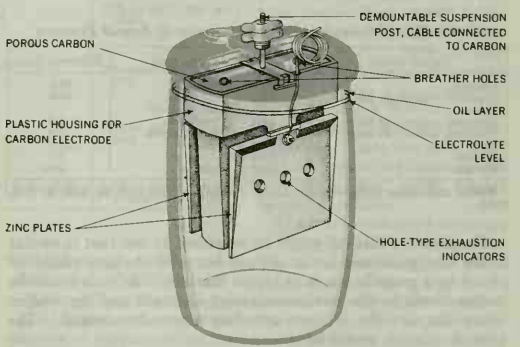


FIG. 8.—AIR CELL BATTERY, RAILWAY TYPE

Solid Electrolyte Cells.—Cells used where a low current drain (in order of microamperes) is required may be constructed with a solid electrolyte. An example of such a cell is the silver-silver iodide-iodine cell. The silver iodide is an ionic conductor. This cell has an open circuit voltage of 0.69 and a peak current of 20 μamp.

Solid electrolyte cells give long shelf lives of 10 to 20 years. Hence they are suitable for long-term operations that require very low drain or for stand-by services. An example of a commercial solid electrolyte cell is a silver-silver bromide-copper bromide cell that is about $\frac{1}{2} \times 1$ in. over-all, weight 0.15 oz., produces 95 v., contains an available charge of 1 coulomb and produces a flash current of 8 μamp.

Solid electrolyte cells are also constructed by encasing the electrolyte in a solid wax. One such cell contains a zinc anode, a manganese dioxide cathode and an electrolyte of zinc chloride dissolved in a solid wax of polyethylene glycol.

Reserve Type Cells.—Primary cells sometimes referred to as "one-shot" or "delayed action" batteries are those that are assembled in an inactive state (usually without the electrolyte), then activated just before use. Two examples are the water-activated magnesium-silver chloride cell and the magnesium-cuprous chloride cell. The dry-charged lead-acid battery employs the same principle in the storage battery class of batteries. Reserve type primary cells are packaged in hermetically sealed containers and stored dry in the inactive state. Hence, they have a long shelf life. They find numerous uses, among them air-sea rescue equipment, radiosonde equipment and emergency lighting.

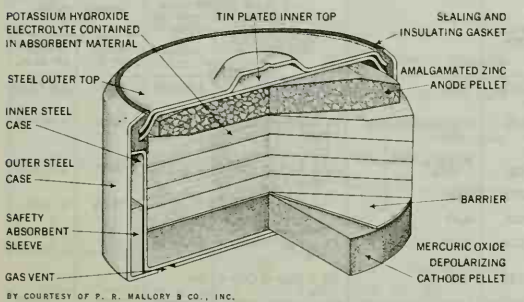


FIG. 6.—ZINC-MERCURIC OXIDE CELL OR MERCURY BATTERY

Another type of reserve cell is the zinc-bivalent silver oxide (AgO) cell, which is stored dry and activated with potassium hydroxide. This is primarily for military operations and is used when high watt-hour capacities per unit weight are required. The main problem with this type of cell is to devise a method for activating it quickly with the electrolyte and to minimize the time lag between activation and the moment of maximum operating voltage.

There are several other systems for reserve type cells such as a zinc (or cadmium or lead) anode with lead dioxide cathode and sulfuric acid electrolyte, the gas activated type that may be represented by the zinc-chlorine gas type using ammonium chloride solutions as the electrolyte, or the heat-activated (thermal) cell, which contains an electrolyte that is a nonconductive solid at room temperature but becomes a conductive liquid as it is melted.

Fuel Cells.—Much interest was given in the early 1960s to the problem of finding a method for converting the energy in fuel directly to electrical energy. The challenge to the scientist is that the theoretical thermodynamic efficiency of using fuel to produce electricity directly in a fuel cell is two or three times greater than that of using the fuel to heat a boiler to run a turbine and a generator (Table III). In 1839 Grove demonstrated the first fuel cell. In later years many types of electrochemical couples were explored for fuel cell use.

TABLE III.—*Efficiency of Energy Conversion by Several Processes*

Energy source	Conversion processes	Efficiency (%)
Chemical	electrochemical	90.0
Chemical, nuclear, or solar	heat → mechanical (*e.g.*, steam-turbine)	40.0
Chemical, nuclear, or solar	heat → therminic	8.0
Chemical, nuclear, or solar	heat → thermoelectric	7.0
Solar	P-N junction	12.0
Nuclear	β-current	1.0
Nuclear	contact potential	0.01

Source: Morebouse, Glicksman, and Lozier, *Proceedings of the IRE*, pp. 1462–83 (Aug. 1958).

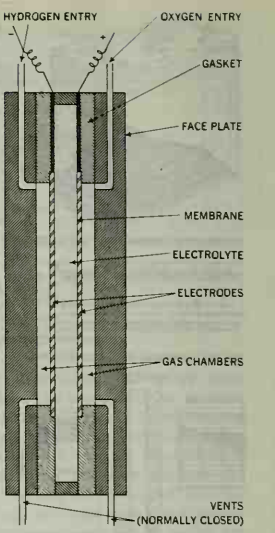
The simplest fuel cell might be described as one that is similar to the air-depolarized Leclanché cell but with the zinc anode replaced by a graphite anode (which is the fuel). In such a cell the carbon would be the electron-releasing electrode and the oxygen (from the air) the electron-accepting electrode material. The over-all reaction would be

$$C + O_2 \rightarrow CO_2$$

The electrolyte can be an acidic or a basic solution. However, this cell is not usable at room temperature because the reaction is very slow and only a very low current can be obtained. These cells have been investigated at high temperatures (600°–800° C.) using molten electrolytes, but the thermodynamic efficiency is considerably reduced and problems of cell construction become very difficult to solve. This cell gives about 0.8 v. with a current density of 55 ma. per square centimeter.

The three fuels that probably have received the most attention are hydrogen gas, carbon monoxide gas and the hydrocarbons. One of the major problems of such a cell is the slow rate of reaction at the electrodes. This can be improved considerably by impregnating the electrodes with a catalyst. The rate can also be increased by operating the cell at elevated temperatures. Many modifications of these cells have been devised. Fig. 9 shows a unique type using ion-exchange material that serves as a solid electrolyte for the hydrogen-oxygen type of cell.

Many uses may be found for fuel cells. One of the important potential large-scale uses is that of replacement for army field generators.



BY COURTESY OF GENERAL ELECTRIC RESEARCH LABORATORY

FIG. 9.—HYDROGEN-OXYGEN FUEL CELL WITH ION-EXCHANGE SOLID ELECTROLYTE

STORAGE CELLS

Electrochemical cells that can be discharged and then recharged to their original state are called secondary or storage cells, or accumulators. The charging process is the reverse of the discharge process, hence the electrode reactions in these cells must be reversible.

The main types of secondary batteries produced commercially are listed in Tables IV and V with some pertinent data.

The Lead-Acid Battery.—The most used of all types of storage batteries in the early 1960s was the lead-acid type. More than 30,000,000 lead-acid batteries were made each year for automobile and truck use alone, and perhaps 500,000 tons of lead were used for these batteries, representing the greatest single use of lead.

Lead-acid batteries are made in many shapes and sizes, depending on the intended use; they are usually classified as automotive (fig. 10), motive and stationary. The automotive type is made in the greatest number.

Chemical Reactions.—The active constituents of a lead-acid cell are sulfuric acid, a set of plates containing lead and another set of plates containing lead dioxide. On discharge the lead atoms of the lead plates give up electrons and form lead ions, which in turn form lead sulfate:

$$Pb \rightarrow Pb^{2+} + 2e^-$$
$$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$$

Since a faraday of electricity is 96,500 coulombs or the flow of 6.02×10^{23} electrons, and since an ampere is a coulomb per second and two electrons are released for every lead atom that reacts, then 103.61 g. of lead and 49 g. of sulfuric acid are required to produce 96,500 ampere-seconds of electric current. The reactions at the lead dioxide plate are:

$$PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$$
$$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$$

Hence the production of 96,500 ampere-seconds of current also re-

TABLE IV.—*Chemicol Composition and Performance Characteristics of Various Secondary Batteries*

Type	Anode	Electro-lyte	Cathode	Current producing reaction; discharge →; charge←	Average operating voltage on light drains* (v.)	Capacity on light drains	
						watt-hr. per lb.	watt-hr. per cu.in.
Lead-acid	Pb	H_2SO_4	PbO_2	$Pb + PbO_2 + 2H_2SO_4 \rightleftharpoons 2PbSO_4 + 2H_2O$	1.95–2.05	16–20	1.5–2.1
Nickel-iron (Edison)	Fe	KOH	$Ni(OH)_3Ni_2O_3$ and NiO_2	$Fe + NiO_2 \rightleftharpoons FeO + NiO$	1.10–1.30	12–13	0.98–1.05
Nickel-cadmium (Jungner)	Cd	KOH	$Ni(OH)_3$, Ni_2O_3, and NiO_2	$Cd + NiO_2 \rightleftharpoons CdO + NiO$	1.10–1.30	10–12	0.75–0.95
Zinc-silver	Zn	KOH	AgO	$Zn + AgO + H_2O \rightleftharpoons Ag + Zn(OH)_2$	1.40–1.50	50–55	3.1–3.6
Cadmium-silver	Cd	KOH	AgO	$Cd + AgO \rightleftharpoons Ag + CdO$	1.05–1.10	33	2.7
Lead-silver oxide	Pb	KOH	Ag_2O	$Pb + Ag_2O \rightleftharpoons PbO + 2Ag$	0.80–0.85	13.6	1.8
Cadmium-mercuric (oxide)	Cd	KOH	HgO	$Cd + HgO \rightleftharpoons CdO + Hg$	0.9	...	...

*Data were calculated from large capacity batteries under optimum conditions.

TABLE V.—*Typical Applications and Performance Characteristics of Various Secondary Batteries*

Type	Application	Life characteristics		Charge retention
		Cycle service life	Float charging life	
Lead-acid				
Automotive	high currents for a few seconds or minutes; *e.g.*, engine cranking	250–400 c.	up to 4 years in automotive service with good care	20% to 30% drop per month
Motive	discharge rate of 3 to 10 hours with nearly complete discharge: electric trucks, air conditioning and lighting of railroad cars	3–6 years	...	...
Stationary	designed for long service life, in particular on float type charging: emergency power, railway signals, telephone exchanges			
Lead-antimony grid		6–8 years	14 years	30% drop per month
Lead-calcium grid		not determined	25 years (est.)	6% drop per month
Planté positive		10–14 years	25 years	...
Low discharge	specially designed stationary for low discharge rates and low self-discharge rates: recording, warning and control devices; industrial and laboratory instruments	10–20 c. with 6 months to a year between cycles	20 years	15% drop per year
Electrolyte retaining	designed to have nonspillable electrolyte for portable high-rate power in place of dry cells: radio, photographic flash units, guided missiles	200–300 c.	...	30% drop per month
Nickel-iron (Edison)	heavy duty industrial and railway applications	1,800 c.	7–12 years heavy industrial; 14–25 years standby	25% to 35% drop per month
Nickel-cadmium				
Pocket plate	general purpose cell with wide applicability where mechanical and electrical abuse and long life are important factors	as good as sintered plate if not better	25 years	20% to 40% drop per year
Sintered plate	high rate and low temperature	several thousand cycles*	20–25 years (est.)	less than 50% drop per year
Zinc-silver oxide				
High rate	discharge rates of 1 minute to 30 minutes	10–20 c. over 3–6 months	...	...
Medium rate	discharge rates of 30 minutes to 5 hours	40–50 c. over 6–9 months	...	20% to 30% drop per year
Low rate (1 hr. and over)	discharge rates over 1 hour	150 c. over a year; 300 c. with special construction	...	...
Cadmium-silver oxide	low-rate and long-life applications	600–700 c., 3,000 c. on a 40% discharge	estimated to be good	estimated to be as good as zinc-silver oxide

*One manufacturer claims 5,000 c.

quires 119.5 g. of lead dioxide and a second 49 g. of sulfuric acid.

The discharge stops before all the materials are consumed, usually when the acid can no longer reach the active materials. When this occurs the cell voltage drops to a very low value.

Since the discharge consumes sulfuric acid, the state of charge of the battery can be measured by measuring the strength of the acid. This is done with a hydrometer. The acid of a fully charged battery will usually have a specific gravity of approximately 1.280; *i.e.*, the acid is 1.280 times as heavy as an equal volume of pure water. Partly discharged automobile batteries will show the following specific gravities for the corresponding percentages of charge: 1.250, 75%; 1.180, 50%; 1.130, 25%; and 1.080, 0%.

Charging a Battery.—Charging a lead-acid battery reverses the chemical changes, displaces the sulfate from the plates and causes a rise in the specific gravity of the acid.

In general, a battery may be charged at a high rate without harm as long as the gas evolution is not excessive and the temperature does not rise above 120° F. for a prolonged period. When a battery is being overcharged only a portion of the energy is used to charge the battery; the remainder is used to decompose water. About half of the electric energy put into the battery during this overcharge period is converted to heat, and the battery temperature rises rapidly. The main gases (hydrogen and oxygen) evolved are explosive, and other gases sometimes released are poisonous. Battery rooms must therefore be adequately ventilated.

Manufacture.—The manufacture of a storage battery begins with the casting of the grid on the plates. The purpose of this grid is to support the active material and conduct current to the cell terminals. The grid in most batteries is cast from a high-purity lead alloyed with approximately 5% to 12% antimony, 0.5% tin and a few hundredths per cent of copper and arsenic. Antimony makes the grid hard; lead will resist continued attack by sulfuric acid under storage battery conditions.

The grid is converted to a plate by filling it with active material in the form of a stiff paste that is made by mixing lead oxide with water and sulfuric acid in the proper amounts.

When making negative plates, the oxide is blended with about 1% of "expander" to provide better capacity. The expander is a mixture of barium sulfate, carbon black and an organic material usually derived from lignin. For positive plates no expander is used, but in other respects the paste and manufacturing operations are the same as with the negative plates.

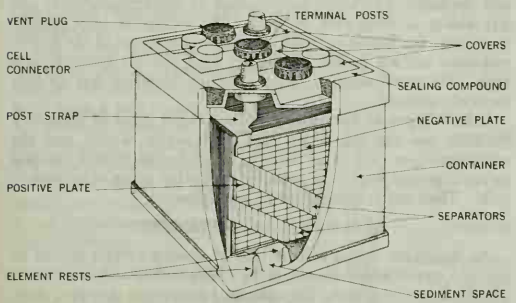
After the plates have been pasted, dried and assembled, they are immersed in weak sulfuric acid and charged. This converts the paste to sponge lead in the negative plate and to lead dioxide in the positive plate.

The positive and negative plates are kept from direct electrical contact by an insulator called a separator, which is porous enough to retain sulfuric acid and allow electric current to flow between the plates when carried by the sulfuric acid. Separators are made of wood, microporous threaded rubber, plastic or glass fibres.

Battery manufacturers in the 1940s began a practice of constructing a battery, charging it, removing the electrolyte, then sealing the battery hermetically to prevent deterioration until it is ready to be put into use. Such a battery is called a dry-charged battery. This practice extends battery life, which actually begins when the acid is added.

The storage battery is quite sensitive to small amounts of some impurities. The lead used in making oxide is of a high purity and contains at least 99.95% lead, the chief impurity being bismuth with traces only of silver, copper and nickel.

The acid used for batteries is also of high purity, containing a few hundredths of a per cent, at most, of iron. The water used for filling the battery is normally specified as distilled water. Chlorides, iron or manganese are all seriously harmful to battery life at concentrations that in some cases appear extremely minute. Manganese can be tolerated in amounts up to 0.00005% of the weight of positive active material, and this amount is occasionally



BY COURTESY OF ASSOCIATION OF AMERICAN BATTERY MANUFACTURERS, INC.

FIG. 10.—CONSTRUCTION OF AUTOMOBILE BATTERY

introduced from water. Chlorides are harmful if present at concentrations of 0.01% or higher; the problem of chlorides is more important in shipboard than in automotive operation of batteries.

Copper from electrical wire occasionally finds its way into the cell, where it deposits on the negative plate and promotes hydrogen evolution. The amount tolerated is less than 0.01%.

Pure sulfuric acid diluted with pure water is the only electrolyte generally accepted for use in lead type storage batteries. For years, however, promoters have sold battery additives that they allege have a secret composition, will remove sulfation, increase capacity, increase cranking ability, reduce operating temperature, prolong battery life and sometimes even rejuvenate worn-out batteries.

The battery additives most frequently consist of a mixture of magnesium sulfate and sodium sulfate. From results of tests on these materials it is usually concluded that they are of little value.

Motive Power Batteries.—A second major class of storage battery is used for motive power to operate electric trucks, mine locomotives, switch engines and the air conditioning and lighting systems of railway cars. These batteries are required to supply power for 3 to 10 hours instead of the few seconds needed to crank an automobile engine. They are designed to withstand frequent deep discharges instead of remaining almost fully charged. The initial cost, which is about three times that of a comparable automobile battery, is not nearly so important as a low cost per year of operation. Finally, the weight and volume, while limited, are not nearly so critical as in the automobile battery. These considerations dictate a construction quite different from that of the automobile battery.

The most important difference is that the positive plates are armoured or protected to prevent the loss of active material that would otherwise occur in batteries that are alternately charged and discharged.

The second difference is that the plates are made thicker, with thicker grid members, to withstand grid corrosion. Finally, because of the large size of the cells, they are usually assembled in thin-walled rubber jars that are then collected in sturdy steel trays. These trays may contain units ranging in capacity and size from a 12-v., 225-amp.hr. battery to special, custom-built units weighing many tons and with capacities as great as 1,000 amp.hr.

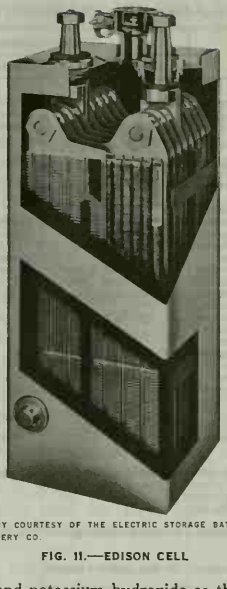
Stationary Batteries.—A third major class of storage battery is described by the term "stationary batteries." These are batteries that are used to supply stand-by emergency power for places where the cessation of electric service would be disastrous, as for example, in hospital operating rooms, naval vessels, telephone exchanges, railway signal systems, municipal fire alarm systems and burglar alarms for bank vaults.

Different requirements for stationary service lead to construction features that are different from both automobile and motive power batteries. The chief difference results from the facts that in the stationary battery weight and volume are less important while long life is more important. The plates are usually heavier, the acid volume is increased considerably and the acid specific gravity is reduced. The insulation between the plates may be either single, double or triple.

One class of stationary batteries has plates practically identical with those of motive power batteries. A second kind, the Planté type, uses antimony-free lead sheets whose surfaces are grooved to increase battery output. The Tudor battery is a modification of the Planté type; instead of grooved flat sheets of lead it uses pure lead castings with surfaces as large as practical.

The Manchester battery is another type of stationary battery. A framework of antimonial lead is cast with large, round holes. These holes are filled with rosettes made from corrugated lead tape wound in a spiral and pressed into the holes.

In about 1935 it was suggested that an alloy of lead and calcium might be a suitable material for storage battery grids. The advantages of such an alloy in battery grids are (1) low hydrogen evolution rate; (2) very low water requirement; and (3) very low floating charge current. (The floating charge is the charge that must be applied continuously to keep the battery fully charged.)



BY COURTESY OF THE ELECTRIC STORAGE BATTERY CO.

FIG. 11.—EDISON CELL

Experimental batteries of this construction have been in use long enough to indicate that they are a practical and important type of battery with a life considerably longer than that of any previous pasted plate type. This battery was developed by the Bell Telephone laboratories and was installed in telephone exchanges throughout the United States. It was believed suitable for stationary use only.

Stationary batteries are expected to have a long life because of the almost ideal conditions under which they are operated.

The Edison Battery.—Edison, after 10 years of research starting in 1898, developed an alkaline cell that uses iron as the anodic material, nickelic oxide (Ni_2O_3) as the cathodic material and potassium hydroxide as the electrolyte. The construction is shown in fig. 11. On discharge the iron atoms lose electrons, forming iron ions (Fe^{2+}), which in turn react with hydroxyl ions to form $Fe(OH)_2$ or FeO. At the cathode the nickel in the 3+ oxidation state picks up electrons to form nickel in the 2+ state—$Ni(OH)_2$ or NiO.

The voltage of these batteries varies with degree of charge but in general varies from 1 to 1.35 v. The degree of charge is determined by measuring the voltage.

These batteries are used widely in industrial and railroad applications that involve heavy-duty use. A disadvantage of these batteries is their drop in voltage at high current drain, which makes them undesirable for automotive applications. However, these batteries may be overcharged or they may remain uncharged for long periods of time; furthermore, they can be operated at higher temperatures and they have a longer life than do lead-acid batteries. However, they are more expensive, have a poorer temperature coefficient and do not retain a charge as well as lead-acid batteries.

The Nickel-Cadmium Battery.—At the same time Edison was working on his cell, Jungner and Berg were developing the nickel-cadmium cell (1893–1909). This cell is similar to the Edison cell except that cadmium replaces iron as the anodic material. The resulting advantages are: (1) a reduction in the rate of self-discharge; (2) better performance at low temperatures; and (3) ability to be trickle charged. The voltage is only slightly lower than the Edison battery. In general two types of the nickel-cadmium cell are in use, the pocket type and the sintered-plate type. For some purposes nickel-cadmium batteries may be hermetically sealed.

Other Types of Secondary Cells.—Other types of secondary batteries are the zinc-silver (II) oxide-alkali battery and the cadmium-silver (II) oxide battery, which furnish higher currents or much greater watt-hour capacity than other types of secondary cells. Their use is determined by requirements.

CELLS FOR MEASUREMENT

An important use of cells is that of making certain special or unique types of measurements in the control or research laboratory. The hydrogen electrode, the calomel (mercurous chloride) electrode, the glass electrode and the standard cell are examples of cells and electrodes used for such purposes. In fig. 12 is shown

a type of hydrogen electrode. The hydrogen gas is adsorbed on the platinum. The system then acts as though the electrode were made of hydrogen and the platinum the inert electrode. The half reaction is

$$H_2 \rightarrow 2H^+ + 2e^-$$

In fig. 13 is shown a calomel electrode, made of mercurous chloride-mercury, and a solution of potassium chloride. The half reaction is

$$2e^- + Hg_2Cl_2 \rightarrow 2Hg + 2Cl^-$$

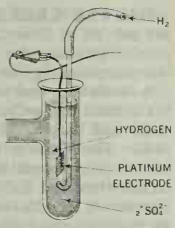


FIG. 12.—HYDROGEN ELECTRODE FOR STANDARD LABORATORY MEASUREMENTS

Both the hydrogen electrode and calomel electrode are used as reference electrodes to couple with other electrodes in making exact measurements.

For very accurate measurements a standard cell is used to calibrate the voltage measuring devices. The Weston standard cell has been used for this purpose. Calibrated cells are kept at the national bureau of standards and are used for standardization purposes.

The glass electrode (fig. 14) is another useful electrode used mainly by control laboratories in measuring pH (acidity or alkalinity) values of solutions. The principle of the operation is as follows: if two solutions of different acidity are separated by a thin glass membrane, a difference in potential exists. This potential can be measured with the aid of a second electrode (usually a calomel electrode is used). These electrodes are frequently built into a compact pH measuring unit with a simple electronic circuit to serve as a voltage measuring apparatus. The scale on the meter is calibrated in pH units rather than volts, and thus the pH of the solution can be determined directly. In the research laboratory the voltage of electrochemical couples has been used for many years as a direct measure of the driving force of chemical reactions and hence is a fundamental thermodynamic measurement. From such data the thermodynamic free energy (available work) of a process can be calculated through the relationship

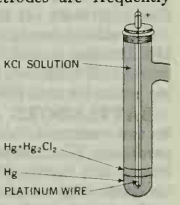


FIG. 13.—CALOMEL ELECTRODE

$$\Delta U = -nF(\text{emf})$$

where ΔU is the change in the free energy, n is the number of chemical equivalents in the reaction, F is 96,500 coulombs and emf (electromotive force) is the voltage of the cell (the electrochemical couple).

From such a calculation it is possible to determine another important thermodynamic quantity—the equilibrium constant for the reaction—through the relationship

$$\Delta U = -RT(\ln K)$$

where R is a constant, T is the absolute temperature and $\ln K$ is the natural logarithm of the equilibrium constant.

Also if the voltage of a cell is determined at two or more temperatures the heat of the reaction (ΔH) can be calculated from a well-known equation in thermodynamics known as the Gibbs-Helmholtz equation. (*See* THERMOCHEMISTRY: *The Gibbs-Helmholtz Equation.*)

Once the values of ΔU and ΔH have been determined, then the entropy change ΔS of the process can be computed through the relationship

$$\Delta U = \Delta H - T\Delta S$$

Hence we find that a very powerful tool in fundamental science is the electrochemical couple (or cell), which can be devised for any oxidation-reduction process to provide thermodynamic data on chemical processes.

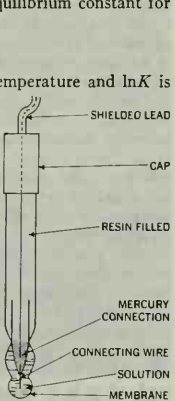


FIG. 14.—GLASS ELECTRODE

THE SOLAR BATTERY

The problem of how to trap and make use of solar energy has been approached through several different methods. One of the most successful is the Bell solar battery. The principle of operation of this cell depends upon the use of a combination of two materials, or electrodes, one of which has a deficiency of electrons (electron holes) in the structures of the atoms (called a P electrode) while the other has an excess of electrons over those needed for a simple 4-electron-pair-bonded structure (called an N electrode). The combination of these two electrodes is called a P-N junction. The energy of sunlight is sufficient to dislodge these extra electrons and cause them to go through the external circuit to the electron-deficient electrode. Such a cell is about 12% efficient in converting sunlight into electrical energy; it gives about 0.4 v. on open circuit voltage and about 40 ma. per square centimetre on electrode area. Cells of this type have a very long life and are among the most promising solar converters devised up to the early 1960s. One of their important uses is to power electronic circuits in artificial satellites.

NUCLEAR BATTERIES

Conversion of nuclear energy directly into electrical energy can be done with a nuclear battery. No highly efficient nuclear battery had been produced by the early 1960s, but a number of designs had been proposed. One of the cells used for industrial purposes was the β-current type. In this cell the β-particles (electrons) emitted by a radioactive source (Strontium-90 is an ideal source) are caught on the collector and discharged to the external circuit. The voltage of such a cell is high (up to 10,000) but the current is very low, being in the order of 50 $\mu\mu$amp.

Another design, the thermojunction type, utilizes the heat produced by the nuclear changes in the radioactive substance. This heat is absorbed on a sensitive thermocouple. Another type, the contact potential-difference cell, contains two electrodes; from one of the electrodes electrons can be driven off readily by the radiations of a radioactive substance; the other electrode is relatively insensitive to these radiations but can collect the electrons from the other electrode.

See also ELECTRICITY: *Batteries;* ELECTRICITY, CONDUCTION OF: *Conduction in Liquids;* ELECTROCHEMISTRY.

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(A. B. GA.)

BATTERY, MILITARY. This term denotes either a group of guns, rockets, guided missiles, or other weapons in position under a single tactical commander, or a tactical and administrative unit of the artillery branch. In the U.S. army an artillery battery corresponds in size to a company of the infantry. The corresponding organization in the British artillery is called a troop. Battery, in the British service, denotes a larger unit of battalion size; it is made up of several troops, and two or more batteries comprise an artillery regiment. In naval usage, the term battery applies to two or more guns of the same calibre controlled as a unit. Guns of the largest calibre are known as the main battery; smaller weapons are referred to as the secondary battery if employed against surface targets or as the antiaircraft battery if used against aircraft. Battery also refers to the ready-to-fire position of an artillery piece or naval gun. *See* also ARTILLERY; GUNNERY, NAVAL.

(H. C. T.)

BATTICALOA, a town and administrative district on the east coast of Ceylon. The town is situated on an island 69 mi. S. of Trincomalee. The population of the town was 17,439 and of the district 270,722, in 1953. Area of district 2,792 sq.mi. Batticaloa was formerly of importance as a port, but this is now used only by local sailing boats. In addition to its function as the administrative capital of the district, it is the railhead of a branch of the Ceylon government railway. Through it pass the coconuts and paddy that are the traditional produce of the district, but it also handles traffic to and from the area of more

than 100,000 ac. in the hinterland which is the care of the Gal Oya Development board. The face of the district as well as the functions of the town have been revolutionized by the board's activities, a part of the nationwide effort to make the economy more self-sufficient. The old Dutch fort of Batticaloa dates from 1682. (B. H. F.)

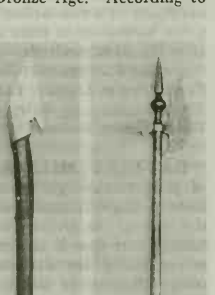
BATTISHILL, JONATHAN (1738–1801), English composer of church music and popular songs. Born in London in May 1738, he was a chorister at St. Paul's cathedral (1747), and later a harpsichordist at Covent Garden. In 1763 he married a singer at Covent Garden and wrote songs and choruses for plays. In 1764 he wrote songs for *Almena*, an opera produced at Drury Lane as the work of Battishill and Michael Arne. In the same year he became organist at St. Clement's and St. Martin's and wrote psalms and hymns, catches, glees and madrigals. After his wife's elopement in 1777, he declined and died, at Islington, Dec. 10, 1801.

See J. B. Trend, "Jonathan Battishill," in *Music and Letters*, vol. xiii (July 1932). (Cs. Ch.)

BATTLE, a market town and parish in Sussex, Eng., 6 mi. N.W. of Hastings by road. Pop. (1961) 4,300. It was named after the battle in 1066, which ensured William, duke of Normandy, the crown of England. Before the battle, which took place on a ridge southeast of the town, William vowed to build an abbey on the spot if victorious, and in 1094 its church was consecrated, the altar standing where Harold fell. The great gateway, built in 1338, survives, but the church was pulled down and the abbey (now a girls' school) was converted into a mansion after the Reformation. The Battle Abbey roll, popularly supposed to have been a list of William's companions, was probably a list of family surnames. It seems to have been compiled in the 14th century; the original document may have been burned at Cowdray in 1793. The parish church, with its Elizabethan deanery of red brick, dates largely from the 12th century.

The battle site was called "Senlac," a French version used by Orderic Vitalis of a local name, but even in Domesday Book the battle is named after Hastings (*q.v.*).

BATTLE-AX, a cleaving weapon for hand-fighting. Its use as a weapon of war dates from the Bronze Age. According to Homer, Agamemnon was attacked by Peisander with such a weapon. In the 11th century the Danish battle-ax was a regular part of the equipment of fighting men in England and under the Statute of Winchester of 1285 certain classes were required to maintain these weapons. In the 14th century the classic example of its effective employment occurred when Robert the Bruce felled Sir Henry Bohun with a single blow the day before the battle of Bannockburn (June 23, 1314). It was sometimes the custom to secure the ax to the wrist by a chain to ensure its retention.



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BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

TWO KINDS OF BATTLE-AXES: (A) 15TH-CENTURY GERMAN POLEARM, (B) 16TH-CENTURY SAXON POLEARM

The oldest bodyguard of the English sovereigns, the Honourable Corps of Gentlemen-at-Arms, introduced battle-axes into its equipment in 1526 and for centuries all their duties were ordered to be carried out "with their axes" or "with their pole-axes." At the funeral of a sovereign the ax was carried in the left hand, reversed and draped.

The Swiss halbert of the middle ages was in effect a battle-ax with a steel head combining the cutting edge of an ax, the point of a spear and a hook for pulling a mounted opponent from his saddle. A long pole served as a handle. *See* Halbert.

(Ln. Ms.)

BATTLE CREEK, a city of Calhoun county, Mich., U.S., 114 mi. W. of Detroit, at the confluence of Battle creek, from which it gets its name, with the Kalamazoo river. (For comparative population figures, *see* table in Michigan: *Population.*)

A combat between two Indians and two land surveyors resulted in the name Battle Creek, that name being taken over, first informally and then officially, with the chartering of the village in 1850. The Western Health Reform institute, founded by the Seventh Day Adventists in 1866, became the Battle Creek sanitarium (renamed Battle Creek Health centre, 1959), under the direction of John Harvey Kellogg from 1876 to 1943. His pioneering in dietetics and experiments with grains motivated the manufacture of ready-to-eat cereals, which became the city's chief industry. Battle Creek's reputation as "the health city" was furthered in 1930 when the W. K. Kellogg foundation was established to improve the well-being of children. The foundation and city stimulated programs primarily for youth, including the Ann J. Kellogg School for Special Education (1931), which integrates one-third of its students who are physically handicapped with two-thirds of its students from a regular school district; the Kellogg Community college (1956); and extensive parks and recreation facilities. Battle Creek exceeds all other places in the number of boys placed on All-American interscholastic swimming teams, and its baseball diamonds are used each year for the American Amateur Baseball congress finals. Besides cereals, manufactures include farm machinery, railroad and loading equipment, pumps, valves, cartons and packaging devices. Cultural groups include a civic theatre, art centre, chorus and symphony. Slum clearance and flood control are the city's most recent improvements.

Operational headquarters of the Office of Civil and Defense Mobilization, located in Battle Creek from 1954, was ordered moved to Washington, D.C., in 1961, but the staff college and training centre for civil defense personnel remained. (B. B. Lo.)

BATTLEDORE AND SHUTTLECOCK, a game played by two persons with small rackets, called battledores, made of parchment, plastic or rows of gut or nylon stretched across wooden frames, and shuttlecocks, made of a base of some light material, like cork, with trimmed feathers fixed round the top.

The object of the players is to bat the shuttlecock from one player to the other as many times as possible without allowing it to fall to the ground.

Ancient Greek drawings represent a game almost identical with battledore and shuttlecock, and it has been popular in China, Japan, India and Siam for at least 2,000 years. In Europe it has been played by children for centuries. A further development is badminton (*q.v.*).

BATTLEMENT, the parapet of a wall consisting of alternating low portions known as crenels or crenelles (hence crenelated walls with battlements) and high portions called merlons. Battlements were devised in order that warriors might be protected by the merlons and yet be able to discharge arrows or other missiles through the crenels. The battlement is an early development in military architecture; it is found in Chaldea, Egypt and prehistoric Greece as well as commonly in Roman fortifications. It was in the middle ages that the battlement received its highest development, crenels being narrowed and frequently given splayed sides, the merlons often having in the centre a thin slit sometimes cross shaped to give the widest possible arc for the discharge of missiles. The developed medieval battlement was frequently bracketed out from the face of the wall and holes in its floor were furnished to allow objects to be dropped directly downward upon attacking forces. In actual siege use the battlement was usually covered with a protecting shed of timber and hides. In the Saracen countries and in Italy, through eastern influence, the battlement frequently takes decorative shapes, and toward the end of the Gothic period, as the military necessity decreased, the battlement became merely decorative. A similar persistence of the battlement as a purely decorative form occurs in much late Gothic throughout Europe, especially in the Perpendicular work in England, when it is richly ornamented with tracery and frequently pierced as well. (T. F. H.)

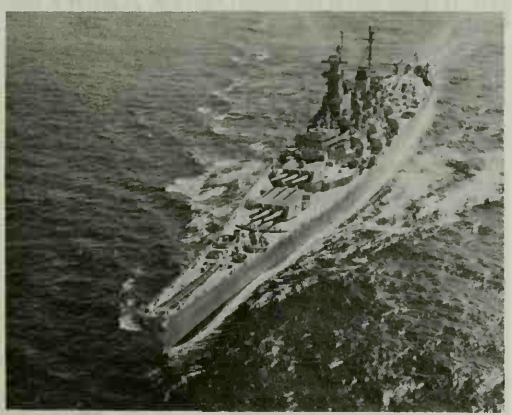
BATTLESHIP, the name for the type of warship which was

the capital ship of the navies of the world from about 1860 until 1943. Battleships were designed to combine large size, the most powerful guns, the best armour and underwater protection, fairly high speed and great cruising radius with general seaworthiness. Before the advent of aircraft carriers they were the largest fighting ships afloat, some displacing as much as 72,000 tons. In their ultimate development, battleships were able to hit targets with great precision at a range of about 22 nautical miles, and to absorb an astonishing amount of damage from enemy shells, bombs, torpedoes or mines while remaining afloat and continuing to fight. The type was superseded as the capital ship by the aircraft carrier because the carrier's planes could discharge their bombs against an enemy at a distance of about 300 nautical miles, as was done with considerable effect in the Pacific during World War II. (*See* AIRCRAFT CARRIER.)

After World War II no nation built or planned to build any new battleships, but the type had played such an important role in world history for nearly a century that interest in it continued. Many persons believed that the splendour and ingenuity combined in the design of battleships entitled them to be regarded among the most magnificent of man's creations. The battleships of the world's navies exhibited from year to year the highest development of shipbuilding skill. The naval architects who designed them spurred the industrial world to make constant improvements in steel and other metals and themselves made important advances in marine engineering and applied electronics.

For the better part of a century, Great Britain was pre-eminent in this field. It completed its first battleship, the "Warrior," in 1861. From that date until construction of the "Lord Nelson," begun in 1905, the Royal Navy built about 110 vessels that might be called battleships, although the name did not come into use until after 1870. Beginning with the "Dreadnought," completed in 1906, the first all-big-gun ship, which gave her name to the type, the Royal Navy built 43 more battleships. This same period saw the construction of 13 battle cruisers, which had big guns and high speed but lacked the heavy armour of battleships. This total excludes the "Courageous," "Glorious" and "Furious," which have incorrectly been described as battle cruisers by many newspapers. (*See* CRUISER.) Great Britain has named its battleships for sovereigns, for great sailors and soldiers and for fighting ships of earlier periods.

H.M.S. "Vanguard," completed in 1946 and the last battleship remaining in the Royal Navy, was sold for scrap in 1960. She displaced 51,420 tons and was the 12th vessel of the Royal Navy to bear the name. Four battleships, "Anson," "Duke of York," "Howe" and "King George V," were scrapped in 1958. Others had been scrapped after the end of World War II.



BY COURTESY OF U.S. NAVY

U.S.S. "MISSOURI"; 57,500 TONS; SPEED, 35 KNOTS; NINE 16-IN. GUNS
The formal surrender of Japan was signed on board the "Missouri" in Tokyo bay on Sept. 2, 1945. The ship was decommissioned Feb. 26, 1955

The U.S. navy built a total of 59 battleships between 1890 and 1945. By an act of March 3, 1819, congress directed that all U.S. ships of the line be named for states. Later acts specified that first-rate ships, ships of the first class and battleships would all be named for states. An exception to the rule came up in 1895 when congress provided for two battleships and directed that one be named "Kearsarge" after the Union vessel that sank the famous Confederate sea raider "Alabama" during the American Civil War.

In 1945, when World War II ended, the "Kentucky" was 73% completed, with her machinery installed, and the "Illinois" was 22% completed. Plans were made to convert the "Kentucky" into a guided missile battleship, but this idea was abandoned and she was scrapped in 1958. The "Illinois" had been scrapped earlier. In 1961 the United States had 8 battleships but all of them were out of commission and in a state of preservation popularly known as "mothballing."

France scrapped some battleships after World War II but in the 1950s had two in commission, though in reserve, the "Jean Bart" and the "Richelieu." Chile had one battleship in reserve, the "Almirante Latorre," and Soviet Russia had one such ship, the "Sevastopol" of World War I vintage.

THE CAPITAL SHIP IN THE 19TH CENTURY

The essential backbone of the world's fleets throughout the great colonial wars was the sailing ship of the line of battle, usually called the ship of the line. This vessel was the predecessor of the battleship. The ship of the line had been developed by the time of the Spanish Armada, and the type changed relatively little between 1588 and 1840. Nelson's flagship at Trafalgar, in 1805, the "Victory," was representative of this type. She was a three-decker, with guns on all three decks; she was 186 ft. in length and of 2,162 tons burden. This historic vessel was preserved in the naval dockyard at Portsmouth, Eng., where it was kept open to the public.

Up to about 1840 there were clear-cut distinctions between types of warships. A sloop of war carried all her guns (usually less than 20) on the weather deck. A frigate had guns on two decks, the number of guns varying between 24 and 50. A ship of the line had 64 or more guns on three decks. The guns themselves varied from 4-pounders to 32-pounders. A few large ships of the line had some 42-pounders instead of 32s on the lower deck, 24-pounders on the middle deck and 18-pounders on the main deck, for a total of from 64 to 100 guns. The frigates and sloops of war carried smaller guns, some only 4-pounders or 6-pounders. It had become common practice to rate ships by the number of guns they carried. These were smooth-bore, muzzle-loading guns, throwing solid balls.

Rifled guns of various kinds were tried for shipboard use, but the early types had many defects. W. G. Armstrong built a rifled field gun for the British army in 1858, and it was adapted for naval use. Improvements in metal went along with the development of better guns. The introduction of 68-pounder guns, and then larger ones, along with steam propulsion, led to the building of steam sloops of war that mounted only 24 guns or less but were more formidable than older ships of the line.

Shipbuilding was an art for many centuries, but it did not become a science until after the battleship had become established as a type. To understand this gradual development it must be remembered that the evolution of the battleship began before there existed any well-understood body of scientific knowledge to guide ship designers and builders. The previous lack of science in shipbuilding was often illustrated by serious losses of ships at sea.

Steam and Iron Produce the Battleship.—The first steamer in any navy was the U.S.S. "Fulton," completed in 1815. A steamer of the French navy crossed the Atlantic to French Guiana in 1824–25, and one of the Royal Navy arrived in Barbados in 1832. The U.S. navy acquired two steam-powered side-wheelers of 3,300 tons each in 1842, "Mississippi" and "Missouri"; and the "Princeton" in 1844, the first man-of-war to use the screw propeller. In various navies auxiliary steam power was installed

in existing sailing ships. The Royal Navy laid down its last sailing ship, "Sanspareil," in 1851, but converted her to a steam-screw ship before launching. In 1852 the "Agamemnon" was laid down as a steam two-decker.

The British squadron that bombarded Sevastopol during the Crimean War, in 1854, included only two steam ships of the line. The sailing ships were pushed or hauled into position by steam tugs, and the Russian forts replied with shell guns. Largely because of their experience in that war, the French planned to build 40 screw ships of the line, 20 frigates, 30 corvettes, 60 dispatch vessels and transports. By early 1857, however, the French experiments with rifled guns led them to conclude that armour was necessary for their warships and they stopped building wooden ships of the line. The able naval architect, Stanislas Dupuy de Lôme (*q.v.*), was then placed in charge of ship design for the French navy. He had devised the method which both England and France had used in converting sailing ships of the line to steamers, and he began the first armoured warship in 1858. His "Gloire" displaced 5,617 tons and carried 36 guns. Her hull was plated from stem to stern with iron 4.3 in. to 4.7 in. thick, backed by 26 in. of wood. Her dimensions were 252½ × 55 × 25 ft. and she was the first seagoing armour-clad.

A parliamentary committee reported in London in 1859 that both England and France had 29 ships of the line built or completing, while France had 34 large frigates without including the 4 new ironclads, and England had 26 frigates. These were all steamers, and the committee concluded that sailing ships had no further value in war. In that same year the "wooden walls" of England reached their final stage of development with the launching of four three-deckers, each displacing 6,930 tons. But by this date the tide was turning; the era of wooden warships was about ended.

In 1859 the British admiralty ordered two ironclads, the abovementioned "Warrior" on April 29, 1859, and, after further discussion, a sister ship, the "Black Prince." Completed in Oct. 1861 and Sept. 1862, they each displaced 9,210 tons and their dimensions were 380 × 58 × 26 ft. They could attain a speed of 14 knots, had a coal capacity of 850 tons and a complement of 707 officers and men. Their main armament consisted of twenty-eight 7-in. (6½-ton) guns. Their hulls were of iron; iron armour 4½ in. thick covered a section 213 ft. long amidships, with a backing of 18 in. of teak; the armour extended 6 ft. below the water line and 21 ft. above it. These two ships, with the French "Gloire" and "Couronne," were the first battleships, although the name was not then applied to them.

In the United States, the ironclad "Monitor" was ordered Sept. 16, 1861. She was built by a group formed by her designer, John Ericsson, and gave her name to this new class of ships. To expedite construction, one New York firm built the hull, another the engines and a third the turret. Her displacement was 987 tons; complement 58; guns two 11-in. in a revolving turret; speed 6 knots; dimensions 172 × 41½ × 11 ft. After trials on March 3, 1862, she departed New York on March 6.

Meanwhile the South also built an ironclad, the C.S.S. "Virginia," better known by her former name, "Merrimack." When the Union navy abandoned the Norfolk navy yard, April 20, 1861, it had scuttled the frigate "Merrimack" and burned her to the water's edge. The Confederates raised her and hauled her into dry dock on May 30. They converted her into an ironclad ram by mounting a cast-iron ram on the stem and building an armoured casemate amidships, about 180 ft. long with slanting sides. Ten guns, including four rifles, were mounted in the armoured casemate. Her displacement after the reconstruction was 3,200 tons; complement 320; speed 5 knots; dimensions: 275 × 38½ × 23 ft.

The battle between the "Monitor" and "Merrimack" on March 9, 1862, was indecisive, but it attracted world-wide attention as the first duel between ironclads. The spectacular success of the "Merrimack" on the previous day, when she rammed and sank the "Cumberland" and then destroyed another sailing vessel, the "Congress," by gunfire, served to convince the general public that the day of the wooden man-of-war was ended. (*See* "Monitor" and "Merrimack," Battle of.)

According to many writers, the U.S. Civil War demonstrated the value of the ram as a weapon. Until about 1900 nearly all the large ships had rams. The United States launched the armoured ram "Katahdin" in 1893. The Austrian Adm. Wilhelm von Tegetthoff won the battle of Vis (Lissa) in 1866 by ramming the Italian flagship, but after that no major warship was sunk in action by ramming. In fleet maneuvers, the "Iron Duke" sank the "Vanguard" in Sept. 1875, and the "Camperdown" sank the "Victoria," June 22, 1893. Both these sinkings were accidental and did not prolong the career of the ram as a practical naval weapon.

Turret Ships.—Capt. Cowper Coles, R.N., used a raft as a gun platform in the Sea of Azov in 1855, and proposed a more elaborate armoured raft for attacking the Russian defenses. He applied for a patent for a revolving turret on March 30, 1859. An experimental turret was built and tested in 1861. Coles had suggested cutting down a ship of the line, armouring her and fitting her with turrets. On April 4, 1862, the conversion of the 121-gun "Royal Sovereign" was ordered. On April 29, 1862, the "Prince Albert" was laid down; she became the Royal Navy's first iron turret ship.

In 1866–67 "Monarch" and "Captain" were laid down as iron turret ships. "Monarch" of 8,300 tons may be regarded as the first truly seagoing turret ship. She mounted four 12-in. guns in two turrets. "Monarch" was commissioned May 1869, and after the death of George Peabody in London on Nov. 4 of that year, carried his body to Massachusetts. The "Captain" capsized during a full gale at sea on Sept. 7, 1870, and sank with the loss of Captain Coles and 473 officers and men. The U.S.S. "Monitor" had been lost at sea on Dec. 31, 1862. H.M.S. "Devastation," completed in 1873, displaced 9,330 tons, had four guns in two turrets and had no sails. From 1865 onward the U.S. navy was neglected until 1883 when five monitors and three small cruisers were authorized.

The Italians introduced the monster gun in 1872 and the British went to the larger guns in 1874, also installing submerged torpedo tubes and electric lights in the "Inflexible." The royal corps of naval constructors dates from 1883. Torpedo nets to protect big ships were installed in 1884. The "Colossus," completed in 1886, used steel for general construction instead of iron; she had breech-loading rifles, which had been readopted and were standard thereafter.

First U.S. Battleships.—Congress authorized three vessels in 1890 that were classed as battleships, "Indiana," "Massachusetts" and "Oregon," officially numbered BB-1, BB-2 and BB-3. Completed in 1895–96, each displaced 11,700 tons. They had belt armour 18 in. thick and a speed of 15 knots. They carried four 13-in. 35 calibre guns in two turrets; eight 8-in. 35 calibre in four turrets; and some smaller guns, besides six torpedo tubes. They

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H.M.S. "VANGUARD": 51,420 TONS; SPEED 30 KNOTS; EIGHT 15-IN. GUNS
Completed in 1946, the "Vanguard," Britain's largest battleship, was too late to see action in World War II

were good ships but their turrets were not balanced, a defect that caused them to list when the guns pointed abeam. Before they were completed, two other vessels, the "Texas" and "Maine," were officially reclassified as "second-class battleships," although first authorized as "armored vessels." Plans for both were purchased in England. The "Texas" displaced 6,300 tons and mounted two 12-in. and six 6-in. guns; the "Maine" displaced 6,700 tons and mounted four 10-in. and six 6-in. guns.

The Chinese-Japanese War of 1894–95, the Spanish-American War of 1898 and the Russo-Japanese War of 1904–05 all resulted in further building of battleships, with improvements of various kinds. Some authorities would have chosen the armoured cruiser as the principal ship, but the consensus supported the battleship. The outbreak of the Spanish-American War was due in large measure to the wave of indignation that swept the United States after the mysterious sinking of the battleship "Maine" in the harbour of Havana, Cuba.

Developments in U.S. Ships.—The 8-in. turrets of the "Indiana" class suffered from blast effects when the 13-in. guns were fired. The "Kearsarge" and "Kentucky," designed in 1897, had 8-in. turrets placed on top of the larger turrets. Later, the "New Jersey" class had an 8-in. turret on a 12-in. turret. Experience in the fleet went against the two-story turret and the arrangement was abandoned in the "Connecticut" class. "South Carolina" and "Michigan," BB's 26 and 27, authorized March 3, 1905, displaced 17,000 tons and had eight 12-in. 45 calibre guns in four centreline turrets. They were the first all-big-gun ships to be designed but they were not commissioned until 1910.

Dreadnoughts.—Completed in 1906, H.M.S. "Dreadnought" gave her name to a more powerful class of battleships and caused all navies to build this larger type. She had four propellers driven by Parsons turbines; displaced 21,845 tons fully loaded; made 21 knots; and mounted ten 12-in. 45 calibre guns in five turrets, three on the centreline. Adm. Lord Fisher was responsible for this type and also for the battle cruiser, first laid down early in 1906, in three of "Invincible" type. Their features were high speed (27 knots), eight 12-in. guns and light armour, in a displacement of 20,135 tons. After the "Dreadnought," Britain built 13 more BB's before the outbreak of war in 1914, and completed 5 of "Royal Sovereign" and 5 of "Queen Elizabeth" class in 1915–16. The "Queen Elizabeth" displaced 33,000 tons, carried eight 15-in. 42 calibre guns in four centreline turrets, used oil fuel and steamed at 25 knots.

The battle of Jutland (May 31, 1916) and other experience in the war years, 1914–18, demonstrated the primacy of the battleship. The German ships at Jutland showed that their greater subdivision and their damage-control system had made them almost unsinkable, but this had been achieved by sacrificing offensive power and making the ships uncomfortable to live in.

The naval conference held 1921–22 at Washington, D.C., limited the size and armament of individual ships and total tonnage. (*See* WASHINGTON, TREATIES OF.) It specifically provided that the strength in capital ships of the three leading naval powers, the U.S., Great Britain and Japan, would be in the ratio of 5:5:3. As a result, the United States scrapped seven of the nine battleships it had under construction, although they were nearing completion. The treaty not only restricted the building of battleships but led to the use of lighter and more expensive materials to keep within weight limits. Tremendous increases in building costs occurred, especially after 1937 when unrestricted building was resumed. In the language of business, the battleship had been "priced out of the market." Nevertheless, a British cabinet inquiry in 1936 reaffirmed belief in the battleship, and five ships of the "King George V" class were completed 1940–42. Armed with ten 14-in. guns, they displaced 44,460 tons and had a speed of 28 knots. Four ships mounting 16-in. guns were ordered in 1939, but work was suspended in 1940.

Germany built two battleships of the "Scharnhorst" type with nine 11-in. guns in three turrets. They displaced 38,100 tons and had a speed of 31.5 knots. Two German battleships of the "Bismarck" class displaced 52,600 tons; they had eight 15-in. guns and a speed of 30 knots. Two so-called "pocket battleships" built by Germany, the "Lützow" and "Admiral Scheer," were actually armoured cruisers rather than battleships. Japan completed two battleships after the Washington conference while England was building the "Nelson" class. The Japanese vessels "Nagato" and "Mutu" were of 36,000 tons, with eight 16-in. 45 calibre guns, and a speed of 23 knots. "Nelson" and "Rodney" were completed in 1927 and displaced 38,000 tons. Their speed was 23 knots, and they mounted nine 16-in. guns in three turrets, all on the centreline forward. Later, Japan built two giant battleships, the "Yamato" and "Musashi," completing them in 1941–42. These ships displaced 72,000 tons, mounted nine 18.1-in. guns and had a speed of 27 knots. They were the largest battleships ever built.

Comparative Strength in Battleships and Battle Cruisers of Major Powers, 1914 and 1939
(Ships Under Construction Are in Parentheses)

Country	1914	1939
Argentina	2	
Austria-Hungary	16(4)	
Brazil	4	
Chile	3	
Denmark	3(1)	
France	28(5)	7(3)
Germany	52(5)	2(4)
Great Britain	71(4)	15(6)
Italy	22(6)	4(4)
Japan	24(6)	10(2)
Netherlands	9	
Norway	2(2)	
Spain	2(1)	
Sweden	4(1)	
Turkey	3(1)	1
United States	35(4)	15(6)
U.S.S.R.	4(8)	3(1)

Note: By 1959 the U.S. had 15 battleships, France 2, Great Britain and the U.S.S.R. each 1.

The later U.S. battleships included three of the 1916 program completed after 1918, "West Virginia," "Colorado" and "Maryland." Seven other ships of this program were scrapped. No additional battleships were begun until 1937–38, when work started on "North Carolina" and "Washington." They displaced 46,800 tons, carried nine 16-in. 45 calibre guns and had a speed of 27 knots. Four more ships were begun in 1939–40 ("Alabama," "Indiana," "Massachusetts" and "South Dakota"), slightly smaller, with the same main battery guns and speed. Four more ships were completed in time to participate in the war in the Pacific, "Iowa," "New Jersey," "Missouri" and "Wisconsin." Each displaced 58,000 tons and had a speed of 35 knots.

See AIRCRAFT CARRIER; ARMOUR, NAVAL; SEA POWER; WORLD WAR I: *Naval;* WORLD WAR II: *The War at Sea; see* also references under "Battleship" in the Index.

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BATTUS, in Greek mythology, a garrulous old man of Lycia (or the Peloponnesus; *see* Ovid, *Metamorphoses*). He saw Hermes in the act of driving off Apollo's cattle, which he had stolen, but promised to say nothing when bribed with a present. Hermes returned in disguise to test Battus' word; the old man, bribed anew, revealed the secret and was turned to stone. (T. V. B.)

BATU ISLANDS (BATOE ISLANDS), 3 greater and 48 lesser islands of Indonesia, lying athwart the equator west of Sumatra. Administratively the islands are part of the Nias district of Tapanuli (North Sumatra). They are separated by the strait of Siberut from the Mentawai group to the south. The three chief islands, from north to south, are Pini (or Mintao), Masa, and Bala; the administrative centre is Tela. The estimated population of the entire island group in 1957 was 13,135 and the area 464 sq.mi. The islands are generally low and covered with forest, notably coconut palm. There is trade in copra and forest products. The natives are of Malayan or proto-Malayan stock, akin

to those of the island of Nias, to the northwest. Only about 20 of the smaller islands are inhabited. Japan occupied the islands during World War II. (J. O. M. B.)

BATU KHAN (d. 1255), Mongol prince, founder of the Golden Horde (*q.v.*), was a grandson of Genghis Khan. Elected commander in chief in 1235 for the Mongol invasion of Europe, he had by 1240 conquered almost all Russia. In the campaign in central Europe, one Mongol army defeated Henry II, duke of Silesia, at Liegnitz on April 9, 1241; another, led by Batu himself, defeated the Hungarians at Mohi on April 11. The securing of the territory conquered and the further conquest of Europe were probably prevented by the death of the great khan Ogadai (Dec. 1241). In order to exercise more influence in the Mongol capital Batu withdrew to the lower Volga. There he established the state of the Golden Horde to which all Russian princes were in some degree subject. (K. Sa.)

BATUMI (Batum), capital of the Adzhar Autonomous Soviet Socialist Republic of Georgian S.S.R., lies on a gulf of the Black sea, about 10 mi. N. of the Turkish frontier and 160 mi. W. of Tbilisi. Pop. 82,000 (1959), with Adzhars, Georgians, Russians and Armenians predominating.

The subtropical climate and mild winter (Jan. average 43° F.) make Batumi a popular resort. Rectangular in plan, its streets and gardens are lined with palms and other exotics. North of the town are the Batumi Botanical gardens, with a rich collection of subtropical and tropical plants. With the best harbour of the trans-Caucasian coast, Batumi is an important port, trading chiefly with other Soviet Black sea ports. The major exports are refined oil and petroleum products, citrus fruits, tea and manganese; and imports are metals, machinery, grain and paper. There is a large oil refinery, using crude oil brought by pipeline from Baku. Other industries include a shipyard, engineering works, zinc-plating works, veneer and furniture works and a range of light industries (woolens, shoes, leather, tobacco, brewing). Power for the town is supplied by the Adzharis-Tskalskaya hydroelectric station. The S. Rustaveli Pedagogical institute is located there.

It has been Russian since 1878, when it was ceded by the Turks. Batumi is the terminus of a railway from Samtredia on the Tbilisi-Tuapse line. (R. A. F.)

BATWA, one of the best known of the many pygmoid groups scattered across equatorial Africa. Like all other African pygmoids the Batwa, averaging somewhat over 5 ft. in height, are a people of mixed ancestry, probably descendants of the original inhabitants of the tropical rain forest. They live in the high mountains and plains around Lake Kivu, in the Republic of the Congo and Ruanda-Urundi, in symbiosis with the pastoral Watussi, the agricultural Bahutu, and other tribes. Many specialize in pottery, which they market; others hunt; some act as court musicians and attendants.

Westward, in the marshes south of the Congo river, is the large (approximately 100,000) group of Batswa, who, like the Batwa, have adopted much of the culture and language of neighbouring tribes. They live largely by fishing and trapping.

North of the Congo, in the forests west of the Ubangi river, are the Babinga. This is also an acculturated group of pygmoids, but perhaps because of similarity of habitat they have retained more of the traits of the pure pygmies of the Ituri forest (*see* Bambuti) and are still mainly nomadic hunters and gatherers.

Further to the west, in Cameroun and Gabon, there are other scattered groups that are even closer, physically, to the true pygmy. *See* also Pygmy.

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BATZ, JEAN, Baron de (1754–1822), French royalist conspirator of the Revolutionary period, was born at Tartas in Gascony on Jan. 26, 1754, of a noble family. During Louis XVI's reign he occupied himself in financial transactions, including the foundation of an insurance company, made a fortune and rose to be grand seneschal of the duchy of Albret. Sent to the estates-general of 1789 as deputy for the nobility of Nérac, he concerned himself with the financial business of the Constituent Assembly. Emigrating in 1792, he returned to France to work against the Revolution. He made an unsuccessful plan to save Louis XVI on his way to the guillotine in Jan. 1793, did much to organize the riots against the Convention in March and tried to rescue Marie Antoinette from prison in June. Meanwhile he and a cosmopolitan clique of financiers were doing their best, by dubious operations, to discredit the republic and to raise funds for the royalists. A number of deputies in the Convention were implicated with them in a fraudulent scheme to make money on the shares of the French India company. In June 1794 the Convention offered a reward for Batz alive or dead, and a number of his associates were guillotined. Arrested for participating in the rising of 13 Vendémiaire (Oct. 1795), Batz contrived to get himself liberated. After this little is known of him, but in Dec. 1801 his name was removed from the list of proscribed *émigrés*.

On the Restoration of the Bourbons in 1814, Batz was made a knight of the Order of St. Louis. Retiring to his estate at Chadieu in 1820, he died there on Jan. 10, 1822.

BAUDELAIRE, CHARLES PIERRE (1821–1867), French poet and critic, one of the greatest poets of the 19th century, the author of *Les Fleurs du mal*. He was born in Paris on April 9, 1821. His father, Joseph François (*b.* 1758), died in 1827, and in 1828 his mother married Jacques Aupick, a soldier who had risen in the ranks and had become a general, an ambassador and finally a senator. Baudelaire was educated at the Collège Royal at Lyons and later (1836) at the Collège Louis-le-Grand in Paris, where he distinguished himself in the writing of Latin verse, for which he won a prize at the public *concours général*. After passing his *baccalauréat* (1839) he began to study law, but rumours of the irregularities of his life reached his parents—it was then that he contracted the venereal disease from which he was eventually to die—and, in May 1841, to wean him from his dissolute associates, they sent him on a trip to India which was intended to last two years. However, when the boat put into Mauritius for repairs, Baudelaire decided that nothing would induce him to go any farther and insisted on being shipped back to France. Nevertheless, this trip made of Baudelaire a true and original poet, and it was on the journey that he wrote the first of his *Fleurs du mal*. He never forgot his only experience of the east but kept for it a nostalgic and mystical longing which is a characteristic feature of his poetry.

Shortly after his return to Paris (Feb. 1842) he reached his majority and obtained control over the capital which he inherited under his father's will. He proceeded to squander it living the luxurious life of a dandy at the Hôtel Lauzun, in the Île Saint Louis, and laid the foundations of the pile of debts which were to cripple him for the rest of his life and to be settled only after his death. It was at this time that he formed the association with the mulatto woman, Jeanne Duval, whom he loved passionately for a time and for whom he remained responsible. She inspired the first cycle of love poems, the cycle of the "Black Venus," which are among the finest erotic poems in the French language. It was in this period of leisure and freedom from anxiety that he composed a large number—perhaps the largest number—of the poems which were eventually to form part of *Les Fleurs du mal; i.e.*, the Lesbian poems, the poems of revolt and decay and the great erotic poems. In this period he became acquainted with many artists such as Delacroix and Courbet and established the knowledge of painting which was to make of him one of the most interesting art critics of the 19th century.

In a couple of years, however, he had squandered half his inheritance and his parents obtained a decree to place the remainder of his capital under trust. As a result he had to give up his life of extravagance and knew straitened means, later real poverty. It was then that he became interested in revolutionary activities and took part, with other men of letters, in the revolution of 1848, but the establishment of the Second Empire ended his active interest in politics. During this period he developed a sympathy for suffering and toiling humanity. He became a professional writer and his first publications were articles of art criticism,

his "Salons" (1845 and 1846—the latter a landmark in aesthetic criticism), but he also printed some of his poems in avant-garde reviews. He tried many forms of journalism and published his only novel, the autobiographical *La Fanfarlo,* in 1847. It was probably composed several years earlier, during his period of luxurious living, and gives a faithful picture of his personality at that time.

What Baudelaire did between the second revolution of 1848 and the *coup d'état* of Dec. 1851 is not clear but, with the advent of the Second Empire, the great and mature period of his creative life opened. He became widely known as the translator of Edgar Allan Poe and as a literary and art critic, for it was at this time that he formulated his aesthetic doctrine which eventually enabled him to publish a considerable number of his poems. He had known English as a child—his mother had been born in London in 1793, the daughter of an *émigré*—and in his youth he had been interested in satanic literature, in such works as M. G. Lewis' *The Monk.* Between 1852 and 1865 he was occupied with translating the prose writings of Poe—he attempted only one poem, "The Raven"—and in studying him critically. His first article on the poet appeared in the *Revue de Paris* in 1852; the *Histoires extraordinaires* was published in 1856, the *Nouvelles histoires extraordinaires* in 1857—each with a long introduction—the *Aventures d'Arthur Gordon Pym* in 1858, *Eureka* in 1864 and *Histoires grotesques et sérieuses* in 1865. When Baudelaire came across the works of Poe he had the sensation of finding himself in him and of discovering poems and tales which he himself had conceived many years before. Poe gave him confidence in his own aesthetic doctrine and in his ideals of poetry. At this time he formed the association with the women who inspired two further cycles of love poems—the cycle of the "White Venus," inspired by Mme Sabatier, and the cycle of the "Green-Eyed Venus," inspired by the actress Marie Daubrun; in many of these poems he reached the highest peaks of his art.

So well known had Baudelaire become as a critic and translator of Poe that the *Revue des deux mondes* ventured to print a selection of his poems and 18 were published in June 1855. It was this that made him notorious.

Baudelaire's one collection of poems, *Les Fleurs du mal,* was published in 1857 by his friend Poulet-Malassis, who had inherited a printing press at Alençon. Shortly afterward the poet, his publisher and the printers were prosecuted at a famous trial for obscenity and as a result they were fined and six of the poems were banned. The consummate art of the collection was understood and appreciated by a few readers—Victor Hugo wrote to him from exile praising the work—but, for the general public, for several generations, the book remained a byword for depravity, morbidity and obscenity. Baudelaire published a further edition of *Les Fleurs du mal* in 1861 greatly enlarged and enhanced, but omitting the banned poems, which were published in 1866, in Belgium, in a collection entitled *Les Épaves.* A third and further enlarged edition was being prepared when the poet became paralyzed in 1866. It was published posthumously by his friend Charles Asselineau, though not, probably, as it was planned, but it contains the six "Nouvelles fleurs du mal" which had appeared in *Le Parnasse contemporain* in 1866, as well as poems which had nothing to do with the collection.

The failure of *Les Fleurs du mal,* from which he had hoped so much, was a bitter blow to Baudelaire, and the remaining years of his life were darkened by growing failure, pessimism and despair. Although some of his finest works were composed then, few of them were published in book form, though some appeared in periodicals—his "Salon" of 1859 in *La Revue française,* his "Richard Wagner et Tannhäuser à Paris" in 1861 in *La Revue européenne,* "Le Peintre de la vie moderne" (Constantin Guys), in 1863 in *Le Figaro,* and prose poems, intended to form part of a collection to be entitled *Spleen de Paris* (1869), in various papers. This was a work of which Baudelaire was particularly fond and he had been engaged on it for many years—he was working on it in Belgium at the time of his final collapse. He had obtained the idea from *Gaspard de la nuit* by "Aloysius" Jacques Bertrand (*q.v.*), but the subject matter is similar to that of the poems in verse composed in this period, and they were written in a pessimistic mood which reflects the aging and saddened Baudelaire. They express, even more poignantly than *Les Fleurs du mal,* his feeling for the large modern town, for Paris, and his compassion for outcasts and failures. Two books—*Les Paradis artificiels* and the second version of *Les Fleurs du mal*—were published in 1860 and 1861 by Poulet-Malassis, who immediately went bankrupt. Baudelaire was involved in his failure, and his financial difficulties were thereby made desperate. In an effort to retrieve his fortunes he presented himself for election to the Académie Française in 1861 but withdrew on the advice of his friends. To escape from his creditors, and to try to dispose of the copyright of the various volumes he had ready for publication, he went on a lecture tour to Belgium in 1864. This proved a failure and he was also unsuccessful in negotiating a contract for his books. He was particularly anxious to publish his aesthetic criticism, for he valued it as highly as his poetry and considered that all his writings were an organic whole. To appreciate his poetry it is necessary to understand his doctrine of art. His poetry is the crystallization of his vision in a poem; while his criticism is a meditation on the nature of a work of art and the principles which underlie it. He believed that every great artist was bound eventually to become a critic. His criticism is an explanation of his poetry and his poetry is an extension of his aesthetic doctrine.

In Feb. 1866, he became seriously ill at Namur, Belgium, and was taken back to Paris where he died on Aug. 31, 1867. He died obscure and almost forgotten and only two speeches were made at the graveside before a handful of people, but they were by close friends, Charles Asselineau and Théodore de Banville.

Baudelaire died unrecognized with all his works out of print and many of his writings unpublished, but the situation has greatly altered since his death. In modern times critics of every country place him among the greatest European poets of the 19th century. His admirers claim that he revolutionized the manner of thinking, writing and feeling in western Europe, and that his aesthetic doctrine marks a date of paramount importance not only in the history of poetry, but also in art in general. It was in him that the Symbolist movement in every country found its source. In May 1949, by the decision of the court of appeal, the ban on Baudelaire's poems was finally removed and the verdict and sentence of Aug. 20, 1857 were rendered null and void, as if they had never occurred. The poet was completely vindicated.

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J. P. Sartre, *Baudelaire* (1947); E. Starkie, *Baudelaire*, rev. ed. (1957); M. Turnell, *Baudelaire* (1953); G. Turquet-Milnes, *The Influence of Baudelaire in France and England* (1913); P. Valéry, *Situation de Baudelaire* (1926); R. Vivier, *L'Originalité de Baudelaire*, 2nd ed. (1952). (E. St.)

BAUDH-KHONDMALS, a district of Orissa, India. Area 4,284 sq.mi. (11,096 sq.km.). Pop. (1961) 514,427. It has two natural divisions, the plain of Baudh in the north and the plateau land (1,700–2,000 ft. [500–600 m.]) of Khondmals and Balliguda in the south. The chief rivers are the Mahanadi, forming the northern boundary, and its tributaries, the Bagh and the Salanki. One-fourth of the plateau is suitable for cultivation, and the aboriginal Khonds (*see* KHOND), who form the bulk of the population, live on forest produce for a quarter of the year. Small-scale irrigation projects are under way, and the cultivation of cash crops like jute and cotton is being tried.

Phulbani (pop. [1961] 4,231) is the district headquarters. Facilities are provided in the form of higher education, public utility services, and other modern amenities. The only other town of comparable size is Baudh (pop. 6,088), picturesquely situated on the right bank of the Mahanadi. It is named in honour of Buddha whose colossal image (11th century) stands there. The Rameswara temple group and the twin temples at Gandharadi (9th century), 7 mi. (11 km.) NW of Baudh, are of great artistic skill. (MA. M.; N. K. S.)

BAUDIER, MICHEL (*c.* 1589–1645), French historian whose works, though full of digressions, inaccuracies and unhistorical judgments, can be enjoyed for their collection of much curious information, especially on the reign of Louis XIII, was a native of Languedoc. As soldier and traveler he acquired a wide knowledge of languages and his histories include an account of the court of the king of China (1626); a religious history of Turkey (1626), translated from the Arabic; and an account of the kings of Persia. On French history his most important work was a *Histoire du maréchal de Toiras* (1644); he also wrote a strongly biased *Histoire du cardinal d'Amboise* (1634) and a curious romance entitled *Histoire de l'incomparable administration de Romieu, grand ministre d'état de Raymond Bérenger, comte de Provence* (1635), as well as some works on near-contemporary English history. His *Vie du cardinal Ximénès* (1635) was reprinted in 1851 with a notice on its author.

BAUDISSIN, WOLF HEINRICH, GRAF VON (1789–1878), German man of letters, who, with J. L. Tieck's daughter, Dorothea, was responsible for the translation of Shakespeare's plays begun by A. W. Schlegel and continued, nominally, by Tieck. He was born at Copenhagen on Jan. 30, 1789, entered the diplomatic service and traveled in Italy, France and Greece. In 1827 he settled in Dresden, where he lived until his death on April 4, 1878. His translations of Elizabethan drama—in *Ben Jonson und seine Schule*, 2 vol. (1836)— of Molière, of Italian plays and of the Middle High German epics *Iwein* and *Wigalois*, as well as of Shakespeare, contributed to the enrichment of German literature and the development of romanticism.

BAUDOUIN I (1930–), fifth king of the Belgians, elder son of King Leopold III and Queen Astrid, was born at the Stuyvenberg castle, near Brussels, on Sept. 7, 1930. Just before he was five he lost his mother in a motor accident. On the German invasion of Belgium in 1940, he was sent with his elder sister Princess Josephine Charlotte and his younger brother Prince Albert to Cahors in southwestern France, and in June he reached Lisbon in Portugal, but at the end of July he rejoined his father at Laeken palace, near Brussels, where the royal family remained in seclusion. He accompanied his father during his internment in Germany (June 1944–May 1945) and his subsequent voluntary exile in Switzerland. Baudouin was for the most part privately educated but during his father's stay at Pregny near Geneva (1945–50) he attended a state college at Geneva. On Aug. 11, 1950, before a joint session of the senate and the chamber of representatives, Baudouin was informed that parliament had granted him power to exercise the royal prerogatives, to which he answered in French and Flemish, "I accede to the will of parliament." He took the oath to observe the constitution and the law. As prince royal he acted as head of state until Leopold's abdication on July 16, 1951. He took the oath as king before both houses of parliament on July 17. On June 30, 1960, he proclaimed the independence of the Belgian Congo in person at Léopoldville. On Dec. 15, 1960, he married a lady of the Spanish nobility, Doña Fabiola de Mora y Aragon.

BAUDOUIN DE COURTENAY, JAN NIECISLAW (1845–1929), Polish linguist, whose works anticipated modern structuralist trends, was born at Radzymin, on March 13, 1845, of a polonized French family. He was educated in Warsaw, Prague, Jena, and Leipzig and in 1871 began his long teaching career. Although he was a specialist in comparative linguistics, he had little of the 19th-century interest in the history of languages. He turned his attention, rather, to general problems—questions of language mixture, child speech, dialect registration and the effect of linguistic structure on world outlook. Most important, he considered the sounds of language structural entities, rather than mere physical phenomena. His theory, cleared of its psychological overtones by such linguists as N. S. Trubetskoi, has become part of modern linguistics. He died on Nov. 3, 1929.

BAUDRY, PAUL JACQUES AIMÉ (1828–1886), French painter, known especially for his mural decorations, was born at La Roche-sur-Yon, Vendée, on Nov. 7, 1828. He won the Prix de Rome in 1850 with his picture of "Zenobia Found on the Banks of the Araxes." Baudry derived strong inspiration from Italian art with the mannerism of Correggio, as was evident in the two works he exhibited in the Salon of 1857, which were purchased for the Luxembourg palace in Paris. His murals show imagination and a gift for colour, as seen in the frescoes in the Paris Cour de Cassation, at the chateau of Chantilly and some private residences —the Hôtel Fould and Hôtel Paiva—but, above all, in the decorations of the Paris Opéra. He died in Paris on Jan. 17, 1886.

BAUER, BRUNO (1809–1882), German theologian and historian, who held that Christianity derived from the consciousness of its early adherents, not from a historical Jesus, and that it was primarily Hellenic rather than Jewish in conception. Born Sept. 6, 1809, at Eisenberg, Saxe-Altenburg, Bauer studied at Berlin where he adopted Hegelian views. In 1834 he became *Privatdocent* at Berlin, but distrust of his views led to his transfer to Bonn in 1839. There his licence to teach was revoked in 1842, after the publication of his *Kritik der evangelischen Geschichte der Synoptiker* (1841), and he retired to Rixdorf near Berlin. In 1843 his most radical book, *Das entdeckte Christentum* (first published 1927) was suppressed by the Zürich censor. His most important historical work was *Geschichte der Politik, Kultur und Aufklärung des 18. Jahrhunderts*, four volumes (1843–45). He died at Rixdorf, April 13, 1882.

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BAUER, OTTO (1881–1938), the leading theoretician of the Austrian Social Democrat party, was born in Vienna on Sept. 5, 1881. He was one of the founders of the Socialist educational movement "Die Zukunft," and with F. Adler of the theoretical Socialist periodical *Der Kampf* and a collaborator on Karl Kautsky's journal *Die Neue Zeit*. Bauer became secretary to the parliamentary fraction of the Social Democrat party in 1904 and at once revealed his gifts as a theoretician. His first work, *Die Nationalitätenfrage und die oesterreichische Sozialdemokratie* (1906; new ed. 1924), was a radical treatment of the problem of nationality in the Dual Monarchy. In this book Bauer proposed a solution based on separate national states, anticipating, in many particulars, the system established after World War I.

As a prisoner of war in Russia Bauer studied Bolshevism at first hand, and on his return to Austria in 1917 he became leader of the left wing of his party, which worked for a republic and self-determination for all nationalities. In the provisional administration of German Austria (Oct. 1918) he was appointed undersecretary of state for foreign affairs by Viktor Adler and became minister a few days later, on the latter's death (Nov. 1918). Bauer was then an advocate of *Anschluss* with Germany, and on March 2, 1919, he signed a secret *Anschluss* protocol with Ulrich von Brock-

dorff-Rantzau, the German foreign minister. He resigned, however, in July 1919, as the constituent assembly's attitude toward *Anschluss* was too cautious for him. After 1918 it was, however, Bauer who really guided the international and internal policy of his party which he preserved as a non-Bolshevik but advanced Socialist organization.

Bauer was a member of the Austrian national council from 1929 to 1934. After the uprising of Vienna Socialists and workers in 1934 he went into exile, but continued to direct the program of the Austrian Socialist party from Czechoslovakia and France. He died in Paris, July 4, 1938.

Bauer wrote an important account of his own and his party's activities, *Die österreichische Revolution* (1923; Eng. trans., 1925). His other chief works are *Bolshevismus oder Sozialdemokratie* (1920); *Der neue Kurs in Sovietrussland* (1921); "Das Weltbild des Kapitalismus" in *Der lebendige Marxismus* (1925).

BAUERNFELD, EDUARD VON (1802–1890), Austrian dramatist, a master of drawing-room comedy who for 50 years dominated the Vienna *Burgtheater*, was born in Vienna on Jan. 13, 1802. He studied philosophy and law at the University of Vienna and became the friend of Schubert and of Grillparzer; the latter had considerable influence on his style. Bauernfeld's comedies were witty pictures of Viennese society but the clever and stimulating talk also reflected the acute social and political questions of the day and the writer was for a while in the forefront of the liberal movement in Vienna. Of his plays may be mentioned especially *Die Bekenntnisse* (1834), *Bürgerlich und romantisch* (1835), *Grossjährig* (1846), *Krisen* (1852) and *Aus der Gesellschaft* (1867). Bauernfeld died at Oberdöbling on Aug. 9, 1890. His collected works were published in 12 volumes in 1871–73; a selection was edited by E. Horner in 1905.

BAUHAUS is the common shortened name of Das Staatliche Bauhaus Weimar, a school of design founded in 1919 by Walter Gropius (*q.v.*) in Weimar, Ger. It was largely responsible for revolutionizing the teaching of painting, sculpture, the industrial arts and architecture throughout the western world. Gropius was selected by the duke of Sachen-Weimar-Eisenach at the recommendation of the retiring director of the Weimar School of Arts and Crafts, the Belgian Henry van de Velde (*q.v.*). The Bauhaus owes the greater part of its success and influence to the sincerity, integrity and perseverance of its founder. The school attracted students from Germany and Austria who became enthusiastic followers of the Bauhaus' principles. The townspeople of Weimar, however, did not appreciate the institution and, in April 1925, after constant attack by the press and public, the Bauhaus moved to Dessau where new administrative, educational and residential quarters were constructed. These buildings, designed by Gropius, marked the maturation of the modern movement in architecture; they housed the Bauhaus until it was closed in 1933 by the German National Socialist government as a reputed centre of communist intellectualism. In 1928 Gropius resigned to enter private practice and was succeeded by the architect Mies van der Rohe who remained until the school was closed. After 1933 some of the dispersed faculty went to the United States. In 1937 Lazslo Moholy-Nagy founded the New Bauhaus in Chicago (later known as the Institute of Design), which with Gropius' appointment to the school of design at Harvard, Josef Albers' at Black Mountain college and Mies van der Rohe's at the Illinois Institute of Technology in Chicago spread the ideas of the Bauhaus throughout the U.S.

The Bauhaus sought to end the 19th-century schism between the artist and the technically expert craftsman by training students equally in both fields. In the first years each workshop was taught by both a craftsman and an artist. Later, as the school developed its own teachers, each workshop was led by one artist-craftsman. Students were bound to complete a full legal three-year apprenticeship. After a six-month preparatory course students went into the various training workshops (crafts and formal) for practical instruction. As instructors in the workshops, Gropius assembled a faculty noted and admired for its brilliance, energy and productivity. Among them were the Germans Gerhard Marks (sculptor), Oskar Schlemmer (scenic designer), Josef Albers (painter) and Adolf Meyer (architect); the Swiss Johannes Itten (painter), Paul Klee (painter) and Hannes Meyer (architect); the Austrian Herbert Bayer (typographer); the Russian Wassily Kandinsky (painter); and the American Lyonel Feininger (painter). The Bauhaus published its own books, pamphlets and quarterly periodical, of which the most important have been translated into English.

See PAINTING: *Modern Painting (Late 19th and 20th Centuries): Expressionism and the German School;* DESIGN, 20TH CENTURY; *see* also Index references under "Bauhaus" in the Index volume.

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BAUHIN, the name of a French family noted for its botanists, all of whom were physicians.

GASPARD BAUHIN (1550–1624), an anatomist and outstanding herbalist, noted for his precise descriptions, was the son of Jean Bauhin, a physician who fled earlier to Switzerland as a Protestant exile. Gaspard was born at Basel on Jan. 17, 1550, and studied medicine at Padua, Montpellier and in Germany. In 1582 he was appointed to the Greek professorship at Basel, and in 1588 to the chair of anatomy and botany. He was afterward made city physician, professor of medicine, rector of the university and dean of his faculty. His most important botanical work was *Pinax theatri botanici* (1623). When he died at Basel on Dec. 5, 1624, he had completed only three parts of a planned 12-part folio entitled *Theatrum botanicum,* only one of which was published (1658).

JEAN BAUHIN (1541–1613), elder brother of Gaspard, after studying at Tübingen under the German botanist Leonhard Fuchs, and traveling with the Swiss naturalist Konrad von Gesner, began to practise medicine at Basel, where he was elected professor of rhetoric in 1566. His great work, *Historia plantarum universalis,* unfinished at his death, was published at Yverdon, Switz., in 1650–51. He also wrote *Prodromus* (1619) and *De thermis aquisque medicatis* (1600).

JEAN GASPARD BAUHIN (1606–1685), the son of Gaspard, was also trained in medicine and was professor of botany at Basel for 30 years.

BAULE (BAOULE), a Twi (Twifo) people who live in the Republic of Ivory Coast between the Kumbu (Comóe) and Bandama rivers and are related to the Akan peoples of Ghana. The ancestors of the Baule had founded the states, or chiefdoms, of Amenfi and Twifo Heman but as a result of dissensions over the chieftaincy, or Stool disputes, between 1570 and 1580 some Twifo migrated from Amenfi and Heman to the area around the source of the Kumbu river. These are the ancestors of the present Baule. Others founded a Kumbu state along the Volta river, which is now the Akwamu state of Ghana. In the 18th century the Baule were joined by migrants from the Ashanti (*q.v.*), whose Warebo family tried to establish their rule over the Baule and build a chiefdom on the Ashanti model but had little success. The Baule preferred to live in independent villages formed of extended family groups. These were divided into quarters, or wards, with family compounds on either side of the main village street, a pattern also found among other Akan peoples such as the Bono.

The Baule, like the Ashanti, have a kinship organization based on matrilineal descent, succession and inheritance. They also have similar religious beliefs and practices in which ancestor worship has a prominent place. *See* also AFRICA: *Ethnography (Anthropology): West Africa.* (K. A. BU.)

BAULE, LA (LA BAULE-SUR-MER), a fashionable seaside resort on the west coast of France near the mouth of the Loire, facing south, is in the middle of a bay with a five-mile sweep of sand. In the *département* of Loire-Atlantique, it is 48 mi. W. of Nantes by road. Pop. (1954) 13,166. The bay extends from Pornichet to Pouliguen. Behind the line of hotels bordering the front are luxurious villas scattered among the pine trees. There is a park, an open-air school, a casino, golf and tennis clubs, and a harbour for yachtsmen. Nearby are salt marshes. During the

season there is air service from St. Nazaire airport (14 mi. E.) to Paris and London. (CH. M.)

BAUMBACH, RUDOLF (1840–1905), German poet whose student songs and narrative verse were widely known, was born at Kranichfeld on the Ilm, in Thuringia, on Sept. 28, 1840, and died at Meiningen, where he was ducal librarian, on Sept. 21, 1905.

Baumbach was a poet of the vagabond school, and wrote, in imitation of Viktor Scheffel, many excellent drinking songs, among which "Die Lindenwirtin" endeared him to the German student world. But his real strength lay in narrative verse, especially concerning the scenery and life of his native Thuringia. Special mention may be made of *Frau Holde* (1881), *Spielmannslieder* (1882) and *Von der Landstrasse* (1882).

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BAUMGARTEN, ALEXANDER GOTTLIEB (1714–1762), German philosopher who established aesthetics as a distinct philosophical discipline (*see* AESTHETICS, HISTORY OF), was born in Berlin on July 17, 1714. Studying under Christian Wolff at Halle, he was subjected early to the influence of Leibniz. He was appointed extraordinary professor at Halle in 1737 and ordinary professor of philosophy at Frankfurt-on-Oder in 1740. He died in Frankfurt on May 26, 1762.

Of his writings, the *Meditationes philosophicae de nonnullis ad poema pertinentibus* (1735; new ed. with Eng. trans. by Karl Aschenbrenner and W. B. Holther, 1954) and the *Aesthetica*, 2 vol. (1750–58), are the most important, being pioneer works in the development of modern aesthetic theory. His *Metaphysica* (1739) was used by Kant in his lectures. Other works are *Ethica philosophica* (1740) and *Acroasis logica* (1761). Posthumous publications are *Jus naturae* (1763), *Philosophia generalis* (1770) and *Praelectiones theologicae* (1773).

His brother, SIEGMUND JACOB BAUMGARTEN (1706–57), was professor of theology at Halle, where Johann Salomo Semler (*q.v.*) was his pupil. His application of Wolffian methods to theology did much to modify the influence of Pietism. His chief work was *Evangelische Glaubenslehre*, 3 vol. (1759).

BAUR, ERWIN (1875–1933), German botanist best known for his studies in experimental genetics, was born at Ichenheim, Baden, on April 16, 1875. He studied medicine in the universities of Strasbourg and Kiel and obtained his M.D. degree in 1900. After practising as physician in mental diseases he entered the University of Freiburg im Breisgau to study botany and was awarded a Ph.D. in 1903.

Baur started his botanical activity in the same year as an assistant in the Institute of Botany of Berlin university and in 1911 became professor of botany in the Agricultural school of Berlin, where he founded the Institut für Vererbungsforschung. After World War I he was instrumental in organizing an institute for the same purpose in Dahlem-Berlin and in 1929 became director of the Institut für Züchtungsforschung in Müncheberg. He died in Müncheberg on Dec. 2, 1933.

Baur started his work in botany as a bacteriologist but later specialized in experimental genetics. He collected wild species of *Antirrhinum* (snapdragon) in Spain and other Mediterranean regions, and investigated their behaviour under controlled crossing and under varying laboratory conditions, such as X-rays, ultraviolet light, etc. He studied also viral chlorosis of certain members of the mallow family (Malvaceae) and carried out investigations on cereals, lupins, tobacco and other important economic plants.

He founded in 1908 and edited, among other periodicals, an important journal, *Zeitschrift für Induktive Abstammungs- und Vererbungslehre*.

Baur's publications include *Einführung in die experimentelle Vererbungslehre* (1911; 2nd ed., 1914; 3rd ed., 1930); *Physiologie und Biologie der Fortpflanzung in Kultur der Gegenwart* (1917) and numerous articles in various periodicals.

BAUR, FERDINAND CHRISTIAN (1792–1860), Protestant theologian and church historian. The 19th century is the era when study and research in Christian theology, Roman Catholic and Protestant, came to be dominated by the modern historical method. Of the movement to apply the critical historical method to theology, Baur may be regarded as the foundation, just as Adolf von Harnack (*q.v.*) is probably its fruition.

Baur was born in Schmiden, near Cannstatt, on June 21, 1792. After receiving an early training in the theological seminary at Blaubeuren, he went in 1809 to the University of Tübingen. In 1817 Baur returned to the theological seminary at Blaubeuren as professor. In 1826 he was appointed professor of theology at Tübingen, where he remained until his death on Dec. 2, 1860.

Baur was the founder of the Protestant "Tübingen school" (the Roman Catholic "Tübingen school" of theologians found its outstanding representative in Johann Adam Möhler [*q.v.*]). As a student and during his early career as a professor, Baur showed the influence of the philosophical and theological thought of Friedrich Schleiermacher. Thus his work of 1824–25 on the natural religion of antiquity, entitled *Symbolik und Mythologie*, interpreted the religious significance of the ancient myths on the basis of Schleiermacher's definition of religious feeling as set down in the latter's *Addresses on Religion* and in his *The Christian Faith*. Baur's early work gives evidence also of impulses from the thought of Schelling.

During his early years as a professor at Tübingen, however, Baur exchanged these influences for that of Hegel, and his fame as a theologian and church historian is due largely to his application of Hegel's philosophy to the stuff of Christian theological history. In 1835 he published a radical examination of the Pastoral Epistles, in which he employed Hegelian analysis to explain the development of early Christianity. That development was viewed as the outcome of a conflict between primitive Jewish Christianity and Gentile Christianity. According to the Hegelian categories Jewish Christianity was the thesis, to which Gentile Christianity then provided the antithesis. What emerged from the conflict was neither Jewish nor Gentile Christianity, thus neither the thesis nor the antithesis, but a synthesis, the Catholic Christianity whose workings Baur discerned in the Pastoral Epistles. He therefore assigned the Pastoral Epistles to the 2nd century and denied their Pauline authorship.

In his work *Paulus* of 1845 (English trans. 1873–75) he carried these principles into a general interpretation of the life and thought of the apostle. He contended that only the Epistles to the Galatians, Corinthians and Romans are genuinely Pauline, and that the Paul of Acts is a different person from the Paul of these genuine Epistles, the author being a Paulinist who is at pains to represent Peter as far as possible as a Paulinist and Paul as far as possible as a Petrinist. Those writings alone he considered genuine in which the conflict between Jewish Christians and Gentile Christians is clearly marked. Two years after his monograph on Paul, in 1847, Baur published a book on the four Gospels, *Kritische Untersuchungen über die Kanonischen Evangelien*. In this he maintained that the authors of the Gospels were conscious of the conflict between the Jewish and the Gentile parties, and that the Gospels reveal a mediating or conciliatory *Tendenz* on the part of the writers or redactors; hence the "tendency theory" is associated with the names of Baur and the Tübingen school. In keeping with this theory, Baur interpreted the Gospels as adaptations or redactions of an older Gospel, such as the Gospel of the Hebrews, of Peter, of the Egyptians or of the Ebionites. The Petrine Matthew, he maintained, bears the closest relationship to the original Gospel; the Pauline Luke is later and arose independently; Mark represents a still later development; the account of John is an idealized portrait and not historically reliable.

Despite his apparent captivity to Hegelian categories, Baur was a historical scholar of genuine independence and creativity. In his later years, indeed, as his research carried him into the history of the church since the New Testament, he manifested an ever greater independence of Hegelian philosophy. On two of the cardinal doctrines of Christianity he wrote historical-theological monographs that are still of considerable value: on the doctrine of reconciliation and atonement (*Die christliche Lehre von der Versöhnung*, 1838); and on the doctrines of the Trinity and the Incarnation (*Die christliche Lehre von der Dreieinigkeit und*

Menschwerdung, 1841–43). His lectures on the history of dogma, published posthumously by his son (*Ausführliche Vorlesungen über die christliche Dogmengeschichte,* 1865–68), helped to establish the history of dogma as a distinct theological discipline.

These works, together with his church history (*Kirchengeschichte,* 1853–63) changed theological and church-historical scholarship for generations. In the century between the beginning of Baur's work and the end of Harnack's work, Christian source materials were subjected to a critical scrutiny unparalleled in all the history of Christian historical study. The very rejection of Baur's theses by Harnack—and of Harnack's theses by later scholarship—bears witness to the importance of Baur's thought. For Christianity is a historical religion, and the sources of Christian history are therefore a legitimate subject for historical investigation and for the speculations to which such investigation leads. Thus both his disciples and his critics have carried out the basic purpose of Baur and the Tübingen school, the interpretation of the Christian faith according to the methods and canons of critical historical scholarship.

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BAUTZEN, a city of Germany which after partition of the nation following World War II became a regional capital of the German Democratic Republic in the district of Dresden, lies about 71 km. (44 mi.) E.N.E. of Dresden and 40 km. (25 mi.) W. of Görlitz, on a granite elevation on the right bank of the upper Spree. Pop. (1961 est.) 41,859. This town in the Oberlausitz (Upper Lusatia) grew out of the Slavic settlement of Budissin. The peace of Bautzen was concluded in 1018 between the German king Henry II and the Polish king, Boleslaw I. Bautzen became German in 1031, and the capital of the Lusatian City federation in 1346. The quaint medieval skyline is dominated by the late Gothic St. Petri-Kirche which contains an undenominational church, the nave being divided in the middle; in one half, Protestant services have been held since 1524 and in the other, Roman Catholic services. Bautzen has long been the seat of the Roman Catholic bishop of Meissen. On the upper side of the town is the 15th-century Ortenburg castle. The town is a centre of the Sorbs (*q.v.*), a West Slavic people numbering about 60,000 to 70,000, also known as the Wends.

The town, which was damaged during the last days of World War II, has a varied industry including wagon and vehicle building, iron foundries, radio equipment and machinery plants. There is also a training school for heavy machinery manufacture. Bautzen is a railway junction, including the Dresden-Görlitz line.

The Battle of Bautzen, 1813.—The town gives its name to the hard-fought battle of May 20 and 21, 1813, between French troops under Napoleon I, Soult and Ney and the allied forces of Prussians led by Blücher, Kleist and Yorck, and Russians commanded by Tsar Alexander I and Barclay de Tolly. Soon after dawn on May 21 it became clear that a decisive victory for the French could be won only by the intervention of Ney, who had originally been stationed nearly 40 mi. from the left of the main body. He reached Preititz at 10 A.M., an hour earlier than ordered, and halted. The respite enabled the allies to organize a fierce counterattack, and when he resumed his advance at 1 P.M. they began a general retreat eastward, the tsar directing the rearguard with the utmost skill and bravery. It was too late for the French to cut them off, and the Russo-Prussian army retired unharmed, leaving no trophies. Napoleon's tactical success was unquestionable but strategically, owing to the want of cavalry and Ney's lack of intelligent initiative, it was a *coup manqué* or barren victory. *See* NAPOLEONIC WARS.

BAUX, LES, a village of France, in the *département* of Bouches-du-Rhône, 11 mi. N.E. of Arles. Pop. (1954) 68. In the middle ages Les Baux was a flourishing town and the seat of the seigneurs des Baux, who owned the Terres Baussenques, extensive *domaines* in Provence and Dauphiné; in 1174 the principality of Orange passed by marriage to Bertrand des Baux. But in their struggles with Raymund Berengar II of Provence in the 12th century, and with the house of Anjou in the 13th century, the influence of the family declined and they were forced to abandon many of their possessions in Provence.

The village has the ruins of a château with a 13th-century dungeon. In Saint Vincent's church (16th and 17th centuries) a *fête du pastrage* (adoration of the shepherds) is held on Christmas eve. At Fontvieille, 5½ mi. away, is the mill, now a museum, which inspired Alphonse Daudet's *Lettres de mon moulin.*

BAUXITE, the principal ore of aluminum, is a mixture of hydrous aluminum oxides. In 1821 P. Berthier discovered that a nonplastic, claylike material from Les Baux, near Arles, France, was practically devoid of silica, either free or combined. Analysis showed 52% alumina, 27.6% ferric oxide and 20.4% combined water. It was named "beauxite" by A. Dufrénoy in 1847; in 1861 the spelling was corrected by H. St. Clair Deville to correspond with that of the type locality. The name "bauxite" was thereafter applied to similar materials the world over and includes rocks in which silica also is an important constituent.

All bauxites are formed by thorough weathering, from many different rock types, but no one process is universally explanatory. Clay minerals may or may not be an intermediate stage, and some bauxites appear to be more truly reworked chemical precipitates than simple alteration products *in situ.* The mineralogy and associations of bauxite and the similar aluminum and iron-bearing material known as laterite (*q.v.*) have been closely examined. Some workers have tried to keep the two terms separate, with laterite indicating iron-rich deposits, but others consider that there is no sharp dividing line. Soil studies in the tropics have pointed to rainfall, seasonal fluctuations, ground-water composition and drainage rate as determining whether products of weathering are ferruginous or aluminous. Such phenomena as dialysis, electrolytic migration and electrokinetics have been claimed to play a part in formation of Indian laterites.

Varieties.—Bauxites vary with the type to which they belong, with the primary or sedimentary nature of the deposit and with their geologic history. The terms "laterite type" and "terra rossa type" were introduced to distinguish bauxites of different appearance or origin. However, some bauxites do not appear to fit in either class. Some deposits are soft, friable and structureless; some are hard, dense and pisolitic, or pealike; still others are porous but strong, or are stratified or largely pseudomorphic after parent rock. Bauxite may grade into laterite or clay, laterally or vertically. The laterite type is commonly pisolitic and mottled. Pisolites vary from buckshot size to a foot or more in diameter. Both pisolites and groundmass may exhibit great colour variations, depending on both composition and texture. Common colours are pink, cream, red, brown, yellow and gray. Exposed surface of lateritic ore is rough, often scoriaceous like lava, and in vertical faces a vermicular, or wormlike, structure with variegated colours may be seen. Such material tends to harden or reconsolidate on exposure. Although terra rossa types are granular and earthy, they also may possess pisolitic structures.

Composition and Character.—Constituent minerals are rarely recognizable in hand specimen, and even in thin section complete identification may be difficult. Combined petrography, X-ray diffraction and differential thermal analysis have shown that gibbsite (trihydrate), boehmite and diaspore (monohydrate) (*qq.v.*), alone or in mixtures, are the constituent alumina minerals. No dihydrate of alumina has been identified, but mixtures of tri- and monohydrate may approximate such a composition. Clay minerals such as kaolinite, and hematite, magnetite, goethite, siderite and quartz are common impurities. Most deposits contain rutile or anatase, with other residual minerals such as zircon. Certain minor elements such as niobium may reach unusual levels; manganese, chromium, vanadium, zirconium and phosphorus are commonly present, and cobalt, nickel, tin, gold and diamond have been found. Specific gravity of bauxite varies with type and composition from 2.45 to 3.25. Hardness also varies with type, geological age and history; monohydrates are generally harder than trihydrate types. Combined water is driven off in two main stages; trihydrate converts at about 250° C. to monohydrate with loss of two moles of water, and most of the remainder is driven off at around 550° C.

Practical dehydration is attained at about 950° C. Bauxites fuse at 1,800° C. or higher.

Occurrence and Production.—Bauxite and laterite are found in most countries, with a tendency toward tropical distribution. In the following examples parent rock types are given in parentheses. It will be seen that some of the major ore deposits are derived from rocks of medium or low alumina content. Extensive mining of monohydrate ores has been done, for example, in France, Italy, Yugoslavia and Greece (all limestone), and of trihydrate ores in Arkansas (nepheline syenite), the Guianas (granitic and dioritic rocks), and after 1950 in Jamaica (limestone). Essentially trihydrate ores occur in Ghana (shale, phyllite and schist) and Guinea (nepheline and gabbroic rocks) and in India (basalt) and Brazil (nepheline rocks). Low-grade ores in Georgia and Alabama occur on sedimentary clays. Malaya, Australia, Nyasaland, Northern Ireland, Germany and other areas contain less extensive or lower-grade deposits. Russian (Urals) and north Asian deposits are largely monohydrate. Examples of compositional ranges are given in the accompanying table.

Compositional Ranges of Bauxite

Constituent	North and South America	Jamaica	West Africa	Mediterranean	Southeast Asia
Water	28%–31%	23%–29%	23%–30%	10%–15%	27%–30%
Silica	1%– 8%	0.5%– 4%	1%– 5%	2%–14%	3%– 8%
Titania	2%– 3%	2%– 3%	1%– 4%	2%– 3%	0.5%–10%
Ferric oxide	1%–10%	15%–22%	5%–20%	16%–22%	3%–10%
Alumina	54%–61%	48%–52%	48%–60%	55%–61%	53%–58%

Much of the silica in bauxites may be combined with alumina in clay mineral and, in ore destined for aluminum production, this silica should be less than about 10%; North American practice sets 6%–8% as top limit for Bayer treatment, a widely used process of selective leaching by a causticized soda solution, but in Europe the maximum is somewhat lower. In the second half of the 20th century ore yielding about 50% caustic-soluble alumina was considered commercial. Iron oxide is objectionable only as a diluent in the Bayer process. As a general rule, four tons of bauxite are required to yield one ton of metal.

World reserves are numbered at least in the hundreds of millions of tons. Jamaica alone has been quoted at more than 300,000,000 tons. Annual world production, exclusive of the U.S.S.R., exceeds 12,000,000 tons, of which roughly 85%–90% is for metal production. The balance is divided among chemicals, abrasives and refractories, and the petroleum industry. Soviet production is estimated at more than 1,000,000 tons annually.

United States.—From the first operation by Edward Nichols in 1883 on the claylike bauxite of northwestern Georgia to the second half of the 20th century, production developed to an important industry serving many fields, with annual production running at an average of about 1,800,000 tons.

American bauxites are predominantly trihydrate in nature as indicated above. As mined, free moisture may be 10%–20%, but this is generally driven off in kilns before marketing. The chief minerals are gibbsite, kaolinite, hematite, goethite, siderite (in some Arkansas ore), anatase or rutile and quartz.

The United States supplies of metal-grade ore suffered during World War II by extended exploitation, which gradually brought about a change in definition of commercial ore, particularly with respect to the permissible amount of combined silica. The Bayer process is less efficient with high silica ores, and a combined treatment may be employed in which, following the Bayer caustic digest, the residue is sintered with lime and soda ash. This renders additional alumina soluble, raises over-all recovery and enables material with as much as 13% silica to be utilized. The smelting step in the production of aluminum, developed simultaneously by Charles M. Hall in Oberlin, O., and Paul Héroult in France in 1886, reduces the purified alumina obtained by the Bayer process in a predominantly cryolite electrolyte.

Although Arkansas remains the centre of U.S. production, by the second half of the 20th century bauxite-consuming industries were nearly two-thirds dependent on imports from Surinam (Dutch Guiana) and Jamaica. Exploration of lower-grade bauxites and bauxitic clays in the southeastern and northwestern states was intensified following World War II, with the industry looking to lower-grade domestic reserves. Nevertheless, the Arkansas region is estimated to contain 95% of the U.S. supply of commercial ore. During and following World War II researchers in the U.S. and Canada also investigated alternative sources of alumina. Kaolinite, anorthosite, nepheline syenite and alunite can be treated by sinter processes but are not competitive with available bauxite.

Compositional restrictions on bauxite for uses other than the production of the metal affect silica, iron and water contents in particular. For abrasive purposes calcined ore with about 86% alumina, 6% silica, 3%–4% ferric oxide and 3% titania is fused in special electric furnaces. The bulk of silica and iron is removed as slag. Considerable purified alumina is also fused to yield a white abrasive of certain specific properties. For refractories, a composition of 82%–85% alumina, 9%–11% silica and 2% or less ferric oxide is required. Chemical-grade ore is again different. Bauxite is also used for aluminous cement, for aluminum sulfate for papermaking and water treatment and for aluminum chloride for petroleum treatment. Purified alumina also is used as a catalyst carrier, an inert filler in plastics and rubber, and in ceramics. The consumption of bauxite in the U.S. in the early 1960s was about 3,500,000 tons annually, with about 85% going into the aluminum industry. *See* ALUMINUM; *see* also Index references under "Bauxite" in the Index volume.

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BAVARIA (German BAYERN), the largest of the *Länder* of the Federal Republic of Germany, though second to North Rhine-Westphalia in population. Bavaria, since the loss of the Palatinate in 1945, has an area of 70,549 sq.km. (27,239 sq.mi.). It is bordered by Austria on the south, Czechoslovakia on the east, Thuringia and Lower Saxony on the north, Hesse on the northwest and Baden-Württemberg on the west.

Physical Geography.—Bavaria, in the southeast of Germany, is framed by the Alps to the south, the Böhmerwald (Bohemian forest) to the east, and the Rhön and Spessart highlands to the north. It merges into the Main and Neckar lands of Württemberg to the west. The Danube river roughly divides the country into a northern and a southern half between which there are marked general contrasts.

The northern half falls into five main physical divisions from west to east. The northwest corner of the state embraces the Spessart, a thickly wooded plateau of horizontal red sandstone rocks. Then follows the upper Main basin, an undulating limestone platform with a cover of loam soils. The Fränkische Höhe is a north-south sandstone plateau (1,500 ft. high), scarped to the west and sloping gradually to the east. The valley of the Rednitz has sandy soils that are covered with pine forests around Nürnberg. The Fränkische Alb is a wooded limestone plateau, with a deeply dissected westward-facing scarp. The Ries, centred on Nordlingen, is a circular, fertile lowland below the level of the plateau. To the east, in Oberpfalz, highlands of crystalline rocks are forested with spruce and fir; across them stretches the north-south valley of the Naab in a damp and wooded lowland.

The southern half is the Bavarian plateau. This lies between the Danube and the Alps and narrows to the west and east. Its altitude rises from about 1,500 ft. along the Danube to 3,000 ft. at the foot of the Alps. It is crossed by the valleys of many rivers from the Alps draining northward to the Danube. Its main physical features are due to the effects of valley glaciers that formerly issued from the Alps. Rolling hill country lies east of the Lech, on which there are considerable areas of fertile loam soils. The glacial gravels west of the Lech are wooded and separated into strips by wide south-north valley floors. A fluvioglacial plain is centred on Munich. Arcuate belts of wooded morainic hills

TABLE I.—*Average Temperature Ranges in Bavaria*

Location	Height above sea level	Average temperature (° F.)	
		January	July
Würzburg	587 ft.	32	65
Nürnberg	1,050 ft.	31	65
Munich	1,736 ft.	28	63
Zugspitze	9,721 ft.	12	35

lie at the foot of the Alps and between them are several large lakes. The Danube valley has fertile areas of drained bogland.

Apart from the Main valley, which is one of the warmest parts of Germany, Bavaria has in general a cold climate (*see* Table I). The total precipitation at Munich is 34 in. as compared with 23 in. at Bayreuth. Würzburg has an average of about 28.5 days with snowfall, as compared with 53 at Munich, and 181 at the Zugspitze (9,721 ft.), Germany's highest peak. (R. E. DI.)

HISTORY

The earliest known inhabitants of the country afterward called Bavaria were highly civilized Celts, who were subdued by the Romans just before the opening of the Christian era, their land being included in the province of Raetia. The cities of Augsburg, Regensburg and Passau were originally Roman colonies. During the 5th century the district was ravaged by the troops of Odoacer and, after being almost depopulated, was occupied by tribes who, pushing along the valley of the Danube, settled there between A.D. 488 and 520. Their origin is disputed, but they were composed of a mixture of Germanic tribes and were known as *Baivarii* or *Baiuwarii*, names derived most probably from *Baya* and given to them because they came from *Baya-Hemum* (between Brno and Lake Balaton). Their country was bounded by the Enns, the Danube, the Lech and the Alps.

Frankish Influence.—The Bavarians soon came under the dominion of the Franks and were ruled from about 555 to 788 by dukes of the Agilolfing family, possibly of Frankish descent. For a century and a half these dukes resisted the inroads of the Slavs, and by the time of Duke Theodo I (d. 717) were independent of the feeble Frankish kings. When Charles Martel became the virtual ruler of the Frankish realm, he brought the Bavarians into strict dependence, and Pepin the Short was equally successful in maintaining his authority.

The first heralds of Christianity in Bavaria were wandering Irish and Scottish friars. They came from Burgundy (from the monastery at Luxeuil) probably as early as the beginning of the 7th century. In the second half of the 7th century the wandering bishops St. Marinus and Annianus worked in the Upper Bavarian alpine foreland, around Bad Aibling. The mission of the three "Bavarian apostles," St. Rupert (*q.v.*) in Salzburg, St. Emmeram in Regensburg and St. Korbinian in Freising, at the beginning of the 8th century, was of more lasting effect. Their work was furthered by Duke Theodo, and Rupert in particular founded several religious houses. St. Boniface (*q.v.*) organized the Bavarian church (739) into the bishoprics of Salzburg, Freising, Regensburg and Passau and thus established the first national church right of the Rhine.

Union With Carolingian Empire.—Tassilo III, who became duke of the Bavarians in 749, did homage to the Frankish king Pepin the Short on coming of age in 757, but, during the early years of the reign of Charlemagne he acted as an independent ruler. He founded several religious houses (Wessobrunn, Innichen in the Pusterthal and Kremsmünster, among others); and in this the bishops and nobility would not lag behind the duke and the ducal house. A wider movement of settlement swept Bavarian territory and pushed the frontiers back in the southeast, east and north. Tassilo's position as possessor of the Alpine passes, as an ally of the Avars and as son-in-law of the Lombard king Desiderius was so serious a menace to the Frankish kingdom that Charlemagne determined to crush him. The details of this contest are obscure. The outcome, however, was that Tassilo had to surrender his duchy in 788. The country was ruled by Gerold, a brother-in-law of Charlemagne, until his death in a battle with the Avars in 799, when its administration was assimilated with that of the rest of the Carolingian empire.

When the empire was partitioned in 817, Bavaria was assigned to Louis the Pious and then to his son Louis the German, king of the East Franks, and thus formed part of the larger territories which were confirmed to the latter in 843 by the treaty of Verdun. Louis, who called himself king of Bavaria, made Regensburg his capital and was active in improving the condition of Bavaria. When he divided his possessions in 865, it passed to his eldest son Carloman, and after his death in 880 formed part of the territories of the emperor Charles III the Fat. His defense was left by this incompetent emperor to Arnulf, an illegitimate son of Carloman, and it was mainly because of the support of the Bavarians that Arnulf was able to take the field against Charles in 887 and to secure his own election as German king. On his death in 899 Bavaria, which was the centre of the East Frankish kingdom, passed to his son, Louis the Child, during whose reign it was constantly ravaged and all but depopulated by the Hungarians.

For the defense of Bavaria the mark, or duchy, of Carinthia had been erected on the southeastern frontier, which during the reign of Louis the Child was ruled by Liutpold, count of Scheyern, who fell in the disastrous defeat of the Bavarians by the Hungarians at Pressburg (Bratislava) on July 4, 907. His son Arnulf I rallied the remnants of the race and drove back the Hungarians. As early as 909 Arnulf styled himself "by the grace of God duke of Bavaria and the adjacent territories."

The Bavarian Duchy.—Refusing to acknowledge the supremacy of the German king Conrad I, Arnulf was unsuccessfully attacked by Conrad. After Conrad's death (Dec. 918) King Henry I made war on Arnulf, who also set himself up as king. The *Salzburg Annals* say that Arnulf was chosen to be ruler *"in regno Teutonicorum,"* but this probably means only in his independent kingdom of Bavaria, with which he was content after recognizing Henry as German king (921). He appointed bishops, struck coins, issued laws and pursued his own foreign policy inclined toward Italy. A similar conflict took place between Arnulf's son Eberhard and Otto I the Great; but Eberhard was less successful than his father, for in 938 he was driven from Bavaria by his uncle Berthold, who received the duchy, with reduced privileges, from Otto. When Berthold died in 947, Otto conferred the duchy upon his own brother Henry (Henry I of Bavaria), who had married Judith, a daughter of Arnulf; Henry's short reign was spent mainly in disputes with his people. The ravages of the Hungarians ceased after their defeat by the emperor Otto on the Lechfeld in 955. In 955 also Henry I was succeeded by his young son Henry II the Quarrelsome (d. 995). The royal succession was still by no means rigidly fixed and the ambitious and forceful Henry, a cousin of the king Otto II, made an attempt to gain the German crown (975). The attempt miscarried; and in 976 Henry was formally deposed, Bavaria being given to Otto, duke of Swabia. At the same time Carinthia was made into a separate duchy. In 985, Duke Henry II recovered Bavaria from the Luitpolding Henry III, who had succeeded Otto of Swabia in 983. Henry II proved himself a capable ruler by establishing internal order, issuing important laws and reforming the monasteries. His son reached the goal toward which his father had striven in vain, being elected German king as Henry II in 1002. He gave Bavaria to his brother-in-law, Henry of Luxembourg, after whose death in 1026 it passed successively to Henry, afterward the emperor Henry III, and then to another member of the family of Luxembourg, as Duke Henry VII. In 1061 the empress Agnes, mother of and regent for the German king Henry IV, entrusted the duchy to Otto of Nordheim, who was deposed by the king in 1070, when the duchy was granted to Otto's son-in-law Count Welf, son of Azzo II, of Este. In consequence of his support of Pope Gregory VII, in his quarrel with Henry, Welf lost but subsequently regained Bavaria and was followed successively by his sons, Welf II in 1101, and Henry IX in 1120. Henry was succeeded in 1126 by his son Henry X the Proud, who obtained the duchy of Saxony in 1137. King Conrad III, however, refused to allow two duchies to remain in the same hands, declared Henry deposed and bestowed Bavaria upon Leopold IV, margrave of Austria.

When Leopold died in 1141, the king retained the duchy

himself. It continued to be the scene of considerable disorder, and in 1142 he entrusted it to Henry II Jasomirgott, margrave of Austria. The struggle for its possession continued until 1156, when the emperor Frederick I Barbarossa persuaded Henry to give up Bavaria to the Welf Henry the Lion (*q.v.*), duke of Saxony.

Rule of the Wittelsbachs.—In 1180 Henry the Lion was placed under the imperial ban, and the duchy was given by Frederick I to Otto, a member of the old Bavarian family of Wittelsbach (*q.v.*) and a descendant of the counts of Scheyern. After the destruction of the Carolingian empire the borders of Bavaria had been continually changing and for a long period after 955 this process was one of expansion. To the west the Lech still divided Bavaria from Swabia, but on three other sides the duchy had been extended and embraced a large area north of the Danube. During the later years of the rule of the Welfs, however, the extent of Bavaria had been reduced. The energies of Henry the Lion had been devoted to his northern rather than his southern duchy, and, when the dispute over the Bavarian succession was settled in 1156, the district between the Enns and the Inn had been transferred to Austria. The increasing importance of Styria, elevated into a duchy in 1180, and Tirol had diminished the strength of Bavaria, which now had few opportunities for expansion.

When Otto of Wittelsbach was invested with Bavaria in Sept. 1180, the duchy was bounded by the Böhmerwald, the Inn, the Alps and the Lech; and the power of the duke was practically confined to his extensive private domains around Wittelsbach, Kelheim and Straubing. Otto was succeeded in 1183 by his son Louis I, who took a leading part in German affairs during the earlier years of the reign of the emperor Frederick II, and was assassinated at Kelheim in Sept. 1231. Louis was the real founder of the Bavarian principality, and he recklessly used every means to extend his power. He increased his dominion, especially toward the east and north, by astute policy, by inheritance, by purchase, by feudal acquisitions and by force; founded cities (Landshut, Straubing, Landau and Iser); and also won the Palatinate of the Rhine (1214). His son Otto II increased the area of his lands mainly by purchases; and he had strengthened his hold upon the duchy before he died in Nov. 1253. The efforts of the dukes to consolidate their power over the duchy had been fairly successful; but they were soon vitiated by partitions among different members of the family, which for 250 years made the political history of Bavaria little more than a chronicle of territorial divisions, family feuds and petty squabblings. The duchy was, however, enriched by a many-sided intellectual and artistic life in the individual newly risen courts and by a very able administration.

Division of the Duchy.—The first division was made in 1255 between Louis II the Stern (1253–94) and Henry I (XIII, 1253–90), the sons of Duke Otto II, Louis obtaining the western part of the duchy, afterward called Upper Bavaria, and Henry the eastern, or Lower Bavaria. In the course of a long reign Louis became the most powerful prince in southern Germany. He was the uncle and guardian of Conradin of Hohenstaufen, and, when this prince was put to death in Italy in 1268, Louis and his brother Henry inherited the domains of the Hohenstaufen in Swabia and elsewhere. Louis helped Rudolf of Habsburg to secure the German throne in 1273, married the new king's daughter Mechtild and aided him in his campaigns. For some years after the death of Louis in 1294 his sons Rudolf I (d. 1319) and Louis, afterward the emperor Louis IV, ruled their duchy in common; but in 1310 a division of Upper Bavaria was made, by which Rudolf received the land east of the Isar, with the town of Munich, and Louis the district between the Isar and the Lech with his capital at Ingolstadt. This arrangement, however, soon led to war between the brothers, and in 1317, three years after he had been chosen German king, Louis compelled Rudolf to abdicate, and for 12 years ruled alone over the whole of Upper Bavaria. Munich rose to importance and became the focus of the great intellectual church-state controversies of the time. But in 1329 Louis concluded the treaty of Pavia with Rudolf's sons, Rudolf and Rupert, to whom he transferred the Palatinate of the Rhine and also a portion of Upper Bavaria north of the Danube which was afterward called the Upper Palatinate. At the same time it was decided that the electoral vote should be exercised by the two lines alternately, and that if either branch of the family became extinct the surviving branch should inherit its possessions.

When in 1290 Henry I of Lower Bavaria died, the duchy was ruled by his three sons, Otto III, Louis III and Stephen I. Otto, who was king of Hungary from 1305 to 1308, died in 1312, leaving a son, Henry III; Louis died childless in 1296; and Stephen left two sons at his death in 1310, namely, Henry II and Otto IV. Henry III died in 1333 and his cousin Otto IV in 1334, and as neither left any sons the whole of Lower Bavaria passed to Henry II. Dying in 1339, Henry left an only son, John I, who died childless in the following year, when the emperor Louis IV secured Lower Bavaria and united the whole duchy under his sway. The union of Bavaria under Louis lasted seven years, with much benefit to the country. When he died in 1347, he left six sons to share his possessions, who agreed upon a division of Bavaria in 1349. Its history, however, was complicated by its connection with Brandenburg, Holland and Tirol, all of which had also been left by the emperor to his sons. All six brothers exercised some authority in Bavaria; but only three left issue, and of these the eldest, Louis, margrave of Brandenburg, died in 1361, his only son Meinhard dying two years later without issue. The two remaining brothers, Stephen II and Albert I, ruled over Bavaria-Landshut and Bavaria-Straubing respectively, and when Stephen died in 1375 his portion of Bavaria was ruled jointly by his three sons. In 1392, when all the lines except those of Stephen and Albert had died out, an important partition took place, by which the greater part of the duchy was divided among Stephen's three sons, Stephen III, Frederick and John II, who founded respectively the lines of Ingolstadt, Landshut and Munich. Albert's duchy of Bavaria-Straubing passed on his death in 1404 to his son William II, and in 1417 to his younger son John, who resigned the bishopric of Liège on becoming duke. When John died in 1425, this family became extinct, and after a contest between various claimants Bavaria-Straubing was divided between the three remaining branches of the family.

The main result of the threefold division of 1392 was the temporary eclipse of Bavaria. Neighbouring states encroached upon its borders and the nobles ignored the authority of the dukes, who for 50 years were mainly occupied with internal strife. This condition of affairs, however, was not wholly harmful. The government of the country and the control of the finances passed mainly into the hands of an assembly called the *Landtag* or *Landschaft*, which had existed since the beginning of the 14th century. The towns, assuming a certain independence, became strong and wealthy as trade increased, and the citizens of Munich were often formidable antagonists to the dukes. Thus a period of disorder saw the growth of representative institutions and of a strong civic spirit. The rule of Stephen III, duke of Bavaria-Ingolstadt, was marked by struggles with various towns and with his brother, John of Bavaria-Munich. Dying in 1413, he was followed by his son Louis, called the Bearded, a restless and quarrelsome prince, who had played an important part in the affairs of France, where his sister Isabella was the queen of King Charles VI. About 1417 he became involved in a violent quarrel with his cousin, Henry of Bavaria-Landshut, fell under both the papal and the imperial ban and in 1439 was attacked by his son Louis the Lame. This prince, who had married a daughter of Frederick I of Hohenzollern, margrave of Brandenburg, was incensed at the favour shown by his father to an illegitimate son. Aided by Albert Achilles, afterward margrave of Brandenburg, he took the elder Louis prisoner and compelled him to abdicate in 1443. When Louis the Lame died in 1445, his father came into the power of his enemy, Henry of Bavaria-Landshut, and died in prison in 1447. The duchy of Bavaria-Ingolstadt passed to Henry, who had succeeded his father Frederick as duke of Bavaria-Landshut in 1393, and whose long reign was almost entirely occupied with family feuds. He died in July 1450, and was followed by his son, Louis IX the Rich, and about this time Bavaria began to recover some of its former importance. Louis IX expelled the Jews from his duchy, took some steps for the security of traders and improved both the administration of justice and the condition of the finances. In

1472 he founded the University of Ingolstadt, which very soon achieved a prominent position, and he made an attempt to reform the monasteries. On his death in 1479 he was succeeded by his son George the Rich, who died without sons in Dec. 1503, whereupon a war broke out for the possession of his duchy.

Bavaria-Munich passed, on the death of John II in 1397, to his sons Ernest and William III, but they only obtained possession after a struggle with Stephen of Bavaria-Ingolstadt. Both brothers were then engaged in warfare with the other branches of the family and with the citizens of Munich. William, a loyal servant of the emperor Sigismund, died in 1435, leaving an only son, Adolf, who died five years later; and Ernest died in 1438. In 1440 the whole of Bavaria-Munich came to Ernest's son Albert, whose attempts to reform the monasteries earned for him the surname of Pious. He died in 1460, leaving five sons, the two elder of whom, John IV and Sigismund, reigned in common until the death of John in 1463. The third brother, Albert IV the Wise (d. 1508), who had been educated for the church, joined his brother in 1465 and, when Sigismund abdicated two years later, became sole ruler of Bavaria-Munich, in spite of the claims of his two younger brothers.

(L. Lk.)

Reunion of the Duchy and Consolidation.—In 1487 Albert married Kunigunde, daughter of the Habsburg emperor Frederick III, partly in order to secure inheritance rights, but Bavarian designs for aggrandizement were checked in 1488 by the foundation of the Swabian league, and the duke, faced also with domestic difficulties, had to abandon hopes of expansion at the expense of the Habsburgs in the treaty of Augsburg (1492). When George the Rich of Landshut left his duchy on his death in 1503 to his son-in-law Rupert of the Palatinate, Albert claimed the inheritance as the nearest male heir. In the war which followed, Albert had the support of his brother-in-law the emperor Maximilian and defeated Rupert, but had to agree to a compromise which, while it secured him Landshut, gave the Upper Palatinate north of the Danube to Rupert's sons. Maximilian received some Tirolese possessions as a reward. In 1506 Albert established by decree the rule of primogeniture for the whole of Bavaria, an act of profound importance which made Bavaria, for the time being, the largest purely German state. However, after Albert's death (1508), the elder of his two sons, William IV (1508–50) was eventually forced by the younger, Louis X, to yield a share in the government and a part of the duchy to him. Louis achieved this concession (1516) by allying himself with the estates, with whom William was constantly at odds. Later, however, with the help of his chancellor Leonhard von Eck, a jurist who aimed at strengthening the prerogative according to the principles of Roman law, William systematically broke the power of the estates, and the unity of Bavaria was restored on the death of Louis in 1545.

William regarded the Reformation primarily as a threat to authority and took measures against the spread of non-Catholic doctrines. In recognition of these measures the papacy granted him larger rights of control over the church. William, however, did not allow his Catholicism to interfere with political considerations. He was usually to be found in opposition to the Habsburgs and allied himself with the Protestant princes of the League of Schmalkalden, and in 1532 the first of many treaties securing French subsidies for Bavaria was concluded. In 1546, however, Bavarian policy changed abruptly to an alliance with the Habsburgs, following the introduction of the Reformation in the Palatinate. William's heir, Albert, was married to the elder daughter of the Habsburg Ferdinand I, and there were vague promises that the Wittelsbachs might one day inherit some Habsburg dominions on the extinction of their male line. William then maintained an attitude of partisan neutrality, which contributed to Charles V's victory at Mühlberg in 1547.

William's son Albert V (1550–79), a great patron of art, made some concessions to the Protestants in the early years of his reign as he could not afford to antagonize the estates, who demanded some relaxation of the pro-Catholic regulations. Even so, he established the Jesuits (whom his father had introduced into Bavaria) at the University of Ingolstadt in 1556. With the revival of Catholicism following the Council of Trent, Albert felt strong enough to strike when, in 1564, letters were discovered which revealed a nascent conspiracy among the Protestant nobles. Bavaria then became a strictly Catholic country. Albert's son William V (1579–97) extended the influence of his dynasty over the church. In 1583 a concordat gave papal sanction to a strengthening of ducal control over the clergy. In the same year William's younger brother Ernest became archbishop and elector of Cologne, being the first of the long series of Wittelsbach archbishop-electors which only terminated in the middle of the 18th century. William was an ineffective ruler under whom finance and administration fell into evil days and in 1597 he abdicated.

William V's son Maximilian I (1597–1651) used absolutist methods to restore order in finance and administration, enabling Bavaria to play a considerable part in European affairs. His dilemma was that, whereas his devout Catholicism and his desire to acquire for himself the electoral dignity held by the Protestant Palatinate branch of his family inclined him toward an alliance with his cousin the emperor Ferdinand II, his leading position among the German princes made him particularly sensitive to any strengthening of imperial power. His leadership of the Catholic league was decisive in the early Habsburg victories in the Thirty Years' War (*q.v.*), and he was well rewarded when he secured both the position of elector (in 1623) and the Upper Palatinate. In 1630, however, as leader of the opposition of both the Catholic and Protestant estates to the growing power of the emperor, he forced the reluctant Ferdinand II to dismiss Wallenstein and with him his independent imperial military power. During the later phases of the Thirty Years' War Bavaria suffered invasion and devastation by Swedish and French armies. In the peace of Westphalia (1648), however, Bavaria retained both the Upper Palatinate and the position of elector.

The reign of Maximilian's son Ferdinand Maria (1651–79) was necessarily devoted to reconstruction. His son Maximilian II Emanuel (1679–1726) had a restless character and was full of schemes which were of little benefit to his country. His marriage to the archduchess Maria Antonia, daughter of the emperor Leopold I and the Spanish infanta Margaret (daughter of Philip IV of Spain), gave him hopes that his son Joseph Ferdinand would succeed to the Spanish crowns, but Joseph Ferdinand died in 1699. In the War of the Spanish Succession, Maximilian sided with the French. After the defeat of Blenheim (1704), in which his army shared, he was dispossessed of his territory, but was restored by the peace of Baden (1714). His son from a later marriage, Charles Albert (1726–45), took advantage of the death of the Habsburg emperor Charles VI without male heirs in 1740 to have himself elected Holy Roman emperor and king of Bohemia, as Charles VII, but could not make good his position against Charles VI's heiress Maria Theresa and spent most of his imperial reign as a fugitive from Bavaria (*see* Austrian Succession, War of the). His early death in Jan. 1745 allowed a settlement with the Habsburgs, and in the peace of Füssen (April 1745) Bavaria escaped without territorial losses.

Charles Albert's son Maximilian III Joseph (1745–77) pursued a policy of reconstruction and economic development and concerned himself with his people's welfare. On his death, however, the line descended from the emperor Louis IV became extinct, and in 1777 Bavaria passed to the head of the senior branch of the Wittelsbachs, the elector Charles Theodore of the Palatinate. Thus Bavaria and the Palatinate (to which Jülich and Berg had been added) were reunited for the first time since the partition of 1329.

The emperor Joseph II took this opportunity to put forward a claim to about one-third of Bavaria and sent troops across the frontier, with the secret consent of Charles Theodore who, having no legitimate heirs, hoped, in return, for the elevation of his natural children to the status of princes of the empire. The protests of the next heir, Charles, duke of Zweibrücken, supported by Frederick the Great of Prussia, led to the War of the Bavarian Succession (*q.v.*). By the peace of Teschen (May 13, 1779) only the Inn district was ceded to Austria, and the succession was secured to Charles of Zweibrücken. Meanwhile Charles Theodore abandoned his predecessor's enlightened internal policy, and the

government was inspired by the narrowest clericalism.

The Revolutionary Wars.—In 1792 the French Revolutionary armies overran the Palatinate; in 1795 the French, under J. V. Moreau, invaded Bavaria itself, advanced to Munich—where they were received with joy by the long-suppressed liberals—and laid siege to Ingolstadt. Charles Theodore fled to Saxony, leaving a regency to arrange an armistice with Moreau (Sept. 7, 1796), in return for a heavy contribution. Immediately afterward Moreau was forced to withdraw, but before the death of Charles Theodore (Feb. 16, 1799) the Austrians had again occupied the country. The new elector Maximilian IV Joseph, a younger brother of Charles of Zweibrücken, succeeded to a difficult inheritance. Though his own sympathies and those of his minister, M. J. von Montgelas, were French rather than Austrian, the state of the Bavarian finances and the disorganization of the troops placed him helpless in the hands of Austria. On Dec. 2, 1800, Bavaria shared in the Austrian defeat at Hohenlinden, and Moreau once more occupied Munich. By the treaty of Lunéville (Feb. 9, 1801) Bavaria lost the Palatinate and the duchies of Zweibrücken and Jülich.

The influence of Montgelas now gave Bavarian policy a new direction. On Aug. 24 a separate treaty of peace and alliance with France was signed at Paris by which compensation was promised, partly at the expense of Austria, for the territory on the left bank of the Rhine ceded at the treaty of Lunéville. Accordingly, in the territorial rearrangements of 1803, Bavaria received the bishoprics of Würzburg, Bamberg, Augsburg and Freising, part of that of Passau, the territories of 12 abbeys and 17 cities, the whole forming a compact territory.

Pursuing the policy of alliance with France, Bavarian troops fought in Napoleon's Ulm-Austerlitz campaign of 1805, and by the treaty of Pressburg (Dec. 26) the principality of Eichstätt, the margraviate of Burgau, the lordship of Vorarlberg, the Tirol and other territories were to be added to Bavaria. On the other hand Würzburg was to be ceded by Bavaria to the elector of Salzburg in exchange for Tirol. The treaty also acknowledged the assumption by the elector of the title of king, as Maximilian I, which formally took place on Jan. 1, 1806. Externally the freedom of Bavaria continued to be restricted by the power of Napoleon—from July 1806 onward technically in his capacity of protector of the Confederation of the Rhine, which the new kingdom joined. Internally, however, full sovereignty provided the basis for the creation of a modern state. Traditional privileges were swept away, often ruthlessly, by Montgelas' central bureaucracy. His reforms were anticlerical in spirit and many monasteries were secularized. French pressure, moreover, helped to bring about equality before the law, universal liability to taxation, abolition of serfdom, liberty of conscience and some individual constitutional safeguards proclaimed in the constitution of May 1, 1808.

Again engaged in war with Austria on the side of France in 1809, Bavaria by the treaty signed at Schönbrunn on Oct. 15 ceded southern Tirol to Italy, receiving as compensation parts of Salzburg, the Inn district, Hausruck and the principalities of Bayreuth and Regensburg. In 1813, however, a few days before the battle of Leipzig, Bavaria made a timely switch to the anti-French side with the treaty of Ried (Oct. 8). In the ensuing territorial settlement, which was only concluded in 1816, Bavaria lost much of what had been gained under the treaty of Schönbrunn but received Würzburg and Aschaffenburg and regained parts of the Rhenish Palatinate on the left bank of the Rhine.

Constitution of 1818.—Meanwhile on Feb. 1, 1817, Montgelas had been dismissed because of his reluctance to concede a liberal constitution. On May 26, 1818, the constitution was proclaimed. The parliament was to consist of two houses with the lower house elected on a very narrow franchise. Religious equality and the rights of Protestants were guaranteed—concessions which were denounced at Rome as a breach of the new concordat that had just been concluded (1817). The parliament was hardly opened (Feb. 5, 1819) before the doctrinaire radicalism of some of its members so alarmed the king that he considered taking repressive measures, but the parliament gradually moderated its tone and Maximilian ruled until his death as a model constitutional monarch. (*See* also MAXIMILIAN I.)

Louis I.—On Oct. 13, 1825, Maximilian was succeeded by his son Louis I, the earlier years of whose reign were marked by a liberal spirit and by financial reform; but the revolutions of 1830 in France and in Germany and the opposition of the parliament to his expenditures in France and in Germany on building and in works of art frightened him into reaction. In 1837 the Ultramontanes came into power with Karl von Abel (1788–1859) as prime minister. Clericalism now gained the upper hand; the Protestants were harried and oppressed; and a rigorous political censorship was imposed. The king's infatuation with an Irish adventuress, Lola Montez, helped to bring about the collapse of the regime. Ultramontanes and radicals, equally incensed at her influence, joined in riotous demonstrations in 1847. Neither the Protestant Georg Ludwig von Maurer, who had succeeded Abel as minister, nor his successor, Prince Ludwig von Oettingen-Wallerstein, the head of the cabinet nicknamed the "Lolaministerium," was able to restore order; and on March 20, 1848, unable to deal effectually with the further crisis caused by the Paris revolution, the king abdicated in favour of his eldest son, Maximilian II. (Louis I's second son Otto had become king of Greece as Otho I in 1832).

Anti-Prussian Policy.—In dealing with the movement for German unity, Maximilian II's aim was to avoid having Bavaria crushed by the superiority of a Protestant Prussia in a Germany which excluded Austria. He therefore refused to support a hereditary German emperorship in Prussian hands. Similarly by refusing to join the Alliance of the Three Kings (of Prussia, Saxony and Hanover) of May 1849, he enabled Saxony and Hanover to withdraw from it in accordance with an escape clause stipulating that Bavarian abstention would constitute grounds for resignation from the alliance. In Feb. 1850, Bavaria founded the Alliance of the Four Kings, with Württemberg, Hanover and Saxony. This was in accordance with the aim of the king and his minister L. von der Pfordten (1811–80) of establishing the medium states—of which Bavaria was the biggest—as a third force in Germany to counter the preponderance of Austria and Prussia. Bavaria propagated the idea of a German "directorate of three" (*Trias*). In the events which led to the humiliation of Prussia at Olmütz in 1850 and to the restoration of the old diet of the Confederation, Bavaria cast its lot with Austria. Von der Pfordten's reactionary internal policy, though less severe than that of statesmen elsewhere in Germany, led nonetheless from 1854 onward to a struggle with the parliament, which ended in the dismissal of his ministry on March 27, 1859. He was succeeded by Karl Freiherr von Schrenck-Notzing (1806–84), who introduced important reforms including the separation of the judicial and executive powers and the drawing up of a new criminal code.

Maximilian was succeeded on March 10, 1864, by his son, Louis II, a youth of 18. The government was at first carried on by Schrenck and Von der Pfordten in concert. Schrenck soon retired, when the Bavarian government, in order to maintain its position in the Prussian *Zollverein* (customs union), found it necessary to become a party to the Prussian commercial treaty with France, signed in 1862.

In the complicated Schleswig-Holstein question (*q.v.*) Bavaria consistently opposed Prussia and finally, in 1866, sided actively with Austria. (*See* SEVEN WEEKS' WAR.)

Union With the German Empire.—The rapid victory of the Prussians and Bismarck's moderation paved the way for a complete revolution in Bavaria's relation to Prussia and the German question. The South German confederation, contemplated by the treaty of Prague, never came into being; and, though Prussia, in order not prematurely to excite the alarm of France, opposed the suggestion that the southern states should join the North German confederation, an offensive and defensive alliance with Prussia was signed at Berlin on Aug. 22, 1866, in reaction against the French demand for "compensation" in the Palatinate. In the Franco-German War of 1870–71, the Bavarian army marched against France under the command of the Prussian crown prince.

In Dec. 1870, Louis sent a letter to the king of Prussia, asking him to become German emperor. The letter had been drafted by Bismarck, who gave the king of Bavaria the promised reward of secret donations from the *Welfenfonds*, the confiscated fortune of

Louis's former comrade in arms, George V of Hanover. Earlier, on Nov. 23, 1870, a treaty had been signed between Bavaria and the North German confederation, by which, though Bavaria became an integral part of the new German empire, it received a larger measure of sovereign independence than any of the other constituent states. Thus it retained a separate diplomatic service, military administration and postal, telegraph and railway systems. The treaty was ratified by the Bavarian chambers on Jan. 21, 1871, in spite of the opposition of the Catholic-Federalist "patriot" party. Bavaria became involved in the *Kulturkampf* ("Struggle of outlooks" between the Prussian government and Rome) that followed the promulgation in 1870 of the dogma of papal infallibility. Munich university, where Johann Josef Ignaz von Döllinger (*q.v.*) was professor, became the centre of the opposition to the new dogma, and the Old Catholics (*q.v.*) were protected by the king and the government. The federal law expelling the Jesuits was proclaimed in Bavaria on Sept. 6, 1871. On March 31, 1871, moreover, the bonds with the rest of the empire had been drawn closer by the acceptance of a number of laws of the North German confederation, of which the most important was the new criminal code, which was finally put into force in Bavaria in 1879. The opposition of the "patriot" party, however, reinforced by the strong Catholic sentiment of the country, continued powerful, and the king's support for successive liberal ministeries alone prevented its finding disastrous expression in parliament.

Regency of Prince Luitpold.—Meanwhile, Louis II and his brother Otto I (d. 1916) both having been declared insane, the heir presumptive, their uncle Luitpold, was proclaimed regent on June 10, 1886; three days later Louis committed suicide. During Luitpold's long rule Bavaria shared in the common prosperity of Germany, but it was long before it forgot its particularism.

The Catholic-Clerical party came into power in Feb. 1912, when Georg von Hertling formed a cabinet. In December of the same year Luitpold died; and on Nov. 5, 1913, his son Louis III, who had succeeded him as regent, was made king even though his cousin Otto I was still alive. Nine months later Germany entered World War I.

Revolution of 1918.—A pacifist Independent Socialist, Kurt Eisner (*q.v.*), a German Jewish journalist from Berlin, took advantage of the war weariness of the population to depose the Wittelsbach dynasty in the night of Nov. 7–8, 1918—before the Berlin revolution—and to proclaim a Bavarian republic with himself at its head. King Louis III fled, thus ending the rule of one of the oldest European dynasties. After the republic had been proclaimed throughout Germany, Eisner became a prominent protagonist of Bavarian rights and of an admission of German war guilt. The disastrous failure of the Independent Socialists at the state parliament elections in Jan. 1919 fatally weakened Eisner's political influence. The following month, he was murdered by a young Bavarian nobleman. There were fresh revoluntionary outbreaks, particularly in Munich. The new government led by the orthodox Social Democrat Johannes Hoffmann and the state parliament went to Bamberg. Munich became the scene of operations of the "Red Terror" of the workers' and soldiers' councils (*Räterepublik*). The insecurity of law and order in turn led to the formation of citizens' defense corps (*Einwohnerwehren*) and of the free corps. These helped the units of the *Reich* army which recaptured Munich in May 1919. Their ruthlessness made people speak of the rule of the "White Terror."

Constitution of 1919.—The new Bavarian constitution was passed by the state parliament at Bamberg in Aug. 1919, shortly before its return to Munich. In accordance with the Weimar constitution, Bavaria became a parliamentary republic; a move to have a president as head of the Bavarian state failed. The centralism of the Weimar constitution led to much criticism in Bavaria. To assert Bavarian rights, the Bavarian wing of the Roman Catholic Reich Centre party seceded from it and formed the Bavarian People's party (*Bayerische Volkspartei*). While not subversively anti-Republican, this party hankered after the Wittelsbach dynasty and never completely gave up the idea of a Bavarian restoration. In 1920, Coburg acceded to Bavaria after a plebiscite.

Conflicts with the Reich.—The Hoffmann government resigned in March 1920 as a result of pressure put on it by the citizens' defense corps and the army after the right-wing Wolfgang Kapp *Putsch* in Berlin. As the strongest party in the state parliament, the Bavarian People's party proposed as prime minister a nonparliamentarian, Gustav von Kahr, the permanent official in charge of Upper Bavaria. Kahr had intrigued with the local *Reich* army commander, Gen. Arnold von Möhl, to undermine the Socialist government. The Social Democrats refused to join the Kahr government and remained in the Bavarian political wilderness until after World War II. The trend to the right was further emphasized by the entry of the German Nationalists into the government. This curious coalition between the particularist and predominantly Roman Catholic Bavarian People's party and the centralist and overwhelmingly Protestant German Nationalists from then on provided the parliamentary basis of Bavarian governments. Kahr provoked several conflicts with the *Reich* government. He refused to disband the citizens' defense corps (on which he was politically dependent) in accordance with the undertakings given to the Allies by the *Reich* government. He only complied in June 1921, following an Allied ultimatum. In his eyes, the danger came from the left and not from the right. Following the murder of the Centre leader Matthias Erzberger by right-wing extremists in Aug. 1921, he therefore refused to carry out a *Reich* "Decree for the Protection of the Republic" and to lift the Bavarian state of emergency, which had been applied principally against the left. But now the Bavarian People's party withdrew its support from Kahr and replaced him as prime minister by the more conciliatory Graf Hugo von Lerchenfeld, who arranged a compromise with the *Reich*. Following the assassination of the *Reich* foreign minister Walther Rathenau in June 1922, Bavaria, stronghold of extremist elements, again tried to evade the application of *Reich* security measures (*see* GERMANY: *History: The German Republic*). The dispute was, however, settled by a compromise between Lerchenfeld and the *Reich* president, Friedrich Ebert. The Bavarian government succeeded in retaining its people's courts (*Volksgerichte*), which operated outside normal court procedure and without the right of appeal. Lerchenfeld's fate illustrates the dilemma of Bavarian politics. The Democrats left his government because they considered him too particularist. He then had to take in the German Nationalists but was thrown over by them and the other right-wing groups as being too conciliatory in his attitude to the *Reich* authorities. The new premier, Eugen von Knilling, was much more right-wing than Lerchenfeld. The conflict between Bavaria and the *Reich* assumed critical proportions in 1923, when the French occupation of the Ruhr brought Germany into the greatest danger. When Gustav Stresemann, then *Reich* chancellor, gave up the passive resistance to the occupation, there was a great outcry in Bavaria which induced Knilling to appoint Kahr as Bavarian state commissioner (*Generalstaatskommissar*) with dictatorial powers, without previous consultation with the *Reich* authorities. The *Reich* government was compelled to counter with a declaration of a general state of emergency. It rightly mistrusted the Kahr-Knilling policy of trying to establish a collaboration with the extreme right-wing groups which had found refuge in Bavaria. Kahr now prompted the local *Reich* army commander, Gen. Otto von Lossow, to refuse to carry out an order of his superiors in Berlin to take measures against the National Socialists. The Bavarian government also attempted to detach the army corps in Bavaria from its allegiance to the *Reich* by assuming authority over it. Adolf Hitler and Gen. Erich Ludendorff (who had established himself in Bavaria) were not slow to take advantage of this situation. Hitler could only have contempt for the Bavarian authorities after a breach of the peace which he had committed in May had gone unpunished. On Nov. 8, 1923, Hitler and Ludendorff struck in Munich. They marched on a meeting at the *Bürgerbräukeller* (beer cellar) where they seized Kahr, Lossow and the Munich police chief. Hitler forced these men in a dramatic scene to support his proclamation of the national revolution and of the deposition of the existing authorities. However, as soon as Hitler's prisoners were free, they disowned him. Belatedly, energetic measures were taken to deal with Hitler and Ludendorff. Their

TABLE II.—*Bavaria's Government Districts, Their Capitals and Populations*

Government district (*Regierungsbezirk*)	Capital	Population (1959 est.)	Area (sq.mi.)
Upper Bavaria (OBERBAYERN)	Munich	2,676,300	6,308
Lower Bavaria (NIEDERBAYERN)	Landshut	961,100	4,152
Upper Palatinate (OBERPFALZ)	Regensburg	872,900	3,725
Upper Franconia (OBERFRANKEN)	Bayreuth	1,072,600	2,897
Middle Franconia (MITTELFRANKEN)	Ansbach	1,343,100	2,942
Lower Franconia (UNTERFRANKEN)	Würzburg	1,067,000	3,277
Swabia (SCHWABEN)	Augsburg	1,331,800	3,938
Total		9,324,800	27,239

armed procession through Munich on the following day ended ignominiously. (Hitler was to take his revenge against Kahr when he had him murdered after the purge of June 30, 1934.) The Hitler-Ludendorff trial should have come up in the supreme *Reich* court. But the Bavarian government succeeded in retaining the right of emergency jurisdiction just long enough to ensure that the case should come up in a Bavarian people's court. Hitler received the minimum sentence for high treason of five years, but with the stipulation that the further execution of the sentence should be suspended after a few months. Ludendorff was acquitted. (*See* also NATIONAL SOCIALISM.)

With the resignation of the state commissioner Kahr in Feb. 1924 and the change of premiership from Knilling to Heinrich Held, the leader of the Bavarian People's party, in June 1924, Bavaria entered more settled conditions. In 1925, the Bavarian People's party tipped the scales of the *Reich* presidential election in Hindenburg's favour by its refusal to support the Roman Catholic Centre candidate, Wilhelm Marx. Held retained power until the National Socialists overthrew the Bavarian constitution in March 1933.

In 1945, Bavaria became part of the U.S. occupation zone. The Bavarian Palatinate was detached from Bavaria and joined the new Rhineland-Palatinate state. The Bonn constitution of 1949 pleased Bavarian wishes far more with its federalist provisions than that of Weimar had done. The grand alliance of the Christian Social Union—the Bavarian counterpart of the Christian Democrats and the successor of the Bavarian People's party—with the Social Democrats was broken up in 1954. A coalition government excluding the Christian Social Union was then formed. This however resigned in 1957, after which the Christian Social Union resumed its leading position in the government. (F. EK.)

Population.—The indigenous population of Bavaria is derived from three separate Germanic peoples: in Upper and Lower Bavaria and the Upper Palatinate from the *Baivarii;* in the Main area and the Frankish hills from the Franks; and west of the Lech and south of the Ries from the Suebi. These separate origins are shown by different patterns of settlement and dwellings. But this basic structure was greatly altered by the influx of refugees, mainly from Czechoslovakia, after 1939 and especially after World War II. The estimated population in 1959 numbered 9,324,800, an increase of 12.6% in relation to the 1939 figure.

Bavaria is divided into seven Government districts, as shown in Table II. It is further divided into 48 urban and 143 rural divisions. Towns with more than 100,000 population (1959) were: Munich, the capital (1,065,104), Nürnberg (448,900) and Augsburg (204,990).

Social Conditions and Government.—Bavaria is mainly a Roman Catholic country, old Bavaria (Upper and Lower Bavaria and the Upper Palatinate), Lower Franconia and Swabia overwhelmingly so. The Protestant population is concentrated in the northwest and east in what were once the princely states of Ansbach and Bayreuth, in Coburg and in the former Frankish imperial cities. In 1950 there were 6,600,895 Roman Catholics and 2,458,032 members of the German Evangelical Church and Old Catholics.

Most schools are parochial. There are universities in Munich, Würzburg and Erlangen, the last being Protestant, a technical school in Munich and a school for economics and the social sciences in Nürnberg.

With the exception of the Main basin, Bavaria is a land of average-size peasant holdings (25–75 ac.) and of small towns with light industries. Farmers, craftsmen and traders predominate among its citizens, without great variety of wealth or status. The old Bavaria was extended during the Napoleonic Wars by the addition of the bishoprics of Würzburg and Bamberg on the river Main. Under the Napoleonic regime, the old divisions were replaced by divisions comparable to the French *départements,* and government was centralized in Munich. The constitution of 1808 brought to the country the essential reforms of the Napoleonic code.

The Bavarian constitution as laid down on Dec. 2, 1946, provides for a minister president to be elected for four years by the lower house of the Bavarian parliament (the *Landtag*) and for an advisory second chamber (*Senat*) consisting of representatives of economic, social, cultural and religious bodies.

The Economy.—In spite of much industrial development during the 20th century, agriculture and forestry still form the backbone of the Bavarian economy. Nearly one-third of the country is covered by forest, mainly coniferous. More than half of the country is farmland; of the balance less than 5% is wasteland and about 7% is urbanized. Of the farmland itself more than half is arable, and more than half the arable land is devoted to grain—mainly wheat in the south and rye in the north. The meadows and pastures lie mainly on the Bavarian plateau in Upper Bavaria and Swabia. Butter is an important product of the Munich, Memmingen and Nürnberg areas and also of the Allgäu district in southwestern Bavaria just north of the Allgäu Alps; the greatest area for cheese is Swabia. Pigs are kept mainly in Lower and Middle Franconia and in Lower Bavaria. Vegetables are widely grown, but especially in the Main valley, around Munich and in Lower Bavaria around Staubing. The greatest hop-growing area in Germany is the Hallertau, between the Danube and the Isar. Vines are cultivated in the Main valley and neighbouring areas.

Bavaria is poor in the two important industrial minerals, coal and iron. Such coal as there is is mined chiefly on the slopes of the Alps in Upper Bavaria and in the Upper Palatinate north of Regensburg. Some iron is found in the Upper Palatinate and Upper Franconia. Of other minerals, notable are salt (around Berchtesgaden, Bad Reichenhall and Rosenheim), kaolin (in the Upper Palatinate, around Tirschenreuth and Amberg, and in Upper Franconia) and crystalline graphite, the deposits of which in the Bavarian forest northwest of Passau are the greatest in Europe. Lignite is mined in Amberg, Schwandorf and in the Sulzbach-Rosenberg district and on the northern slopes of the Bavarian Alps.

Industry was long undeveloped in Bavaria but during the 20th century this state of affairs changed. Industrialization was greatly helped by the development of hydroelectric power and was accentuated after 1939 by the influx of refugee industrial workers. Industry is largely centred in the great towns and is varied in character. China and glass, scientific instruments, textiles and paper are all important manufactures, while in the great industrial centres of Munich, Augsburg and Nürnberg-Fürth the manufacture of automobile engines and agricultural machinery has been built up. Special mention must also be made of brewing, which is situated mainly in and around Munich. Tourists are also a source of revenue especially in the Alpine area.

The Main is navigable as far as Bamberg for 600-ton barges. The Danube is navigable upstream to Regensburg, and, for small barges, to Ulm.

See also Index references under "Bavaria" in the Index volume.

(M. KL.; R. E. DI.)

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BAVARIAN SUCCESSION, WAR OF THE (1778), between Austria and Prussia. After the loss of Silesia the Austrian emperor Joseph II and his chancellor Prince Kaunitz wished to acquire Bavaria in order to restore Austria's position in Germany. When the Bavarian electoral line of the Wittelsbachs failed on the death of Maximilian Joseph on Dec. 30, 1777, a treaty was signed (Jan. 1778) with his successor Charles Theodore the elector Palatine which ceded Lower Bavaria and the lordship of Mindelheim to Austria. However, as imperial troops were already in occupation of the territory, Frederick II of Prussia declared war on July 3, 1778, in support of the claims to Bavaria made by Charles, duke of Zweibrücken, the next Wittelsbach in the succession to Bavaria after Charles Theodore. Austria's ally France refused to give aid, and Frederick with Saxony as his ally entered Bohemia where he was opposed by an imperial army led by the emperor himself, Ernst Gideon Laudon and Franz Moritz Lacy. There was little fighting, since each force was concerned to cut its opponent's communications and deny it supplies. Hence contemporaries nicknamed the war the "potato war" (*Kartoffelkrieg*). Maria Theresa, whose consent to the occupation of Bavaria had been given very unwillingly, made peace proposals to Frederick II against Joseph II's wishes. With France and Russia acting as intermediary between Austria and Prussia, the representatives of the two powers met at Teschen on March 10, 1779. On May 13, 1779, they reached an agreement whereby Austria was to receive the Inn district, a fraction of the territory originally occupied. (FH. WR.)

BAX, SIR ARNOLD EDWARD TREVOR (1883–1953), English composer, whose work represents romantic musical tendencies between World Wars I and II, and contributed considerably to the revival of English music, was born in London on Nov. 8, 1883. In 1900 he entered the Royal Academy of Music where he studied the piano under Tobias Matthay and composition under Frederick Corder. Influenced by the Celtic revival and Irish poetry, in 1909 he wrote the symphonic poem *In the Faery Hills.* He spent the year 1910 in Russia. During the following years, under the pseudonym Dermot O'Byrne, he published short stories and poems in Ireland where he spent much time. In 1916 and 1917 he wrote three symphonic poems, *The Garden of Fand, Tintagel* and *November Woods,* which established his reputation. In 1920 Sergei Diaghilev produced his ballet, *The Truth About the Russian Dancers,* on a scenario by J. M. Barrie. Between 1921 and 1939 he wrote seven symphonies dedicated to the musicians he admired, among them John Ireland and Jean Sibelius. He also wrote numerous piano and chamber works, including a sonata for viola and harp (1928) and a nonet (1930). Living for long periods on the coasts of Ireland and Scotland, he wrote music that was romantically evocative and richly orchestrated, though sometimes turgid in texture. He was knighted in 1937, and in 1942 was appointed master of the king's music. He died at Cork, Ire., on Oct. 3, 1953.

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BAXTER, ANDREW (1686 or 1687–1750), Scottish metaphysical rationalist who maintained the essential distinction between matter and spirit against tendencies that he suspected in the more advanced British epistemology of his century, was born at Aberdeen and educated at King's college there. Having gone to Utrecht in the Netherlands as tutor to two young gentlemen in 1741, he went on an excursion to Spa in 1745 and there met John Wilkes, for whose intellect he conceived a fervent admiration subsequently expressed in a number of letters. Returning to Scotland in 1747, he lived at Whittingehame, near Edinburgh, till his death on April 23, 1750.

Baxter published anonymously *An Enquiry Into the Nature of the Human Soul* (1733; 3rd ed., 1745; *Appendix,* 1750) and *Matho, sive cosmotheoria puerilis* (1738; Eng. trans., enlarged, 2 vol., 1740), a compendium of scientific knowledge. *The Evidence of Reason in Proof of the Immortality of the Soul* (1779) was edited from his papers by John Duncan. In his *Enquiry,* Baxter begins by arguing (1) that matter is essentially inert (this seems to be aimed at John Toland's "Motion Essential to Matter," *Letters to Serena,* 1704) and (2), in opposition to any mechanistic explanation of change and movement, that all effects in matter are immediately produced by "an immaterial Being," "a constant and universal Providence." Then, in a long argument against John Locke, who had suggested that man might be a simple material substance endowed by God with the power of thinking, Baxter insists on the immateriality of the human soul and on its continued consciousness after the body's death. Next follows "An Essay on the Phaenomenon of Dreaming," in further support of his antimechanistic theme. After this he attacks George Berkeley, whom he mistakenly supposed to have denied the existence of matter. The last section of the *Enquiry* is an argument against the eternity of matter.

BAXTER, GEORGE (1804–1867), English engraver and printer who invented a patented process of colour printing that made available reproductions of paintings on a mass scale. He was the second son of JOHN BAXTER (1781–1858), printer and publisher of Lewes, Sussex, who was responsible for the popular illustrated "Baxter" Bible. George was born on July 31, 1804, in Lewes, where he learned engraving, and moved to London in 1827. In 1835 he obtained his patent. Basically Baxter's process consisted of carefully etched plates (sometimes as many as 20), a system of register points and superlative printing on a hand press, using only the best colours and oils and paper. He mixed the colours himself and, since he left no record of their preparation, this part of the process remains unknown. He collaborated with the publisher, G. Mudie, supplying colour illustrations for new volumes, and also worked for the London Missionary society, producing prints depicting scenes in missionary history. He visited Buckingham palace at the command of Queen Victoria and the prince consort but, while patronized by high personages, he seems not to have had great business sense and never made a fortune. His patent, upon expiring in 1849, was renewed for another five years despite protests from competitors in the same line, but the fiercest competition came from cheap coloured lithographs. In 1860 he retired to Sydenham, where he died on Jan. 11, 1867.

See C. T. Courtney Lewis, *George Baxter* (1908) and J. Cordingley, *Early Colour Printing and George Baxter* (1949). (J. C. MN.)

BAXTER, RICHARD (1615–1691), one of the greatest English Puritan ministers, was famous for his preaching, learning, writing and his pastoral counseling. His influence on English Protestantism was more profound than that of any other 17th-century Puritan minister. He was born at Rowton, Shropshire, in Nov. 1615, and after completing free school at Wroxeter studied divinity. Though greatly influenced by Puritans, he was ordained into the Church of England in 1638. Within two years, however, he had definitely allied himself with the Puritans in opposition to episcopacy. In 1641 he was elected minister of Kidderminster, where he remained, with several interruptions, until the Restoration in 1660. Baxter's ministry at Kidderminster is classic in Protestant history. He reformed the town and made it a model for Protestant pastor and English priest alike. His church was packed for each service, and it was enlarged to accommodate the crowds.

Baxter preached with passion and conviction, though he never was emotionally uncontrolled. His sermons were classic Puritan models. They had two primary objects. First, he aimed to convert the congregation away from self-centredness, indifference and pride—from sin—to a life of utter trust and faith in God; the conversion itself was always foremost in his sermons. Second, he sought to lead his congregation into a life of disciplined Christian obedience; the converted Christian reflected the life of faith in his day-to-day activities of business, family and personal relations, his conversation and deportment. Baxter's preaching was soundly doctrinal, with a very practical application. He was ill most of his life and claimed he preached as a "dying man to dying men." His concern for conversion is reflected in a large number of his published works, such as *A Call to the Unconverted* or *A Treatise on Conversion.*

One of the most important aspects of his ministry was long overlooked. Baxter epitomized the Puritan concern for the pastoral ministry. At Kidderminster he developed a systematic and comprehensive scheme of personal pastoral counseling and catechising. His program included every family and person in his parish. As he stated it, "Two days every week my assistant and I, myself, took fourteen families between us for private catechising and conference." In these personal conferences Baxter sought to deal with all personal questions that disturbed his parishioners. So successful was he that people came from miles around for his advice and counsel, and letters came to him from all over England. Even pastors sought his advice on counseling methods and techniques.

His efforts and methods were clearly outlined in *The Reformed Pastor* and in *The Right Method for a Settled Peace of Conscience.* His pastoral concern was further reflected in a vast amount of devotional writing prepared for the use of the perplexed and the steadfast in the parish. His *Saints' Everlasting Rest* (1650) is a classic in Protestant devotional literature, and the *Poor Man's Family Book* brought comfort and inspiration to countless people.

Baxter was not an introverted pastor and preacher. He was in the centre of every major controversy of his age and acted in and wrote on most of them. He served a short time as a chaplain in the Parliamentary army. He fought the Quakers and Baptists, and he published highly controversial doctrinal treatises such as his famous *Aphorisms of Justification* (1649). He helped to bring about the restoration of the king and fought for toleration of moderate dissent within the Church of England. Though he failed to win his point and was persecuted for over 20 years, he lived to be vindicated in the revolution of 1688. He died, a distinguished and honoured minister, on Dec. 8, 1691.

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BAY, an architectural term for any division of a building, between vertical lines or planes, especially the entire space included between two adjacent supports; thus, the space from pier to pier in a church, including that part of the vaulting or ceiling between them, is known as a bay.

A term also applied to a roofed structure projecting from a wall and one story high, a bay window being such a structure. When a bay window is carried on brackets, or a corbel, it is called an oriel. Bay windows came into use during the late Gothic period. Although found throughout Europe, they are peculiarly characteristic of England. They usually occur at the end of the great hall of large Tudor and Jacobean manor houses and castles, reserved for the lord's dais, from which they open. Occasionally there is one on each side of the hall at each end of the dais. Befitting their position, they are often extremely rich, with fan vaults and window seats at the sill. They are also found in similar positions in the great halls of the English colleges. During the Jacobean period their use was much increased and they are found on the fronts of houses wherever an accent was desired.

BAYAMÓN, a town situated in a beautiful and fertile valley about 15 mi. S. of San Juan, the capital of Puerto Rico. In the ten years between 1950 and 1960 the town doubled its population, rising from 20,171 to 41,731. The community's population spurt was caused by the fact that many of the capital's middle-class families moved into the area. As a result, Bayamón is considered part of the greater metropolitan area of San Juan (*q.v.*).

The town was founded in 1772. Within its municipal district is located the first settlement of Puerto Rico, known as Villa de Caparra and founded in 1508 by Juan Ponce de León. The rural area around Bayamón is one of the most productive fruit-growing sections of Puerto Rico. Oranges, limes, lemons, bananas, grapefruit and pineapples are grown on well-managed farms, and canning is one of the principal industries. The area also contains an oil refinery, bottling plants, a grain storage mill and many other important industries. Bayamón, on the main highway between San Juan and Arecibo, is connected with the capital by means of rapid throughways. Roads also lead into the mountains and the interior towns of Comerío and Barranquitas. (T. G. Ms.)

BAYAR, CELAL (1883–), Turkish statesman and third president of the Turkish republic, was born at Umurbey, a village near Bursa, on May 15, 1883. His father became the local mufti and brought his son up in the Muslim tradition. For a time Celal attended a French school at Bursa, where he specialized in economics and finance. Joining the Bursa branch of the German Orient bank, he rose to be local manager. Becoming interested in politics, he joined those seeking to rid Turkey of the tyrannical sultan Abdul-Hamid II. After the Young Turk revolution in 1908 he became secretary of the Izmir branch of the Committee of Union and Progress. During World War I he was active in organizing the railway system of Anatolia. After the collapse of Turkey he promoted resistance to the Greek occupation of the Izmir region. Elected deputy, he took part in the last Ottoman parliament in Jan. 1920.

When the British arrested Turkish nationalists, Bayar escaped and joined the great national assembly in Ankara. Because of his experience in finance, he served as minister of national economy from Feb. 1921 to Jan. 1922. After the liberation, he was elected deputy for Izmir. In March 1924 he was made minister of reconstruction and resettlement of refugees, but in July he resigned to become head of the newly founded Turkish Commercial bank. He held this post until Sept. 1932, when he again was made minister of national economy, in which capacity he did much to develop Turkish industries and mines. He became prime minister on Oct. 25, 1937, but resigned on Jan. 25, 1939, because of his disagreement with the policy of the Republican People's party, as he wanted more economic freedom for the country.

In June 1945 he resigned from the party and also from his seat in parliament. In Jan. 1946, together with Refik Koraltan, Adnan Menderes and Mehmed Fuad Koprulu, he organized the opposition Democratic party, which won 62 seats in the general election of July 1946. Under Bayar's leadership the Democratic party secured an overwhelming victory at the election of May 1950, and he was elected president of the Turkish republic by the new parliament. He was re-elected president on May 14, 1954. Arrested during the *coup d'état* of May 27, 1960, he was subsequently brought to trial, with other leaders of the Democratic party, on charges of crimes against the state, and in Sept. 1961 was sentenced to death; the sentence subsequently was commuted to life imprisonment. (M. P. P.)

BAYARD, PIERRE TERRAIL, SEIGNEUR DE (*c.* 1473–1524), French soldier known as *le Chevalier sans peur et sans reproche* or as *le bon chevalier* because of his knightly fearlessness and magnanimity, was born at the Château Bayard (near Pontcharra) in Dauphiné, of a noble family, nearly every head of which for two centuries past had fallen in battle. He accompanied Charles VIII into Italy in 1494 and was knighted after the battle of Fornovo (1495). Shortly afterward, entering Milan alone in pursuit of the enemy, he was taken prisoner, but was set free without a ransom by Ludovico Sforza. In 1502 he was wounded at the assault of Canossa. Bayard was the hero of a celebrated combat of 11 French knights against an equal number of Spaniards and is said on one occasion to have made good the defense of the bridge of the Garigliano singlehanded against about 200 Spaniards, an

exploit that brought him such renown that Pope Julius II sought to entice him into the papal service, but unsuccessfully. In 1508 he distinguished himself again at the siege of Genoa by Louis XII. At the siege of Padua he won further distinction by his valour and his consummate skill. Severely wounded at Brescia, he nevertheless hurried to join Gaston de Foix in the terrible battle of Ravenna (1512). In 1513, when Henry VIII of England routed the French at the battle of the Spurs (Guinegate), Bayard found his escape cut off. Unwilling to surrender, he rode up to an unarmed English officer and summoned him to yield; the knight complying, Bayard in turn gave himself up to his prisoner. Henry VIII released him without ransom, merely exacting his parole not to serve for six weeks. On the accession of Francis I in 1515, Bayard was made lieutenant general of Dauphiné; and after the victory of Marignano he had the honour of conferring knighthood on his youthful sovereign. When war again broke out between Francis I and the emperor Charles V, Bayard, with 1,000 men, held Mézières, which had been declared untenable, against an army of 35,000 and after six weeks compelled the imperial generals to raise the siege. This stubborn resistance saved central France from invasion and gave Francis time to collect the army that drove out the invaders (1521). In 1523 Bayard was sent into Italy with Guillaume de Bonnivet, who, being defeated at Robecco and wounded during his retreat, implored Bayard to assume command. Guarding the rear at the passage of the Sesia, he was mortally wounded by an arquebus ball (April 30, 1524). He died in the midst of the enemy. His body was restored to his friends and interred at Grenoble.

Bayard was one of the most skilful commanders of the age. He obtained complete information about the enemy by reconnaissance and espionage. In the midst of mercenary armies he remained absolutely disinterested, and to his contemporaries and his successors he was the faultless knight, heroic, devout, generous, gay and kindly.

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BAYARD, THOMAS FRANCIS (1828–1898), U.S. statesman, diplomat and lawyer, was born in Wilmington, Del., on Oct. 29, 1828, of a distinguished family. He was directly descended from the French hero, Chevalier Bayard, and from Ann Bayard, a sister of Peter Stuyvesant. His great-grandfather, Richard Bassett (1745–1815) was governor of Delaware; his grandfather, James Asheton Bayard (1767–1815), was a prominent Federalist congressman from Delaware and one of the U.S. commissioners who negotiated the treaty of Ghent with Great Britain that ended the War of 1812; his uncle, Richard Henry Bayard (1796–1868), was chief justice of Delaware; and his father, James Asheton Bayard (1799–1880), was a well-known constitutional lawyer. All of the foregoing represented Delaware in the U.S. senate.

Thomas Francis Bayard's formal education was limited to a few years in an academy in Flushing, N.Y. He did not attend college but in 1848 began the study of law in the office of his father and was admitted to the bar in 1851. He practiced chiefly in Wilmington and for one year, 1853–54, served as U.S. attorney for Delaware, an office his father had held some years earlier. During the crisis of 1860–61, which led to the Civil War, he opposed secession and was instrumental in keeping Delaware in the Union. As a peace Democrat, he opposed the war. From 1869 to 1885 he was a U.S. senator from Delaware and opposed the reconstruction policies of the Radical Republicans. His abilities made him a leader of the Democrats in the senate, and his views on financial and legal questions gave him a high reputation for statesmanship. He was a member of the electoral commission of 1877. In the Democratic national conventions of 1880 and 1884 he received votes for nomination as the party's presidential candidate. From 1885 to 1889, during the first administration of Pres. Grover Cleveland, he served as secretary of state. While in office, the most important problems he faced concerned relations with Great Britain: the Alaskan boundary, the North Atlantic fisheries, fur sealing in the Pacific, and Samoa. In 1893 he was appointed ambassador to Great Britain, the first U.S. representative in Great Britain to hold that diplomatic rank. As ambassador he was considered too pro-British and after several speeches which were considered critical of the United States, the house of representatives passed a vote of censure. Because of failing health, he left London in 1897 and died the following year on Sept. 28 in Dedham, Mass.

His son, THOMAS FRANCIS BAYARD (1868–1942) carried on the remarkable family tradition of public service, representing Delaware in the U.S. senate from 1923 to 1929.

See Lester B. Shippee, "Thomas Francis Bayard," in S. F. Bemis, ed., *The American Secretaries of State and Their Diplomacy* (1928), vol. viii, pp. 47–106. (AR. R.)

BAYAZID I (1354–1403), Ottoman Turkish sultan from 1389 to 1403, called Yildirim ("the Thunderbolt"), was the son of Murad I, on whose death on the battlefield of Kosovo he succeeded to the throne. In the earlier years of Bayazid's reign Ottoman suzerainty over Serbia was established, Bulgaria definitely conquered and Walachia reduced to vassal status. There were also successful campaigns against Hungary, Bosnia, Albânia and Greece. Moreover, in 1394, Bayazid began a blockade of Constantinople that lasted for seven years. The Ottoman advance in the Balkans gave rise to a strong counteroffensive organized in Europe. This "crusade" suffered a crushing defeat at the battle of Nicopolis (Nikopol, on the Danube) in 1396. It was imperative, however, that the Ottomans—a small minority ruling, in Europe, over a vast non-Turkish and non-Muslim subject population—should extend their territories in Asia Minor if their state was to retain its Turkish and Muslim character. Bayazid, throughout his reign, was engaged in a series of campaigns which led to the annexation of the other Turkish amirates in Asia Minor. This policy caused discontent both among the Ottoman warriors, loath to make war on their fellow Muslims, and among the populations of the subjugated amirates. It also brought Bayazid into conflict with Timur (*q.v.*). The Ottoman army, its unity impaired by the discontent, was routed by Timur at Ankara in 1402, and Bayazid was taken prisoner. He died in captivity at Akshehir in March 1403.

See P. Wittek, *The Rise of the Ottoman Empire* (1938). (V. J. P.)

BAYAZID II (*c.* 1447–1512), Ottoman Turkish sultan from 1481 to 1512, was the elder son of the sultan Mohammed II. On Mohammed II's death (1481) Bayazid's brother Jem contested the succession, but Bayazid was victorious (1482). Jem took refuge with the Order of St. John of Jerusalem at Rhodes, was sent to France and remained, until his death in 1495, a captive in Europe. The earlier years of Bayazid's reign saw the consolidation of Ottoman control over Hercegovina (1483) and the capture (1484) of Kiliya and Akkerman (Belgorod-Dnestrovski) on the estuaries of the Danube and the Dniester. This success gave the Ottomans a firm hold on the land route to the Crimea, where the Tatar khan was the sultan's vassal. There followed (1485–91) a local war in Cilicia between the Ottomans and the mamelukes of Egypt and Syria, both sides claiming a dominant influence in the frontier lands along the Taurus mountains. Cilicia, in 1491, remained under mameluke control. The Ottomans, however, fearing that a Christian coalition, using Jem, might be formed against them, could only commit a moderate proportion of their resources to fighting in Cilicia, but even so, the mamelukes held their position on the frontier only by deploying their full military strength.

When Jem died in 1495 the Ottomans threw off their restraint, built a new and powerful fleet and made war against Venice (1499–1503). This brought them valuable gains in the Morea and on the Adriatic shore (Lepanto, Modon, Coron, Navarino and Durazzo).

Meanwhile, a serious danger arose in the east. The Safawid dynasty, established in Persia during the years of the Ottoman-Venetian war, was Shi'ite Muslim, whereas the Ottomans were Sunnite or orthodox. The Safawids had long conducted religious and political propaganda amongst the Turkmen tribes in Asia Minor, which indeed supplied their main military strength, and it became increasingly possible that Ottoman control over large areas might be undermined and eventually destroyed. Tension grew until, in

1511, a great Shi'ite revolt broke out in Tekke, in southwestern Asia Minor. At this time also conflict broke out between Bayazid's sons over the future succession. One of them, Selim, moved from Trabzon (Trebizond) to the Crimea, won the aid of the Tatar khan and crossed the Danube into the Balkans. Fearing that the strong forces which had crushed the Shi'ite rebellion in Asia Minor (June 1511) might be used to gain the succession for his chief rival, Ahmed, Selim then marched against his father, but was defeated at Çorlu (Aug. 1511) and took refuge in the Crimea. Ahmed, failing to secure the support of the janizaries, who favoured Selim, now seized much of Asia Minor by force. The attitude of the janizaries and the fear that Ahmed might turn to Persia for assistance led to the recall of Selim from the Crimea to Istanbul and to Bayazid's abdication in favour of Selim (April 1512). Bayazid died near Demotika in May 1512.

See S. N. Fisher, *The Foreign Relations of Turkey, 1481–1512* (1948). (V. J. P.)

BAYBARS (Bibars) **I** (1223–1277), mameluke sultan of Egypt and Syria, whose official title was al-Malik al-Zahir Rukn-al-Din al-Salihi. He came as a boy from the Kipchak Turks beyond the Caspian sea and was taken as a slave to Egypt. Rising to military eminence, he led the mameluke vanguard at the battle of Ayn Jalut in Palestine against the Mongols in 1260. In that year, having defeated and killed his own sultan, Sayf al-Din Kutuz, he was acclaimed by the army commanders as their chief. A leader of great, even foolhardy, courage, he typified mameluke morality by his entire lack of scruple in the struggle for power. A refugee caliph from Baghdad solemnly invested him with the governance of the sultanate and so gave religious sanction to his rule. With shrewd statesmanship backed by force and trickery, Baybars broke the ring of potentially dangerous states surrounding him and made Egypt the most powerful Muslim state in the middle east. By alliances and commercial concessions he neutralized the maritime powers of the Mediterranean. His command of the Red sea enabled him to exercise paramount influence over Mecca and Medina. He deprived the Frankish crusaders of most of their remaining possessions on the Syrian coast, seizing Jaffa and Antioch in 1268, crushed the Armenians in a bloodthirsty raid, punished the Assassins in their Syrian strongholds and, beyond the southern border of Egypt, sent his armies as far as Dongola, whose Christian king they dethroned. His exploits, real and fictional, gave rise to popular legends such as the *Romance of Baybars*, a cycle of stories of Arab chivalry. Baybars died in Damascus in 1277.

Bibliography.—C. Cahen, *La Syrie du nord à l'époque des croisades* (1940); L. J. M. Gaudefroy-Demombynes, *La Syrie à l'époque des Mamelouks* (1923); S. F. Sadeque, *Baybars I of Egypt* (1956). (R. L. Hl.)

BAY CITY, a port of entry in Michigan, U.S., 100 mi. N.N.W. of Detroit, on both sides of the Saginaw river near its mouth on Saginaw bay (Lake Huron); the county seat of Bay county. The city has been governed by a council-manager form of government since 1921. Pop. (1960) city, 53,604; standard metropolitan statistical area (Bay county), 107,042. (For comparative population figures *see* table in Michigan: *Population.*)

Between 1836 and 1867 six villages were platted along the Saginaw river, on which the Chippewa Indians had plied their canoes. The present Bay City was formed by a series of consolidations of five of these villages, culminating in 1905 with the union of Bay City and West Bay City. The sixth, Essexville, adjoins Bay City on the northeast.

The Bay county region played a leading part in the saga of the Saginaw valley lumbering era, 1850–90. All the available sites along its rivers were occupied by sawmills, shingle and other woodworking mills, saltworks and shipyards. Saginaw river teemed with rafts of logs, tugboats, scows, schooners and steamboats. Immense quantities of rough pine lumber and other wood products, salt and frozen fish were shipped out by water and rail. With the depletion of local forests and the high tariffs and duties on Canadian lumber, the mills began to close one after another.

With the end of the lumber era, the city's chief industries were soft-coal mining, commercial fishing and beet-sugar production. Lean decades followed the lumber boom, but new industries developed, and by mid-20th century Bay City was one of the busiest ports on Lake Huron.

Among Bay City's leading industries are the manufacture of ships, heavy machinery, castings, welding machines, automobile parts, electrical equipment, precut houses, furniture, cement, beet sugar, clothing and petrochemical products. Bay county has several oil-producing wells, and its rich farm lands produce sugar beets, potatoes, a variety of other vegetables, and dairy and meat products.

There are several riverside parks and, along the bay shore, Bay City state park, amusement parks, bathing beaches and summer cottages; boating and fishing are enjoyed on the river and the bay.

Public education includes a junior college, established in 1922. (G. E. Bu.)

BAYER, FRIEDRICH (1825–1880), founder of the well-known German chemical firm, Farbenfabriken Bayer Aktiengesellschaft Leverkusen, was born at Barmen on June 6, 1825. He served as an apprentice with a firm dealing in chemical products and quickly became the deputy of the owner. He soon established his own business in chemicals and dyewoods and took up the manufacture of dye extracts and dyestuffs. In 1863, together with Friedrich Weskott, Bayer founded a new firm producing triphenyl methane and azo dyestuffs and later also alizarin dyestuffs. At the time of his death at Würzburg on May 6, 1880, his business served textile firms throughout the world and the foundation for Farbenfabriken Bayer A. G. Leverkusen was already laid. After his death the management of the firm was taken over by his son, Friedrich Bayer, together with H. T. von Böttinger. (E. C. K.)

BAYERN: *see* Bavaria.

BAYES, THOMAS (1702–1761), English mathematician, author of the first expression in precise, quantitative form of a mode of inductive inference, was born in 1702. He was the eldest son of Ann Bayes and Joshua Bayes, a fellow of the Royal society and one of the first six Nonconformist ministers to be publicly ordained as such in England. Educated privately, he was ordained and began his ministry by helping his father, then minister of the Presbyterian meetinghouse in Leather lane, near Holborn, London. Between 1720 and 1731 Bayes went to minister at the Presbyterian chapel in Tunbridge Wells, where he remained till his death on April 17, 1761, having retired from the ministry in 1752. In 1731 he published a tract entitled *Divine Benevolence, or an attempt to prove that the Principle End of the Divine Providence and Government is the Happiness of His Creatures*, and in 1736 another, entitled *An Introduction to the Doctrine of Fluxions, and a Defence of the Mathematicians against the objections of the Author of the Analyst.* He was elected to fellowship of the Royal society in 1742.

Bayes's main works, the paper which contains the theorem which bears his name (*see* Probability: *Inverse Probability*), and a paper on asymptotic series, were published posthumously in the *Philosophical Transactions* by his friend the Rev. Richard Price (*q.v.*).

See J. G. Anderson, *Mathematical Gazette*, vol. 25 (1941), and *Biometrika*, vol. 47 (1958). (G. A. B.)

BAYEUX, a town of northwestern France in the *département* of Calvados, lies on the Aure 6 mi. S.W. of Arromanches (where the Allies set up an artificial harbour during the Normandy landings in World War II) on the coast and 17 mi. N.W. by road of Caen. Pop. (1954) 9,077. A bypass encloses the city, in part modern, with white buildings, and in part medieval. In the old town, with its cobbled streets and timbered houses, is the splendid Gothic cathedral. The Romanesque west towers (12th century) survive from an earlier church, while the central tower is 15th century with a modern upper part; the 11th-century crypt was restored in the 15th century. The former bishop's palace (11th–14th century) is now the hôtel de ville, law courts and art gallery. Near the cathedral is the Museum of Queen Matilda containing the celebrated Bayeux tapestry (*q.v.*), telling the story of the Norman conquest of England. During World War II Bayeux was occupied in June 1940 and recaptured on June 7, 1944, the first town of France to be liberated from German occupation. At the entrance to the

King Edward the Confessor, in his palace, gives instructions to Earl Harold (the shorter figure), who then sets out (extreme right) for France

The Battle of Hastings: Eustace of Boulogne points to William, who lifts his helmet and shows his face to dispel a rumour that he has been killed

SCENES FROM THE BAYEUX TAPESTRY

PHOTOGRAPHS, PHOTO GIRAUDON, PARIS

BAYEUX TAPESTRY

Crowds gaze up in awe at the comet and a courtier tells King Harold of this terrible omen. Below (in the border) are seen the ghostly invasion ships which Harold now fears will follow

Duke William leads his army down to the ships and one of the vessels, with men and horses on board, is seen getting under way

Harold, touching two shrines, takes an oath of allegiance to William, who looks on from his throne

DETAILS FROM THE BAYEUX TAPESTRY

FROM "THE BAYEUX TAPESTRY," EDITED BY SIR FRANK STENTON. PUBLISHED BY PHAIDON PRESS LTD., LONDON

town on the Cherbourg road is the memorial to the Allied landings of 1944 and to the liberation, and to the east of the city is the British memorial and war cemetery. Lacemaking and the manufacture of plastic goods are carried on, but the chief industries are the making of dairy products (cream and butter) and the export of meat, especially canned beef.

Bayeux was known as Augustodurum and later Civitas Baiocasium to the Romans and had a bishopric from the late 4th century. Captured in 880 by the Scandinavian Rollo, it was soon after settled by the Normans, one of whom, Duke Richard I, built the castle which survived from 960 until the 18th century. During quarrels between the sons of William the Conqueror it was pillaged by Henry I of England in 1106. It was besieged and captured on several occasions during the Hundred Years War and the religious wars of the 16th century. (S. Be.)

BAYEUX TAPESTRY is a band of linen, 231 ft. long and 20 in. wide, now light brown with age, on which were embroidered, in worsteds of eight colours, about 72 scenes representing the Norman conquest of England. The story begins with a prelude to Harold's visit to Bosham on his way to Normandy and ends with the flight of the English from Hastings; originally, it may have been taken further, as the end of the strip has perished. Along the top and the bottom run decorative borders with figures of animals, scenes from the fables of Aesop and of Phaedrus, from husbandry and from the chase and occasionally scenes related to the main pictorial narrative. It has been restored more than once, and in some details the restorations are of doubtful authority.

When first referred to (1476), the tapestry was used once a year to decorate the nave of Bayeux cathedral. There it was "discovered" by Bernard de Montfaucon who published the earliest complete reproduction of it in 1730. Having twice narrowly escaped destruction during the Revolution, it was exhibited in Paris at Napoleon's desire in 1803–04 and thereafter was in civil custody at Bayeux, except in 1871 and from Sept. 1939 to March 1945.

Montfaucon found at Bayeux a tradition, possibly not more than a century old, that assigned the tapestry to Matilda, wife of William the Conqueror, but there is nothing else to connect the work with her. It may have been commissioned by the Conqueror's half-brother Odo, bishop of Bayeux: Odo is prominent in the later scenes, and three of the very few named figures on the tapestry have names borne by obscure men known to have been associated with him. This conjecture would date the work not later than *c.* 1092. Various 12th-century dates have sometimes been proposed; but after *c.* 1924 it was generally agreed that nothing in the tapestry is incompatible with an 11th-century date and that its affinities are with works, especially English works, of the 11th century, rather than with those of the middle and end of the 12th. That it was made in England is not proved, though there is a circumstantial case for thinking that it was.

The tapestry is of great interest as a work of art. It is also important evidence for the history of the Conquest, especially for Harold's relation to William before 1066; its story of events seems straightforward and convincing, despite some obscurities. The decorative borders have value for the study of medieval fables. The tapestry's contribution to knowledge of everyday life *c.* 1100 is of mediocre importance, except for military equipment and tactics.

Bibliography.—For good photographic reproductions *see* F. R. Fowke, *The Bayeux Tapestry* (1875 and 1898); J. Verrier, *La Broderie de Bayeux* (1946); Sir E. Maclagan, *The Bayeux Tapestry*, rev. ed. (1949); and *English Historical Documents*, vol. ii, ed. by D. C. Douglas and G. W. Greenaway (1953), which also provides a bibliography for critical discussion of the tapestry. *See* also E. A. Freeman, *Norman Conquest*, vol. iii, appendix A (1875); J. H. Round, "The Bayeux Tapestry" in *The Monthly Review*, vol. xvii (1904); H. Prentout, "La Tapisserie de Bayeux" in *Revue des cours et conférences*, 23e année (1922). (J. H. R.; Er. S.)

BAY ISLANDS (Islas de la Bahía), a group of small islands in the Caribbean sea, constituting the department of Islas de la Bahía, Honduras. Area, 101 sq.mi. Pop. (1961) 9,060. The population is English-speaking and Protestant. Discovered in 1502 by Columbus, the main islands were settled in the 17th century by the British and by "Carib Indians" from the mainland. They were annexed to Great Britain in 1852 but were ceded to Honduras in 1859. The islands include Roatán, 30 mi. long by 9 mi. wide; Guanaja, 9 mi. long by 5 mi. wide; and several smaller islands and a number of cays or islets. The islands are low, the highest point being about 900 ft. in the hills of Roatán. Agriculture is the chief activity, although there is some fishing and lumbering. The chief products are bananas, plantains, cassava, coconuts, sweet potatoes, poultry, swine and cattle. (C. F. J.)

BAYLE, PIERRE (1647–1706), French philosopher famous for his encyclopaedic dictionary, was born the son of a Calvinist minister at Carla-le-Comte (now Carla-Bayle), near Pamiers, on Nov. 18, 1647. Converted to Catholicism in 1669, he relapsed into Calvinism in 1670 and went for a time to Geneva, where he became acquainted with Cartesianism. Returning to France, he worked as a tutor till, in 1675, he was appointed professor of philosophy at the Protestant academy of Sedan. On the suppression of that academy in 1681, he went to Rotterdam, where he was appointed professor of philosophy and history. In 1682 he published, anonymously, his reflections on the comet of 1680. After deriding the universal superstition that held comets to presage catastrophe, he suggests that other equally long-standing opinions may be equally questionable, including much Christian tradition. His *Critique générale* (also 1682), defending the Calvinists against Louis Maimbourg's *Histoire du Calvinisme*, is said to have earned him the personal enmity of Pierre Jurieu, who had written less successfully against the same book. Subsequent publications were the *Recueil de quelques pièces curieuses concernant la philosophie de M. Descartes* (1684) and a pioneer plea for religious toleration, to be extended even to atheists, *Commentaire philosophique sur ces paroles de Jésus-Christ: "Contrains-les d'entrer"* (1686). From 1684 to 1687 he was editor of the influential periodical *Nouvelles de la république des lettres*. Serious trouble arose when he was accused of having written a pamphlet *Avis important aux réfugiez sur leur prochain retour en France* (1690), advocating a conciliatory attitude to the French government (whereas Jurieu's party stood for full participation by French Protestants in the War of the Grand Alliance against France). Bayle defended himself in *La Cabale chimérique* (1691) and other pamphlets, but was eventually deprived of his professorship (1693).

Thereafter Bayle devoted himself to the composition of his remarkable *Dictionnaire historique et critique*, the first edition of which appeared in 1697 (the *Projets et fragments d'un Dictionnaire critique* had appeared in 1692). In this encyclopaedia the articles themselves, on religious, philosophical and historical subjects, are little more than summary expositions; the importance of the work consists in the copious notes and commentaries on the articles. These erudite annotations are cleverly designed to undo whatever effect of orthodoxy the articles may have. From the mass of quotation, anecdote, obscenity and speculation that they offer, the sceptical intention emanates persistently. It was Bayle who devised this oblique method of subversive criticism, which the 18th-century *Encyclopédistes* adopted. Ostensibly a supplement to Louis Moréri's dictionary, Bayle's was in fact a work of considerable originality, the significance of which was plain enough to his contemporaries.

Objections were promptly made; in particular to the article "David"; to the bias in favour of Manichaeism, Pyrrhonism, atheism and Epicureanism; and to the use of Scripture to introduce indecencies. Bayle undertook to modify his text in the second edition (1702); but in fact no change of any importance was made.

Bayle's last years were troubled by allegations that he was conspiring with France to detach the Dutch from their Anglo-Austrian alliance. He died on Dec. 28, 1706.

BAY LEAF, the leaf of the sweet bay tree, a species of laurel (*Laurus nobilis*) that grows in Mediterranean countries, especially Turkey, Greece, Yugoslavia and Portugal. Dried bay leaves, grayish-green in colour, are a popular seasoning for marinated meats, soups, stews, sauces and fish and are indispensable in pickling. Bay is one of the earliest known herbs, the leaves having been used to form the wreaths of laurel with which victorious athletes were crowned in ancient Greece. During the middle ages they were employed in various rituals to prevent evil and were prized for supposed medicinal values. (M. W. N.)

BAYLIS, LILIAN MARY (1874–1937), English theatrical manager and founder of the Old Vic, was born in London on May 9, 1874. She received a musical education, appeared as a child prodigy in London and went with her parents, who were singers, to South Africa in 1890. She returned to England in 1898 to assist her aunt, Emma Cons, who had turned the Coburg theatre (renamed the Victoria theatre in 1833) into a temperance hall under the name of the Royal Victorian Coffee Music hall. Taking complete control in 1914, Lilian Baylis created the Old Vic, world famous as the home of Shakespearean productions, and in 1931 took over the derelict Sadler's Wells theatre and made it a centre of opera and ballet which likewise became famous. Nobody did finer service for the English theatre. Lilian Baylis was created a companion of honour in 1929. She died in London on Nov. 25, 1937. (W. J. M.-P.)

BAYLISS, SIR WILLIAM MADDOCK (1860–1924), English physiologist, one of the most distinguished of his generation, was born at Wolverhampton on May 2, 1860. In 1881 he entered University college, London, as a medical student, but preferring the pursuit of science to the practice of medicine, in 1885 he went to Oxford and continued to study physiology under his former teacher, John Burdon-Sanderson. In 1888 he returned to London and worked in the physiological laboratories of University college, where he carried on his researches for 35 years.

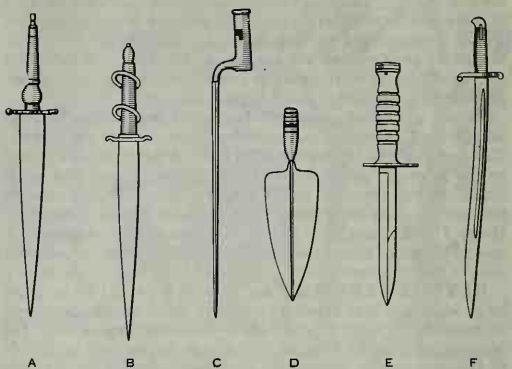
Bayliss' researches covered a wide range and resulted in valuable discoveries, the more important being those on the electromotive phenomena associated with the heart's action; the nervous mechanisms controlling the activities of the viscera and of the circulation to the various parts of the body; the application of recently acquired knowledge of surface phenomena to physiology; and the discovery, in conjunction with Ernest Starling, of secretin, the hormone which excites the pancreas to secrete its digestive juice when acid chyme passes from the stomach into the duodenum.

During World War I Bayliss experimentally investigated the nature of wound shock and devised methods for treatment which were widely and successfully used and saved many lives. His original contributions to science appeared in the scientific journals devoted to physiology and biochemistry between the years 1890 and 1924. His *Principles of General Physiology,* published in 1914, had a world-wide influence and was regarded as the best exposition of the foundations of modern physiology, made particularly palatable by interesting historical allusions. Bayliss' pre-eminence as a discoverer was suitably recognized by learned societies at home and abroad. In 1919 he received from the Royal society the Copley medal, the highest honour for philosophical researches, last given to a physiologist in 1739. He was knighted in 1922 and died at Hampstead on Aug. 27, 1924. (A. B. L.)

BAYLY, THOMAS HAYNES (1797–1839), English popular song writer and dramatist, was born at Bath on Oct. 13, 1797. He was educated at Winchester college and at St. Mary hall, Oxford. In 1824 he became famous with the song "I'd Be a Butterfly," which he followed with "We Met—'t was in a Crowd," "She Wore a Wreath of Roses," "Oh, No, We Never Mention Her" and other ditties. He himself set some of his songs to music; a well-known example is "Gaily the Troubadour." Bayly also wrote two novels, *The Aylmers* and *A Legend of Killarney,* and many plays, the most successful being *Perfection,* which was produced by Madame Vestris and praised by Lord Chesterfield. Bayly died on April 22, 1839. His *Songs, Ballads and other poems* were published in 1844 with a memoir by his widow.

See A. Lang, "T. H. Bayly," in *Essays in Little* (1891).

BAYONET, a short, edged weapon designed for attachment to the muzzle of a firearm. The origin of the bayonet is obscure, but tradition states that it was developed in the town of Bayonne, France, early in the 17th century and that it derived its name from its place of origin. There is considerable circumstantial evidence to support this tradition, for the earliest references to the use of the bayonet (1640–47) are all connected with Bayonne. Maréchal de Puységur, a native of that city, described these first bayonets as having a straight double-edged blade a foot long with a tapering wooden handle, also a foot long, that could be inserted into the muzzle of a musket. This new weapon, considerably shortened, gradually spread throughout Europe and supplanted the pike. Certain regiments of the British army used it in Tangier as early as 1663, and in its native France, the regiments of fusiliers and grenadiers raised in 1671 also were armed with it.



BAYONETS FROM THE EARLY 17TH CENTURY TO WORLD WAR II

(A) Plug bayonet, (B) ring bayonet, (C) socket bayonet, (D) Rice-Chillingworth trowel bayonet, (E) World War II M4 knife bayonet, (F) sword bayonet for 1855 rifle. (Not drawn to scale)

The plug bayonet, as this first type was called, had several serious defects as a weapon. Once it was inserted in the muzzle of the musket, no shot could be fired until it was removed. If pushed in too tightly, it was difficult to remove, and if not driven in tightly enough, it might fall out or be left in the body of an enemy. Further refinements were obviously necessary. Before 1689 a new bayonet was developed with loose rings on the haft to fit around the muzzle. This system also had disadvantages, and was superseded almost immediately by the socket bayonet that Vauban (*q.v.*) introduced into the French army in 1688. This new bayonet had a sleeve that slipped over the muzzle and was held in place by a stud on the barrel that locked in a right-angled slot in the socket. Usually the blade was triangular in cross section, useful only for thrusting. The socket bayonet rapidly became popular and was adopted by all European armies shortly after 1700. With a few alterations to make the attachment more secure, it remained the basic bayonet form for more than 150 years. In America the bayonet was adopted more slowly. Militiamen were allowed the choice of a bayonet, a sword or a tomahawk until the beginning of the American Revolution.

Since the triangular bayonet could be used only for thrusting or stabbing, attempts were soon made to develop a more versatile weapon. Flat blades with both single and double edges and of various lengths were tried before 1750 with the thought that they could be used separately as swords. Because they tended to make the gun muzzle-heavy, they were applied primarily to the shorter arms such as musketoons and rifles. On some of these bayonets, swordlike handles instead of sockets were used, and they were attached to a lug on the side of the barrel by means of a spring catch. By 1855 such bayonets were standard for the shorter rifles. Some sword bayonets were equipped with saw teeth and could be used as pioneer or engineer tools; others were equipped with heavy bolo blades for cutting brush; and still others were developed as trowels for entrenching purposes. Experiments were carried out with rod bayonets that could be retracted into the stock, and still others were hinged to the muzzle and folded back against a spring so they would fly out into position when released.

As long as firearms were predominantly single-shot weapons and battle tactics called for hand-to-hand fighting in mass formation, the bayonet was an arm of the utmost importance. With the adoption of multishot firearms for general military use (*see* SMALL ARMS, MILITARY), the bayonet became merely an auxiliary

weapon, useful primarily when all ammunition had been expended or when silence was desired. The American Civil War was the last major conflict in which hand-to-hand fighting with the bayonet sometimes decided actions.

In World War I there were a few raids and "over the top" advances in which the bayonet was important tactically. A few instances of bayonet fighting occurred in World War II and the Korean conflict, but mass bayonet attacks were no longer common. Yet the bayonet still had its uses and was retained even on the newer types of rifles. In keeping with its new status, however, it was shortened and modified so that it could also be used as an all-purpose knife. As such it was found to have great morale value during World War II and was one of the last pieces of equipment to be discarded by a soldier in an emergency. The U.S. army bayonet (M1) used in World War II and the Korean war had a 10-in. blade in contrast to the M-1905 bayonet with its 16-in. blade. Both were equipped with hand grips and could be carried in scabbards when not affixed to a rifle.

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(HD. L. P.)

BAYONNE, a port town in the extreme southwest of France, centre of an *arrondissement* in the *département* of Basses-Pyrénées, is situated at the confluence of the Nive river with the Adour, 5 mi. from its mouth. Pop. (1954) 26,897. The Roman name was Lapurdum, whence the name Labourd applied to the coastal district between the Adour and Bidassoa rivers. The mouth of the Adour is an artificial channel made in 1578 by diverting the river from its former outlet at Capbreton, which was being closed by the southward drift of sand from the Landes. Bayonne developed during the 19th century as an importing port for British coal and Spanish ore and an exporting port for the products of the Landes forests. Imports of coal and ore have fallen off, but the development of the production of oil at Parentis and of natural gas at Lacq in its hinterland have given new life to Bayonne. It is also a fishing port, chiefly for tunny.

Grand Bayonne, the old town encased within the ramparts of Sebastien Vauban's fortification, lies on the left bank of the Nive. Its principal buildings are the Château Vieux and the cathedral of Sainte Marie. The latter, built on the site of a Roman temple, dates from the 13th to 16th century; two high towers (210 ft.) are 19th-century additions. Across the Nive, Petit Bayonne is the quarter of museums, the Château Neuf and arsenal. The Musée Basque is a fine regional museum displaying the distinctive features of Basque culture. The Bordeaux road is carried across the Adour by the Pont St. Esprit, and downstream along the right bank of the Adour are the port and industrial establishments at Le Boucau and Forges. Biarritz on the coast is almost continuous with Bayonne, the whole forming an urban concentration of 70,000 inhabitants. (AR. E. S.)

BAYONNE, a city of Hudson county, N.J., U.S., on a peninsula adjacent to Jersey City about 7 mi. S.W. of New York city. In 1960 the population of this highly industrialized port city was 74,215. (For comparative population figures *see* table in NEW JERSEY: *Population.*)

Settled by the Dutch in 1646, it was originally known as Konstable's Hoeck (Constable's Hook). In 1869 the townships of Constable's Hook, Bergen Point, Centerville and Salterville were consolidated and incorporated as the city of Bayonne.

In 1875 the Prentice Oil company established the first oil refinery there. The subsequent establishment of other oil refineries made Bayonne one of the major oil refining centres of the United States. The city is the eastern terminus of many cross-country pipeline systems. Bayonne's other industries include the manufacture of chemicals, heavy structural shapes, textiles, food products, electrical equipment, heating apparatus and cork products.

During World Wars I and II Bayonne was a major shipping, shipbuilding and embarkation point. It is included within the Port of New York. There are 9 mi. of heavy-duty waterfront docks and wharves and a U.S. navy supply depot. The Elco works, the oldest builder of standardized cruisers in the United States, was established at Bayonne in 1892; it manufactures both naval and pleasure craft.

The Bayonne bridge, spanning the Kill van Kull and connecting the city with Staten Island, is one of the longest (1,652 ft.) steel arch span bridges in the world. (D. N. A.; M. P. M.)

BAYOU, a term applied to creeks, secondary water courses, and minor rivers in the flood plains of the lower Mississippi basin and Gulf Coast region of the U.S. that have little or no current. A bayou lake (in some cases called simply a bayou) is a lake formed in a river channel abandoned because of a shift in the stream's course. The term bayou is an American-French adaptation of a Choctaw Indian word. It is not applied to similar water features that are characteristic of river flood plains and low coastal plains elsewhere.

BAYREUTH, a town of Germany which after partition of the nation following World War II was located in the *Land* (state) of Bavaria, Federal Republic of Germany. The capital of the government district of Upper Franconia, site of the Wagnerian festivals, it is situated 70 km. (43.5 mi.) N.N.E. of Nürnberg, on the upper basin of the Rote (Red) Main river in a wide valley between the Fichtelgebirge and the Franconian Jura. Pop. (1959 est.) 61,088.

The first reliable historical reference to it dates from 1194, and a document, bearing the seal of Duke Otto VII of Merano, confirms its existence in 1231 as a town. In the strategic position near the Main, at the intersection of the trade routes from Eger to Bamberg and from Nürnberg to Kulmbach and Lichtfels, the dukes of Merano in 1170 erected a fortified castle and a number of dwelling houses which ultimately became part of the town centre. After the death of Otto VIII, the last of the house of Merano, Bayreuth passed into the possession of the Hohenzollerns, and became one of the principal centres of that part of the country. Early in the 17th century the margrave Christian made Bayreuth his residence, and he and his successor built many of its fine baroque buildings. The other arts were also attracted to Bayreuth: in 1614 Heinrich Schütz came from Dresden to inaugurate the new organ in the main church, and in 1726 Georg Philipp Telemann was appointed master of music to the court. Although he never lived there he composed each year an opera for performance in the court theatre. In 1732 Wilhelmina, sister of Frederick the Great, came to Bayreuth as the wife of the young heir, and during their reign the town enjoyed a period of considerable artistic splendour. The opera house, built at her request, survives as a charming foil to that other opera house which was to bring world-wide fame to the town.

The name of Richard Wagner appeared in the programs of the court theatre for the first time in 1860, when his opera *Tannhäuser* was performed before an illustrious audience, which included King Maximilian II and his family. The young crown prince Ludwig, who ascended the Bavarian throne six years later, was to become Wagner's most devoted and generous champion. In 1872 Wagner settled there and the foundation stone of the Festival theatre was laid, the culmination of years of persistent planning. The theatre was erected during the next two years on a slight eminence just outside the town, and was uncompromisingly plain, being entirely designed to give the most perfect possible realization to the vast visual and aural demands of Wagner's music dramas. It opened in 1876 with the complete *Ring* cycle, but this first season, although an unquestionable artistic success, was so costly that six years passed before the theatre was able to open its doors again for the première of *Parsifal* in 1882. After Wagner's death in 1883 Bayreuth became, under the aegis of his widow, Cosima, a place of pilgrimage for lovers of Wagner from all over the world. Wagner's son, Siegfried, carried on the tradition from 1909 until his death in 1930. World War I once more closed the theatre, and when the festival performances were resumed in 1924 there were many obstacles to be overcome, both financial and also in the changed cultural atmosphere. Yet such men as Arturo Toscanini, Heinz Tietjen and Wilhelm Furtwängler brought fresh international glory to the festival. Under Adolf Hitler's protection the theatre was enabled to continue throughout World War II, until performances were suspended in 1945. In 1951 under the revolutionary artistic leadership of Wagner's grandsons, Wolfgang and Wieland, the

theatre gave its first postwar season, and Bayreuth once more took its place among the major European cultural centres.
(Ru. L.)

BAY RUM, a fragrant liquid cosmetic widely used by hairdressers. It is composed of oil of bay, called also oil of myrcia, to which has been added alcohol, water, oil of orange peel and oil of pimenta. *See* Bay-Rum Tree.

BAY-RUM TREE, a small aromatic tree (*Pimenta racemosa*) of the myrtle family (Myrtaceae), native to the West Indies and closely related to the allspice (*q.v.*) and the clove. From the leathery leaves, sometimes five inches long, is distilled bay oil used in making a bay rum (*q.v.*). In Jamaica the tree is called bayberry.

BAYTOWN, a highly industrialized city of southeastern Texas, U.S., on Galveston bay, in the Houston metropolitan area. The unincorporated community of Baytown was annexed by Pelly in 1945 and the new city was founded in 1947 by combining the cities of Pelly and Goose Creek, being called Pelly till 1948, when the name was changed to Baytown. The area, rich in early Texas history, was settled in 1822; in 1864 a Confederate shipyard was built at Baytown. But oil, not history, has marked Baytown since 1916, when petroleum was discovered in the area, and for a time it was one of the most colourful of the state's boom towns. Oil is produced, refined and shipped to the world from docks on the Houston ship channel at Baytown, which has been the site of a major refinery since 1919. Other dominant industries are petrochemicals and synthetic rubber. For comparative population figures *see* table in Texas: *Population*. (G. M. F.)

BAZAINE, ACHILLE FRANÇOIS (1811–1888), marshal of France who was sentenced to death for his capitulation to the Germans at Metz in 1870, was born at Versailles on Feb. 13, 1811. Failing in the competitive examination to the École Polytechnique, he entered an infantry regiment as a private in 1831. As a second lieutenant in 1833, he served with distinction in Algeria and with a French mission during the Carlist War in Spain. With the rank of colonel in 1850, he led a brigade in the Crimean War and was promoted major-general and appointed governor of Sevastopol (1855). In the French and Sardinian war against Austria, he captured the tower of Solferino (1859). In Mexico, in 1863, he conquered Puebla at the head of his division in May and became commander of the French expeditionary corps in August. A widower, he married at 57 a girl of 17, Maria Josefa de la Peña y Barrajón. Promoted marshal on Sept. 5, 1864, he skilfully conducted the retreat of the French troops from Mexico City to Veracruz in 1867.

Bazaine was commander of the army corps in Lorraine at the outbreak of the Franco-German War and became commander-in-chief on Aug. 10, 1870. As it had been decided that the French forces were to be regrouped at Châlons, he began half-heartedly to move toward Verdun, but allowed himself to make a stand at Borny (Aug. 14), where he was wounded, and fought inconclusive battles at Rezonville and Gravelotte (Aug. 16). After failing to support F. C. Canrobert at Saint-Privat two days later, he resolved to avoid battles in the open and withdrew his forces into the entrenched camp at Metz, where he was invested by the Germans. Apparently unconcerned at the disastrous turn of the war, he remained militarily inactive, but began negotiations with Bismarck, probably hoping to play a political role with his intact forces as a trump card. On Oct. 28, 1870, however, he capitulated to the Germans at the head of an army of 140,000 men. Denounced immediately as a traitor by Léon Gambetta, but defended in the national assembly by N. A. T. Changarnier (May 29, 1871), Bazaine returned to France from captivity and asked for a commission of inquiry. This started on April 12, 1872, and ended in a severe censure of his conduct at Metz. Rejecting the commission's report, Bazaine demanded a trial by a military court. He was defended by two famous barristers, C. A. and G. Lachaud (father and son), and accused by Gen. R. A. Séré de Rivière. On Dec. 10, 1873, the court sentenced him to degradation and death, but recommended mercy. Marshal de MacMahon commuted the sentence to 20 years' seclusion.

Incarcerated on the Île Sainte-Marguérite, Bazaine escaped on Aug. 9, 1874, helped by his wife. He fled to Italy and later to Spain, where he died destitute, in Madrid, on Sept. 28, 1888. *See* Franco-German War.

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BAZALGETTE, SIR JOSEPH WILLIAM (1819–1891), English civil engineer, notable for designing the main drainage scheme for London as it was actually carried out, was born at Enfield, Middlesex, on March 28, 1819. Various drainage authorities were superseded in 1848 by the metropolitan commission of sewers. Bazalgette served with this from 1849, becoming chief engineer in 1852, a post he continued to hold under the metropolitan board of works which replaced the commission in 1855. Inexperience, reluctance to commit themselves to vast expense and disagreement among numerous consultants held the board back from starting work until 1859; Bazalgette completed most of it by 1865. Other works he executed for the board included the Victoria (north side) and Albert (south side) embankments (1860–70), Chelsea embankment (1871–74), Northumberland avenue (1876), new bridges at Putney and Battersea and the Woolwich steam ferry. Bazalgette was knighted in 1874. He was president of the Institution of Civil Engineers in 1884. He died at Wimbledon park, London, on March 15, 1891. (S. B. Hn.)

BAZILLE, (JEAN) FRÉDÉRIC (1841–1870), French painter who, as friend, benefactor and colleague of the Impressionists, played an important role during the movement's formative years. He was born at Montpellier on Oct. 6, 1841, and studied medicine before his wealthy parents permitted him to switch to painting. At Charles Gabriel Gleyre's classes in Paris he met Monet and Renoir with whom he frequently traveled and worked, occasionally also sharing his studio with them when they could not afford their own. As a painter he combined a certain naïveté and stiffness with a delicate feeling for nature and an exquisite sense of colour. He seemed destined to occupy a prominent place among the Impressionists had he not been killed on Oct. 29, 1870, during the Franco-German War.

See J. Rewald, *The History of Impressionism*, 2nd ed., which includes bibliography (1955); F. Daulte, *Frédéric Bazille et son temps* (1954). (Jn. R.)

BAZIN, HENRI ÉMILE (1829–1917), was one of a group of notable engineers of the French *corps des ponts et chaussées* ("corps of bridges and roads") who made significant contributions to the science of hydraulics and fluid mechanics in the 19th century. Born at Nancy on Jan. 10, 1829, he became the fifth in a succession of brilliant engineers including Adhémar Jean Claude Barré de Saint-Venant (1797–1886), personally the most remarkable; Arsène Jules Émile Juvénal Dupuit (1804–66), famous for his work on open-channel flow; Jacques Antoine Charles Bresse (1822–83), who extended the work of Dupuit into an exact mathematical form; and finally Henri Philibert Gaspard Darcy (1803–58), best known for his scientific work on pipe flow.

Bazin, acting as Darcy's assistant, was trained to be a careful and assiduous experimenter. He carried on Darcy's original program of tests on open-channel resistance. His studies also extended to wave propagation, to flow over weirs and to the contraction of the liquid vein coming from an orifice. His most valuable publications describing his researches in these fields were published by the French Academy of Sciences in 1865 (to which he was elected in 1913) as well as in the *Annales des ponts et chaussées* during the period 1888–98. In 1875 Bazin became engineer in chief of the corps and was placed in charge of the Bourgogne Canal system. In 1886 he was appointed inspector general of the corps in Paris.

Bazin retired from active duty in 1900. By the time of his death he had 35 titles of scientific writing to his credit. He died on Feb. 7, 1917, at Dijon. (W. E. Hd.)

BAZIN, RENÉ (FRANÇOIS NICOLAS MARIE) (1853–1932), French novelist of provincial life, strongly traditionalist in outlook and style, was born at Angers (Maine-et-Loire), Dec. 26, 1853, and educated at Paris and Angers, where he became professor of law. He entered the Académie Française in 1903 and

was made an officer of the Légion d'honneur in 1918. He died in Paris, July 20, 1932. He wrote many novels and travel books and two excellent biographies, *Charles de Foucauld* (1921; Eng. trans. 1923) and *Pie X* (1928; Eng. trans.). Of his novels, the best are *Donatienne* (1903); *De Toute son âme* (1897); *Le Terre qui meurt* (1899); *Les Oberlé* (1901); *L'Isolée* (1905); *Le Blé qui lève* (1907) and *Magnificat* (1931), all of which are available in English translations.

Bazin's work is traditional in the best sense, marked by purity, clarity and elegance of style, delicacy in the painting of word pictures, and a love of nature, of work, especially on the land, and of the simple virtues. Also a poet, he transfigured all he touched. A Catholic writer, he was concerned with the spiritual development of his characters and with the action of grace on their souls. He was, before the word acquired its later associations, a deeply "engaged" writer and his work had great influence on the upholders of traditionalism in French literature.

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BAZOOKA, the popular name given the 2.36-in. shoulder-type rocket launcher adopted by the U.S. army early in World War II. The weapon was simply a smooth-bore steel tube, originally about 5 ft. long, open at both ends and equipped with hand grip, shoulder rest, trigger mechanism and simple sights. It was named bazooka because of its resemblance to the crude horn of that name used by the radio comedian Bob Burns. The 14½-lb. bazooka was an important new U.S. weapon of World War II, and surprised the Germans when first used in the North African landings in Nov. 1942. It not only revived the ancient principle of the rocket and stimulated further work in that field, but in tactical situations it provided infantrymen with the striking power of light artillery.

The bazooka was developed chiefly for attacking tanks and fortified positions at short range in situations where artillery was not available. It fired a 19-in.-long rocket that weighed about 3½ lb. The bazooka rocket carried 8 oz. of pentolite, a powerful explosive, and was designed according to the "shaped charge" principle that gave it power to penetrate as much as 5 in. of armour plate at 300 yd. As the launcher tube was open at both ends, the bazooka had the added advantage of being recoilless. Its chief defects were short range and lack of accuracy, both stemming from the rocket's low velocity, about 300 ft. per second. Another drawback of the bazooka was the backblast that accompanied its firing, making use of the weapon impossible in enclosed spaces. To escape the backblast the operator held the bazooka on his shoulder with about half the tube protruding behind him. Normal procedure called for one man to load the launcher and another to fire it.

The bazooka was fired by an electrical trigger mechanism consisting, in the earliest models, of small flashlight batteries, later replaced by a simple impulse generator. Many different types of sights were tried out during World War II, a reflecting sight becoming standard equipment in 1944. To facilitate carrying the bazooka in the field, especially in jungles, later models were built in two sections that could quickly be fitted together for firing. A lightweight aluminum launcher was developed in 1945 to replace the earlier steel models.

The German counterparts of the U.S. bazooka were a light 88-mm. rocket launcher known as *Panzerschreck* ("tank terror") or *Ofenrohr* ("stovepipe") and a heavy 88-mm. launcher mounted on a two-wheel carriage.

During the final stages of World War II a more powerful launcher of 3.5-in. bore was under development for the U.S. army to combat heavily armoured German tanks. It saw active service during the Korean war (1950–53) and made the 2.36-in. launcher obsolete. Like its predecessor, it was a two-piece, smooth-bore launcher with reflecting sights. Made of aluminum, it was 5-ft. long and weighed about 15 lb. It fired smoke rockets or antitank rockets (length 23½-in., weight 8½ to 9 lb.) for a maximum range of about 900 yd. *See* also ROCKETS. (H. C. T.)

BDELLIUM, a name applied to the bitter aromatic gum resins derived from species of *Commiphora*. Bdellium is similar to true myrrh (*q.v.*) and is sometimes found as an adulterant of it. *See* also RESINS.

BÉ, NOSY: *see* NOSSI-BÉ.

BEACH, AMY MARCY (née CHENEY) (1867–1944), U.S. pianist and composer, whose *Gaelic Symphony* (1896) was the first work in this form by an American woman, was born Sept. 5, 1867, in Henniker, N.H. She was a precocious and prolific composer of choral works, piano pieces and songs in an unpretentious romantic vein. She was soloist in her piano concerto with the Boston Symphony orchestra on April 6, 1900. She died in New York, Dec. 27, 1944.

See P. Goetschius, *Mrs. H. H. A. Beach, Analytical Sketch* (1906). (N. SY.)

BEACH refers to those parts of the shore of a lake or sea upon which material is being deposited by waves and currents. In technical writing those shore segments formed mostly of mud are not designated beaches. The materials making up a beach are of mixed sizes, but usually one size of material—sand, gravel or cobbles—predominates. A beach made up largely of cobbles, large pebbles and boulders is called a shingle beach, and the term beach may derive from an ancient dialect word for shingle. In general the material making up beaches exposed to vigorous wave action tends to be more homogeneous than that found on protected beaches.

The limits of beaches have not been precisely defined. Some physical geographers define the seaward edge of the beach as the low-tide mark; others include an offshore area beyond the low-tide mark. The landward edge of the beach is likewise variously defined and delimited. Some authorities define the inner edge as the ridge of material thrown up by the highest tides and storms, while specialists include the landward slope of this ridge and the depression, swamp or lagoon behind it.

Both the materials and forms of beaches depend upon the state of waves and currents along the particular stretch of beach and upon the kinds of materials available along the shore at the beach or nearby. For example, along several coasts of the world, limestone cliffs are attacked by the waves, the soluble materials are removed, and the insoluble residue of flint accumulates as shingle on the adjacent beaches.

Conversely, shore lines made up largely of loosely consolidated sandstones or certain kinds of granites will produce unmixed sandy beaches.

Beach form is influenced by the general nature of the shore line, the kinds of water movement along the shore and the type of materials of which the beach is composed. The cross section of the beach at right angles to the shore line is generally rather low and flat if the beach material is largely sand, whereas the slope may be quite steep if the beach material is coarse—pebbles and cobbles. In general, beaches tend to become steeper near their landward margin. Most beaches where waves normally break have a slope of less than 20°.

The commonest location of beaches is at the heads of bays or other re-entrants in the shore front. Material is carried by waves and currents from more-exposed locations into the quiet waters of the bay and there deposited as bay-head, or crescent, beaches having the shape that their name implies.

Beaches with special shapes or locations are often designated by special terms such as spit, hook, bay-mouth bars and others.

Most beaches exhibit a number of interesting and characteristic small features and shapes. For example, ripple marks formed on sandy beaches by currents are asymmetrical, and perpendicular to the current; waves, however, form symmetrical ripple marks at right angles to their own movement. Another small feature is the beach cusp, looking like a tiny bay, up to several inches deep and a few feet wide, whose mode or origin is almost certainly associated with wave action. (W. C. C.)

BEACH PEA (*Lathyrus japonicus*), a characteristic beach plant of northern regions that because of its ability to bind sandy soil has found some use in seaside gardens. It is a perennial herb of the family Leguminosae native to cool sandy shores throughout the northern hemisphere and extending northward to the Arctic sea.

The beach pea is a smooth, stout, trailing or climbing pealike

plant, one foot to three feet high, with tendril-bearing leaves divided into six to ten oblong, thick leaflets, and with clustered, showy, purple flowers about one inch long.

BEACH WORMWOOD (*Artemisia stelleriana*), a perennial plant of the family Compositae native to northeastern Asia and naturalized in North America on sandy sea beaches from Quebec to Delaware and also on the coasts of Sweden. The white woolly plant, with foliage similar to that of the dusty miller (*Senecio cineraria*), is cultivated as a border plant, and is especially suited to seaside rock gardens. *See* also ARTEMISIA.

BEACHY HEAD, BATTLE OF, a naval action, known to the French as the battle of Béveziers (*i.e.,* Pevensey), fought off the coast of Sussex, Eng., near Eastbourne, on July 10 (new style; June 30, old style), 1690, between an Anglo-Dutch and a French fleet during the War of the Grand Alliance (*q.v.*). The allied force, which consisted of 35 British sail under the earl of Torrington (Arthur Herbert) and of 22 Dutch commanded by C. Evertzen, was at anchor under the headland at Beachy Head, when a French fleet of more than 70 sail under the comte de Tourville appeared. The French fleet, which had been trying for some days to engage the Anglo-Dutch, had instructions to co-operate with an expected Jacobite rising in England. In view of the French fleet's known superiority, Torrington had wanted to retire to the mouth of the Thames, but he was ordered to remain and fight. He therefore bore down on the French, but his line became separated. The rear under Sir Ralph Delaval engaged; the Dutch in the van fought a close action with the French and were isolated by them until the tide turned and the French were carried westward, the English and Dutch ships having dropped anchor. At the first opportunity Torrington withdrew to the Thames. Brought to trial before a court martial on a charge of retreating, he defended his conduct on the grounds that he had maintained "a fleet in being" as a potential threat which rendered any proposed invasion impossible, and was acquitted. This doctrine subsequently often inspired the strategy of maritime powers which found themselves in an inferior situation. In 1692 Tourville's command of the English channel ended when his fleet was annihilated by Adm. Edward Russell at the battle of La Hogue (*q.v.*).

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BEACON, a signaling object or device, such as a radio transmitter that indicates geographical location or direction to ships or aircraft by transmitting special radio signals, or a conspicuous object, either natural or artificial, visible as a mark from a distance by day and, if lighted (*e.g.,* a lighthouse), at night. The term is also applied to a watchtower or signal station. Marker beacons used to assist mariners are erected on small islands, isolated rocks, reefs, shoals and at suitable positions on the coast line, and are also used to mark the limits of the fairway in harbours, estuaries and rivers. Rotating light beacons mark airports at night and during periods of low visibility. Various types of beacons also mark established airways. *See* AIRPORT; AIRWAYS; LIGHTHOUSES; NAVIGATION; RADAR: *Accessory Devices: Radar Beacons.*

BEACONSFIELD, BENJAMIN DISRAELI, EARL OF (1804–1881), British statesman and novelist, who was prime minister in 1868 and 1874–80, and the creator of the modern Conservative party, was born in London on Dec. 21, 1804. He was of Italian-Jewish descent, the eldest son and second child of Isaac D'Israeli (*q.v.*) and of Maria Basevi. His grandfather Benjamin D'Israeli emigrated to England from Cento, near Ferrara in Italy, in 1748 and after a moderately successful business career became a member of the London Stock exchange. He left £35,000 on his death in 1816. The elder Benjamin's second wife, Disraeli's grandmother, was descended from the great Portuguese Jewish family of Villareal—a connection of which her grandson was very proud. The numerous picturesque details with which he embroidered his own story of his descent are, however, for the most part fictitious or nonproven. The most important event in Disraeli's boyhood was Isaac D'Israeli's quarrel in 1813 with the Sephardic synagogue of Bevis Marks, which led him in 1817 to decide to have his children baptized as Christians. Since Jews (by religion) were excluded from parliament until 1858, it can be safely asserted that but for this curious accident Disraeli's subsequent political career could never have taken the form it did.

Early Career.—Disraeli went to school first at Blackheath, then to an establishment called Higham hall, in Epping forest, kept by a Unitarian minister. At the age of 17 he became articled to a firm of solicitors in the City, but he longed to make his mark on the world in a more sensational manner than was open to a mere lawyer's clerk. His first efforts were disastrous.

In the autumn of 1824 he began to engage in reckless speculation in South American mining shares. The bubble burst a year later and Disraeli was subsequently burdened with a debt which was to encumber him till he was well past middle age. Before this calamity he had persuaded his father's friend, the great publisher John Murray, to launch a daily newspaper, the *Representative,* which proved a complete failure. Disraeli was unable to pay his promised share of the capital and the resulting recriminations involved him in quarrels with Murray, J. G. Lockhart, J. W. Croker and other people of importance in the Tory literary-political world. As if this were not enough for a young man of barely 21, he then produced an anonymous novel, *Vivian Grey,* five volumes (1826–27), in which he lampooned Murray and related the whole story of the *Representative* under the thinnest of disguises. The author's identity was soon discovered and the critics did not spare him. Certainly the crudities and absurdities of the novel are obvious enough, but an impudent gusto carries the story along and there are many flashes which hint at the Disraeli of later literary fame.

The strain of all these events induced in Disraeli something that would now be called a nervous breakdown. He did little of interest during the next four years apart from writing another equally extravagant novel *The Young Duke,* three volumes (1831). In 1830 he set off on 16 months of travel in the Mediterranean and the middle east with his sister Sarah's fiancé, William Meredith. This "Grand Tour" ended in tragedy with Meredith's death from smallpox in Cairo. Disraeli's experience of the colour and glamour of the east left a lasting effect on his whole cast of mind. The oriental descriptions with which his novels abound are merely one aspect of this. It also affected his attitude toward foreign affairs and it is by no means fanciful to see in those experiences the origin of his policy toward India, Egypt and Turkey in the 1870s.

On his return to England he at once plunged into London social and literary life. His friend Sir Edward Bulwer (later Lord Lytton) introduced him into the salons of such people as Lady Blessington, Mrs. Norton and Lady Cork. His dandified dress, his conceit and affectation, his exotic good looks made him a striking though not always popular figure wherever he went. He soon found himself beset with invitations to fashionable parties and met most of the celebrities of the day. During the next few years he published a number of books; the only one of any literary value was *Contarini Fleming,* four volumes (1832), which also has considerable autobiographical interest.

Political Beginnings and Marriage.—Disraeli had by 1831 made up his mind to enter politics and since his family was now settled at Bradenham, near Wycombe in Buckinghamshire, it was natural that he should seek a seat in that locality. As an independent radical, he fought and lost High Wycombe no less than three times: twice in 1832, once in 1835. He realized after the third attempt that he must attach himself to one of the great political parties, and, since his radicalism had many features not inconsistent with a somewhat eccentric interpretation of Toryism, he gravitated toward the Tory-Conservative party. His increasing friendship with Lord Lyndhurst, a brilliant but rather disreputable former Tory lord chancellor, led in the same direction. In 1835 he fought Taunton as the official Conservative candidate. He was again defeated, but he secured much notoriety from a resounding quarrel with the Irish leader Daniel O'Connell, arising out of an election speech. Disraeli's extravagant behaviour, load of debts and open liaison with Henrietta, wife of Sir Francis Sykes (and the original of his novel *Henrietta Temple*), combined to give him a dubious reputation at this time. Finally at the election of 1837 he was returned to parliament as Conservative member for Maidstone in Kent. His maiden speech in the house of commons (Dec. 7, 1837)

was a failure. A combination of elaborate metaphors, affected mannerisms and foppish dress resulted in his being howled down, the Irish members, in revenge for O'Connell, leading the uproar. But he was not silenced. The last words of his speech shouted high above the clamour were both defiant and prophetic: "I will sit down now but the time will come when you will hear me."

Disraeli was never a man to ignore the lessons of experience. He learned to adapt himself to the ways of the house and before long was a speaker who commanded attention. His social position was consolidated by his marriage in 1839 to Mrs. Wyndham Lewis (née Mary Anne Evans), widow of Disraeli's colleague as member for Maidstone. She was 12 years older than Disraeli and highly eccentric but she had a life interest in a house in Park lane and in a fortune which produced some £4,000 a year, and was deeply devoted to her second husband. It would be absurd to deny that Disraeli's motives in proposing were principally material. Indeed on one occasion he actually admitted as much in a letter to her. But there is no reason to doubt the truth of her own half jesting remark: "Dizzy married me for my money but if he had the chance again he would marry me for love."

Breach With Peel.—Sir Robert Peel, anxious to cultivate talent in his party, seems to have encouraged Disraeli, inviting him to attend sessions of the 19th-century equivalent of the "shadow cabinet." When in 1841 the Conservatives won the election Disraeli had reason to expect office. No offer came and when he wrote a supplicating letter to Peel he received a cool and formal refusal. It is said that Peel would have included him, but that Lord Stanley, a key figure in the cabinet who had conceived a strong personal aversion for Disraeli, absolutely vetoed any offer. Disraeli was much mortified at the rebuff and began to assume an ever more critical attitude toward Peel and the type of Conservatism that he represented.

Disraeli's pen had not been idle during the past ten years. He had written a number of novels; *The Wondrous Tale of Alroy* and *The Rise of Iskander* (1833) were of little merit, but *Venetia* (1837), a fictional account of the lives of Byron and Shelley, remains very readable and *Henrietta Temple,* three volumes (1837) is one of the most attractive of all his romances, with a memorable portrait of his friend Count d'Orsay. He also produced a long and bad epic poem *The Revolutionary Epick* (1834) and an equally unsuccessful blank verse *Tragedy of Count Alarcos* (1839). During these years too he wrote a series of pamphlets and open letters and a political treatise in which he adumbrated the theory of Toryism that was to be fully expounded in the first and greatest of his political novels, *Coningsby.* These political works published in the 1830s include *A Vindication of the English Constitution* (1835) and *The Letters of Runnymede* (1836). The latter was a reprint (together with a tract on "The Spirit of Whiggism") of a series of pseudonymous letters, satirizing the characters of the principal ministers on Lord Melbourne's second administration, which had appeared in the *Times* during 1836.

Disraeli maintained that the Tories, although seeming to be the party of monarchical and ecclesiastical privilege, had in reality always been on the popular side. The Whigs were a group of selfish oligarchs who by destroying crown and church were destroying the two great safeguards for popular liberties. The revolution of 1688 had, he argued, been in the interest of a narrow class and the Reform bill of 1832, though ostensibly aimed at widening popular suffrage, was in fact designed to consolidate the supremacy of the Whig party. In the 1840s Disraeli's Toryism took on a new colour with the emergence of a group of youthful Tories (of which George Smythe, later Lord Strangford, and Lord John Manners, later duke of Rutland, were the most important members) who were nicknamed "Young England," and who looked to Disraeli for their inspiration. *Coningsby; or, The New Generation,* three volumes (1844) is the novel which immortalizes their attitudes and aspirations, and the hero is a portrait of Smythe. "Young England" was hostile to the cool pragmatic humdrum middle-class Conservatism of Peel. It was romantic, aristocratic, nostalgic and escapist. It looked to a nonexistent golden past where the people and the nobility were united in a generous alliance supporting an enlightened throne and a conscientious church. The contemporary flirtation of some Chartists with Toryism seemed to give a certain plausibility to the creation of such an alliance. A year later (1845) Disraeli published *Sybil; or, The Two Nations,* three volumes, in which the causes and nature of Chartism were vividly analyzed and depicted.

By this time he was in more or less open revolt against Peel and had publicly clashed with him, declaring at the beginning of the parliamentary session in 1845 that "a Conservative government is an organized hypocrisy." In the autumn of that year a combination of the Irish famine and the arguments of Richard Cobden decided Peel to repeal the protective duties on foreign imported grain known as the corn laws. Here was an issue on which Disraeli could rally not merely the romantic scions of noble houses but the great mass of country squires who formed the backbone of the Conservative party. Lord Stanley, in the house of lords, was the only important member of the cabinet to resign, but a large majority of backbenchers declined to follow Peel. Acting ostensibly as lieutenant to Lord George Bentinck, who nominally led the rebels, Disraeli in a series of brilliant speeches consolidated the opposition to Peel. But his invective greatly embittered politics and created lasting resentment among the supporters of his former chief. Peel himself seldom responded in kind, but he did on one occasion taunt Disraeli with having solicited office from him. Disraeli categorically denied the charge but whether this was genuine forgetfulness or a deliberate lie will never be known. The protectionists could not stop the repeal of the corn laws because the bill had the backing of Lord John Russell and the Whigs, but they were able to put Peel in a minority on the question of Irish coercion and thus force him to resign (June 1846).

Conservative Leader in the House of Commons.—The corn laws crisis was a turning point in Disraeli's career. The loyalty of nearly all the Conservative ex-ministers to Peel and the death of Bentinck in 1848 gave him an indisputable claim to the leadership of the opposition in the house of commons—a claim which even Stanley who led the party as a whole could hardly contest. Disraeli devoted the next few years to endeavouring to extricate his party from what he now recognized to be "the hopeless cause of protection." The policy was sensible enough but it inspired mistrust among his followers, as too did Disraeli's pride in and insistence upon his Jewish ancestry. He had voted with the Liberals in 1847 for removing Jewish civil disabilities and in *Tancred; or, The New Crusade,* three volumes (1847), the third of the trilogy including *Coningsby* and *Sybil,* he set forth some highly unorthodox views about the relationship between Christianity and Judaism. The party could not, however, dispense with his talents whatever it thought of his character. Besides, with his election for Buckinghamshire in 1847 and his purchase of Hughenden manor in 1848 with the help of the Bentincks, his social and political position was fortified: he had become a county member and a country gentleman with a landed estate. His finances, however, despite his father's death (1848) and his wife's income, remained shaky in the extreme. He closed the protectionist phase of his career by writing a remarkably impartial *Life* of Lord George Bentinck (1852).

Russell's government fell in 1852 and the earl of Derby (as Lord Stanley had become since his father's death in 1851) formed a short-lived minority government. Nearly all its members were new to office. Disraeli was chancellor of the exchequer despite his protest that he knew nothing of finance. "You know as much as Mr. Canning did," replied Derby, "They give you the figures." His budget in fact brought the government down (Dec. 1852), but Disraeli can hardly be blamed for this. The free trade majority in the house was determined to defeat measures which relieved agriculture, even though the method chosen did not involve protection, and yet Disraeli could not escape bringing forward some such proposals if he was to placate his own followers. For the next six years the Tories were in opposition. The balance of power in a house of commons where neither of the traditional parties seemed able to secure a clear majority rested with the Peelites, the Irish and the Radicals, and none of these groups, however hostile on occasion to the Whig-Liberal party, was likely to favour the Tories for long. The Peelites were perhaps the most likely converts, but

Gladstone, their most vigorous figure, was animated by implacable personal animosity for Disraeli. In 1855 the collapse of the earl of Aberdeen's coalition gave Derby a chance to take office and secure renown as the man to end the Crimean War. He timorously hesitated and much to Disraeli's indignation let the opportunity go to Lord Palmerston. It was difficult to be more conservative in home or more jingoistic in foreign affairs than he, and Disraeli's party found most of their potential thunder stolen. Temporary unpopularity, however, resulted in a defeat for Palmerston in 1858 and once again Derby formed a minority government with Disraeli as chancellor of the exchequer. Disraeli with his notions of popular Toryism had for some time felt that there was no reason to leave parliamentary reform as a Whig monopoly, and no need for Conservatives to conserve the 1832 settlement which had been made in the Whig interest. Accordingly he introduced a moderate reform bill in 1859. But its provisions seemed too obviously designed to help his party and the majority of the house combined to defeat them and turn out the government. Palmerston was in office for the next six years. It was a period of quiescence for Disraeli. In his private life the most notable event was his inheritance in 1863 of some £30,000 from an aged Jewish widow, Mrs. Brydges Willyams of Torquay, who had been his devoted friend and admirer.

The "Leap in the Dark."—Palmerston died immediately after the general election of 1865 had given him a comfortable majority. He was succeeded by Earl Russell (as Lord John Russell had become) who promptly brought forward a measure of parliamentary reform. Moderate though this was, it aroused the strong opposition of the Tories and, more seriously, a revolt within the Whig-Liberal party. Russell was defeated and Derby formed his third minority government with Disraeli again chancellor of the exchequer. Disraeli's opposition to the Liberal bill had been based on opportunism rather than principle. Although the initiative for a new Conservative reform bill came from the queen and Lord Derby, Disraeli plunged into the battle with an enthusiasm combined with a mastery of parliamentary tactics unsurpassed by any other statesman of the day. He believed strongly that the measure should be a sweeping one, subject to certain safeguards, for which he cared much less, and so persuaded most of his party, although Lord Cranborne (later 3rd marquess of Salisbury) resigned together with two other members of the cabinet. Above all Disraeli was determined that the bill should be carried by a Conservative government.

These considerations dictated the course of events in 1867. The bill in its original form abolished the £10 rating qualification and gave the vote in the boroughs to all householders who paid their own rates; *i.e.*, did not "compound" them along with their weekly rent to a landlord. In addition there were to be a number of "fancy franchises" as Disraeli's enemies called them, designed to give the vote to men of means and education. But with the Liberals in a majority in the house of commons, Disraeli was obliged to accept their amendments. In the end nearly all the so-called safeguards vanished, including the proviso against "compounders." The resulting measure doubled the existing electorate and was undoubtedly far more democratic than most Conservatives had envisaged. It was indeed "a leap in the dark," as Derby called it, but Disraeli could fairly claim that it had gone far toward "realizing the dream of my life and re-establishing Toryism on a national foundation."

The "Top of the Greasy Pole."—In Feb. 1868 Derby, worn out by repeated attacks of gout, retired from politics and Disraeli became prime minister. "Yes," he said in reply to a friend's congratulations, "I have climbed to the top of the greasy pole." It was in a sense a "caretaker" premiership, for everyone awaited the general election which was due to be held as soon as the new electoral register was completed. Meanwhile Gladstone, now undisputed leader of the opposition, seized the initiative by moving a series of resolutions in favour of disestablishing the (Anglican) Church of Ireland. Disraeli's hope of countering by a successful "no-popery" cry failed and the autumn election gave the Liberals an increased majority. Disraeli set a precedent by resigning without waiting for parliament to meet. Before he left office Queen Victoria conferred at his request a peerage upon his wife who became Viscountess Beaconsfield in her own right.

The whole face of politics had changed in the three years since Palmerston's death. From a chaotic collection of ill-defined shifting groups influenced as much by personalities as politics there emerged two great parties with intelligible coherent policies. Their respective leaders seemed singularly well chosen to polarize the confused forces which had hitherto animated British politics. For 12 years they fought a deadly duel. Each detested the other and history records scarcely a flicker, on either side, of those generous emotions toward the political enemy, which have so often softened the seeming acerbity of parliamentary life.

For the moment Disraeli deemed it wise to play a comparatively peaceful role, gradually creating for the Conservative party a new image, which would in the course of time, he hoped, persuade the new electorate. His seeming apathy, however, disturbed his supporters and there was talk of supplanting him by Derby's son and successor, the 15th earl. These misgivings were increased by the publication of *Lothair*, three volumes (1870), described by G. E. Buckle, Disraeli's biographer, as "a gaudy romance of the peerage so written as to make it impossible to say how much was ironical or satirical, and how much soberly intended." It is a most enjoyable novel full of wit and epigram, and contains a good-humoured satire on the Roman Catholic Church, but to many grave persons it must have seemed an undignified production for a former prime minister.

From 1872 onward, however, Disraeli took charge of his party with a firm hand. On three broad issues he sharply differentiated Conservative from Liberal policy. In a speech at Manchester (April 3, 1872) he defended the monarchy, the house of lords and the church against the radical threat which he claimed to discern in Gladstone's policy. At the Crystal palace three months later he asserted for the first time the Conservative belief in consolidating the empire, with special emphasis on India. And in the same speech he dwelt on the importance of social reform: the old "condition of the people" question which he had analyzed so vividly in *Sybil* a quarter of a century earlier. During these years of opposition yet a fourth distinctive Conservative policy began to emerge: upon Disraeli there descended in some degree the inheritance of Palmerston: the belief in a strong foreign policy, in a firm line with Russia and in the greatness of Britain; and he severely criticized Gladstonian tendencies toward "little Englandism" and reduction of armaments.

In Dec. 1872 Disraeli suffered a personal bereavement none the less poignant for having been long expected. His wife died of cancer after many months of illness. Her oddities never disturbed Disraeli, while her affection, her management of domestic affairs, and her deep devotion to him had rendered his life happy as it had never been before. There were more material losses too. He no longer had her house in London, and her fortune, which was entailed, passed to her cousins. Disraeli was now 68 and his health was not good. It is a testimony to his indomitable will that he determined to continue the political battle despite the personal distress and confusion into which he was thrown. The society of women remained essential for him. From this period dates his romantic friendship with the sisters, Lady Bradford and Lady Chesterfield, to whom he poured out the secrets of politics and the affections of his heart in a profuse and fascinating series of letters which only ceased with his death.

At this juncture he had the consolation that public affairs at last began to move in his favour. Gladstone's ministry, declining in popularity, was defeated in the house of commons in 1873 on a proposal for an Irish university. Gladstone promptly resigned but Disraeli shrewdly, and much to Gladstone's anger, refused to take office on the ground that he could not dissolve parliament for some months owing to the amount of uncompleted business and that a minority government could only damage his party's prospects. Gladstone reluctantly returned to office, but less than a year later himself decided on a sudden dissolution. Disraeli had not neglected the vital problems of party organization and machinery so necessary in the new era of mass democracy. Indeed he had always kept a careful eye on party management, delegating the work

first to his own solicitor, Sir Philip Rose, and then after 1868 to Sir John Gorst. The result of Disraeli's ideas, Gorst's labours and Gladstone's unpopularity was reflected in a triumphant election which returned the Conservatives by a substantial majority over the Liberals. For the first time since Peel's victory in 1841 the Conservative party was in undisputed command of the house of commons.

Second Administration, 1874–80.—It was Disraeli's tragedy that power came to him too late. He had never possessed the vitality and the iron constitution of a Palmerston or a Gladstone, and he aged rapidly during his second premiership. Certainly he achieved much but he could have done far more, even a few years earlier. He formed a strong cabinet, his great catch being Lord Salisbury, who swallowed his personal doubts and returned as secretary for India. The 15th earl of Derby as foreign secretary, Sir Stafford Northcote as chancellor of the exchequer and R. A. Cross at the home office were the principal other appointments. Disraeli was further fortified by his friendship with the queen who was politically conservative and had already acquired a considerable dislike for Gladstone. This was perhaps surprising. The prince consort, whose opinions dominated the queen long after his death, was a friend of Gladstone and declared that Disraeli "had not one single element of a gentleman in his composition." But the queen was frightened at Gladstone's radicalism and susceptible to Disraeli's extraordinary charm with women. He treated her as a human being where Gladstone treated her as a political institution. In doing so Disraeli indulged in a degree of flattery to which the word oriental has been legitimately applied. As he himself observed, where royalty is concerned butter should be laid on with a trowel, and he certainly acted up to his precept.

His anxiety to please the queen landed him in difficulties at once. Largely at her instance he gave his support to the archbishop of Canterbury's measure (known as the Public Worship Regulation act) to suppress the more extreme ritualistic practices of the high church party in the Church of England. This was a subject in which it was unwise to meddle; although the bill was passed, it was never effective and Disraeli was to pay dearly for it in the bitter opposition of the high churchmen to his eastern policy three years later. But in the session of 1875, embarking on a program of social reform which touched the real interests of the masses more effectively than most of Gladstone's measures, he was at last able to show that Tory democracy was not a mere phrase. The Artisans' Dwellings act was the first measure to make effective slum clearance possible. A Public Health act codified the complicated law on that subject and translated into reality Disraeli's own half-joking witticism in the Manchester speech of 1872: "Sanitas sanitatum, omnia sanitas" (an alliterative misquotation of *vanitas vanitatum, omnia vanitas*, "vanity of vanities, all is vanity," taken from the Book of Ecclesiastes). Equally important were an enlightened series of factory acts preventing the exploitation of labour and two trades union acts which clarified the doubtful legal position of those bodies. These reforms have been described as "the charter of the social and industrial freedom of the working classes." The detailed work was done by Cross, the home secretary, but the measures would never have been enacted without Disraeli's initiative, support and supervision.

Important though Disraeli's domestic program was, it took second place in the public eye to his imperial and foreign policy. He felt that British prestige in both these fields had declined during Gladstone's administration and he entered office in a mood to reverse that trend. His first great success was the affair of the Suez canal shares. The canal, opened in 1869, had at once transformed the strategic considerations which affected the route to India. The extravagant and spendthrift ruler of Egypt, the khedive Ismail, owned slightly less than half the Suez Canal company's shares, and was anxious to sell them. This fact was communicated by a patriotic journalist to the foreign office which regarded a purchase as absurd. Disraeli, however, boldly overruled Derby and at the end of Nov. 1875 bought them for the government, the money being put up by his friends the Rothschilds until parliament could confirm the bargain. The transaction did not in itself affect the control of the route to India, but it gave England an indirect stake in Egypt which in the end led to military occupation. Financially it was an excellent bargain and in terms of imperial prestige it seemed a notable triumph.

Disraeli's next effort, early in 1876, was to bring in a bill conferring on Queen Victoria the title empress of India. This was intended to symbolize the special status of that great dominion and to vindicate the personal relationship of the sovereign with her Indian subjects. The measure passed but there was a good deal of opposition, and despite subsequent claims it is hard to see that much was gained by it. Disraeli himself would gladly have postponed it, but the queen insisted. For some time his health had been poor and it became clear to him in the summer of 1876 that the strain of leading the house of commons was too much. Accordingly in August he accepted a peerage, taking the title earl of Beaconsfield.

From 1876 to 1878 his life was dominated by a major issue of foreign policy. The conflict between Russia and Turkey which had lain dormant since the Crimean War was abruptly reopened by the revolt of the Christian subjects of the Ottoman empire against intolerable misrule (*see* EASTERN QUESTION). Russia declared war on Turkey in April 1877 and its troops reached the gates of Constantinople early the next year. British sentiment then veered steeply against Russia. Hitherto, thanks to an unparalleled moral crusade by Gladstone, whose pamphlet, *The Bulgarian Horrors and the Question of the East*, sold 40,000 copies in four days, public opinion had been strongly hostile to the Turks. But the Russian victories aroused the old Crimean sentiments and renewed fear for the safety of the route to India. Beaconsfield was determined not to allow Russia to dictate a victor's peace and, knowing that the Russian forces were exhausted, he rightly reckoned that the threat of British intervention would be enough. Gladstone's pro-Russian propaganda was highly embarrassing at this juncture and both Beaconsfield and the queen came to regard him with an almost pathological hatred. The cabinet was divided and after much vacillation Lord Derby resigned on the question of sending the fleet to Constantinople. But the prime minister stood firm, Salisbury succeeded Derby at the foreign office and Russia was obliged to submit the highly pan-Slavist treaty of San Stefano, which it had forced upon Turkey, to a European congress. Beaconsfield attended the congress of Berlin (*q.v.*) in the summer of 1878, and made a great personal impression, obtaining nearly all the concessions that he wanted. Many of the arrangements had been fixed beforehand, but at one moment the Russians seemed inclined to make difficulties and Beaconsfield gave orders for his special train to be ready to take him from Berlin. The threat worked and he was able to return in triumph to London declaring that he had brought back "peace with honour."

This was the climax of his career. The queen offered him a dukedom which he refused and the Garter which he accepted. His prestige was at its height. Thereafter his fortunes waned. The forward policy of Lord Lytton, the viceroy of India, brought disaster in Afghanistan, and in South Africa an unwary British force was slaughtered by the Zulus at Isandhlwana. Agricultural distress combined with an industrial slump to bring the government into disfavour. At the general election of 1880 the Conservatives received a heavy defeat. Beaconsfield courageously agreed to retain the party leadership, and despite this burden found time to finish *Endymion*, three volumes (1880)—a mellow political novel (for which his publishers paid him £10,000) in which he surveyed his own early career through the rose-coloured spectacles of romantic nostalgia. His health was, however, failing rapidly and he died at his London home on April 19, 1881. A few days after his burial in the family vault at Hughenden, Queen Victoria came in person to lay a wreath upon the coffin of her favourite minister.

Character and Influence.—On any assessment of his character Disraeli must be regarded as one of the most extraordinary figures ever to have reached the summit of British politics. That a man of Jewish origin, loaded with debts, and widely regarded as a combination of flashy litterateur and opportunist adventurer should have become leader of the Tory party may well be evidence of the unexpected fluidity of the Victorian social structure, but it is also evidence of a determination, a courage, and a parliamentary genius

seldom surpassed in British history. On the Conservative party his influence was profound. He provided it with a romantic ideology none the less potent for being based on a very dubious version of history; and at a more material level he reorganized the party machinery on lines from which it had not far departed three-quarters of a century later. If the "myth" of popular Toryism by which he interpreted past history can be easily destroyed, this does not alter the fact that he made it a reality in his own day. More than almost any other contemporary statesman he discerned intuitively what the newly enfranchised masses wanted both at home and abroad. His policy of social reform, his vision of the empire as a great confederation of self-governing states tied to the mother country by an imperial tariff, and his determination, perhaps all the greater because of his basically alien origin, to stand up for what he deemed to be Great Britain's vital interests, might well have ensured a long lease of power for the Conservative party, had his health been stronger and his energy greater. The sincerity of his beliefs and the extent to which he was influenced by opportunism and love of power rather than high principle must always remain a matter of argument. He was an enigma to his contemporaries. He remains one even today.

See ENGLISH HISTORY; *see* also Index references under "Beaconsfield, Benjamin Disraeli" in the Index volume.

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BEACONSFIELD, probably from Old English *beacnes-feld,* "field marked by beacon," an urban district in the South Bucks parliamentary division of Buckinghamshire, Eng., 24 mi. W.N.W. of London by road. Pop. (1961) 10,019. It lies just off the Chilterns and in the days of coach travel was an important posting station on the London-Wycombe road and some of its coaching inns still survive. The four wide streets of the old town are bordered with early 17th-century houses; the new town is mainly residential, although there is furniture and machinery manufacture and a filtration plant. In the parish church Edmund Burke is buried and the poet Edmund Waller (lord of the manor in 1624), lies in the churchyard. G. K. Chesterton's grave is in the churchyard of St. Teresa of the Child Jesus. In the town there is the famous miniature village of Bekonscot built in a large rock garden with its own railway system and minster. Beaconsfield was adopted by Disraeli for his earl's title.

BEADLE, GEORGE WELLS (1903–), U.S. geneticist, co-winner of the 1958 Nobel prize for physiology and medicine and, from 1961, president of The University of Chicago, was born in Wahoo, Neb., on Oct. 22, 1903. He was educated at the University of Nebraska, Lincoln (B.S., 1926; M.S., 1927), and Cornell university, Ithaca, N.Y. (Ph.D., 1931). His Ph.D. thesis dealt with the genetics of maize.

In 1931 Beadle went to the California Institute of Technology, Pasadena, where, in the laboratory of T. H. Morgan (*q.v.*), he began work on *Drosophila melanogaster,* the small fly that the Morgan school had made into one of the classic organisms of genetic research. In 1935 he went to Paris where, with Boris Ephrussi, he initiated a study of gene action in *Drosophila* by means of organ transplantation techniques. Beadle and Ephrussi investigated certain inherited defects in the formation of the brown pigment of the eyes of *Drosophila* by this method and showed that the chemical steps in the synthesis of the pigment are under the control of specific genes. Beadle taught genetics at Harvard university for one year (1936–37) and then was made professor of biology at Stanford university, Stanford, Calif. (1937). In 1946 he became professor and chairman of the division of biology at the California Institute of Technology. He was elected chancellor and, after a faculty reorganization, president of The University of Chicago in 1961.

At Stanford, Beadle was joined in the *Drosophila* investigation by Edward Lawrie Tatum (*q.v.*). Technical difficulties inherent in the use of *Drosophila* for biochemical studies became apparent, however, and Beadle and Tatum cast about for another organism in which a biochemical approach to genetics could be effectively pursued. The red bread mold, *Neurospora crassa,* filled their requirements, and they began experiments on this organism. In 1941 they made the important discovery that the synthesis of vitamins and amino acids in *Neurospora* is under the control of the genes. This finding opened a rich field, the exploration of which brought to light much new knowledge about genes and biochemical processes. The basic fact that emerged from these studies was that the function of the genes in the cell is that of determining the synthesis of enzymes and other proteins. This principle found wide application in biology, including human genetics, and its revelation won for Beadle and Tatum (with Joshua Lederberg) the Nobel prize. (N. H. H.)

BEADLE (BEDEL or BEDELL), originally a subordinate officer of a court charged with the duty of securing the appearance of defendants at law suits. Now, seldom used, the word denotes a court crier, a minor parish officer or other person charged with purely ceremonial functions. *See* JUDICIARY AND COURT OFFICERS. (P. B. K.)

BEADS. From the earliest times beads have been worn by man either for ornament or for their magical properties. Among primitive peoples they were as much magical as decorative; hence great conservatism was observed in their shapes and materials. Through the value attached to beads as light articles of trade and as substitutes for coinage they bear useful witness to ancient trade and cultural contacts. (The word "bead" is derived from the Saxon *biddan* [German *bitten* "to pray"] because of its association with the rosary.) In prehistoric times beads were worn not only around the neck but around the hips, over the ears, threaded through the nose and even attached to the eyelashes. In Arab countries today, single blue talismanic beads are attached to domestic animals, children, brides and even automobiles to avert ill luck.

HISTORY

Stone Age.—The earliest beads probably were plant seeds, but by Acheulian times collars of sea shells and small fossils were bored for stringing, and from the Aurignacian and Magdalenian periods (*c.* 30,000 B.C.–10,000 B.C.) whole necklaces of pierced shells have survived, some of them carried long distances from the sea. Collars of pierced canine teeth of arctic foxes and of chamois and human teeth pierced for stringing also have been found.

A type of bilobed bead derived from the Paleolithic steatopygous Venus figurine was carved out of mammoth ivory and much worn in Siberian Paleolithic settlements. It was perhaps ancestral to a bone or stone bead of double-ax shape that was popular in the Neolithic period, especially in northern Europe, Britain and southern France. Spherical steatite beads became popular in Neolithic Switzerland (Cortaillod culture), and spread into western Europe. Beads of stone, bone and amber, pierced through their narrower ends, became common in the late Neolithic in Scandinavia and are found in Megalithic graves of western Europe, especially in Ireland.

Early Egypt.—The earliest Egyptian beads, dating from *c.* 4000 B.C., are made generally of stone, usually steatite, covered with a near-glass glaze; glass itself is not found until much later. In the predynastic period appeared beads of blue faïence, which continued essentially the same until Roman times. These beads have a core of quartz fragments cemented together by heat with a small admixture of lime; this core is covered with a thick glaze coloured blue with copper salts or purple and black with manganese. These faïence beads gradually were perfected until the 12th dynasty, the greatest period of Egyptian beadmaking. Glazed quartz beads, which appear in the predynastic period, continue until this dynasty. Other favourite materials were green feldspar, lapis lazuli (possibly from Persia), carnelian, turquoise and hematite;

amethyst also appears. These materials were made up into predominantly spherical, barrel-shaped and discoidal beads, but locust, falcon, crouching baboon, hippopotamus-head and conus shell shapes are well represented. It was during the 12th dynasty that collars of multiple strings of beads with plaque ends in the shape of lotuses or hawk heads began to be worn. Some of the beads were strung into these collars both laterally and vertically, so that spacer beads with multiple borings were needed to keep the strings in position. This development had a considerable influence on beadmaking outside Egypt. From the 19th to the 22nd dynasty, small oblate and cylindrical beads were made by the millions to cover mummies, and in some cases were worked into complete covers and funerary shirts of bead network. During this period and down to about 600 B.C., amuletic beads and pendants in various materials become popular. Beads in the form of a small double-handled pot, a hawk's claw and a human leg can be traced from the late 12th dynasty onward, but beads in the shape of poppy heads (often of carnelian) do not become common until the 18th.

Ancient Mesopotamia.—In the late 4th millennium B.C., a number of shapes were common to the Sumerian culture and the cultures of the Indus valley. Materials were lapis, carnelian, pearls, etc., which were shaped into ribbed spheres or "melons," or into barrel shapes of octagonal section. Biconical beads were made of carnelian and shorter, barrel-shaped beads were of carnelian and chalcedony, often decorated with a hatched white eye or with a check-board pattern. Chalcedony, carnelian and agate were favourite materials among the Sumerians and the later Babylonians, and the most elaborate set of beads to have survived from their territory is an early 2nd-millennium necklace from Uruk (Warka; biblical Erech) of banded agate with gold bindings and settings. These materials were introduced for beadmaking throughout the near east in the Persian period. Faïence also was used for beadmaking by the end of the 4th millennium B.C. at Ur and Kish.

Metal Beads.—In the Sumerian and Indus civilizations variously shaped gold beads were in use by the early 3rd millennium B.C. There were tubular, spherical and melon-shaped beads, but most distinctive was a tubular bead with two semicircular wings attached to each side as though in imitation of a plant seed. By 2000 B.C. a spherical bead like a nasturtium seed, with light flutings along the line of the piercing, was in use; it remained popular with the Babylonians and lasted into Assyrian times.

Elaborate gold beads shaped like cowrie shells produced during the Egyptian 12th dynasty were worn around the hips; others, from Dashur and Lahun, were shaped like flat double lion heads. These were sometimes mounted on necklaces with double-rhombic beads of a peculiar shape that is imitated by the earliest gold beads from Mochlos in Crete. Twelfth-dynasty beads from Byblos, on the coast of Lebanon, are shaped like the head of the goddess Hathor. Both there and in Egypt beads shaped like drops of liquid are found.

Similar to the double-rhomb beads are the gold beads from the famous treasure of the "second city" of Troy (*c.* 2000 B.C.) and contemporary gold beads from Poliochni on the island of Lemnos (Greece). At these two sites, however, and at Alaca Huyuk in Anatolia, there occur tubular gold beads with double coils of gold wire soldered on each side of the tube; this appears to be a central Anatolian design.

Meanwhile the Minoan and Mycenaean peoples of Crete and the Aegean developed gold beads of great originality and beauty in the shapes of polyps, lilies and lotuses, after motifs painted on Mycenaean and Minoan vases; copies of these exist in gray and green glass pressed into shaped molds. In addition there are a number of spherical Mycenaean gold beads with granulated patterns on them, and tubular beads built up entirely of granules. All these are more elaborate than anything found in 18th-dynasty Egypt, where there are few new shapes except for beads resembling flies, which also were known in Canaanite territory.

Faïence and Amber Beads.—Although faïence beads had been known in Egypt and Sumer and other parts of the ancient near east from the 4th millennium B.C., the faïence industry underwent a large technical expansion in the second half of the 2nd millennium, and a considerable number of beads were transported to Crete and Mycenae, thence finding their way to central and western Europe. Two major routes by which these trade beads could have traveled are now known: via the Danube and the Rhine rivers, or by sea to the south of France, down the Garonne river to the Atlantic coast. Large numbers of them are found in the rich Aunjetitz graves of central Moravia and of the contemporary Bronze Age culture in Wessex, Eng. There, as elsewhere in Europe, the beads are of a long, tubular, segmented type known from the 18th-dynasty Tell el-Amarna remains. Their mean date is 1400 B.C. and they provide a valuable chronological link between Early Bronze Age Europe and the Late Bronze Age Mediterranean cultures. Elaborately bored amber spacers found in Wessex, ancestral to spacers used in elaborate Bronze Age necklaces of Yorkshire jet, are of a type known at several Mycenaean sites.

Glass Beads.—Although glass was used in Egypt for beads in the 5th dynasty, true glass beads first became common in the near east in the second half of the 2nd millennium B.C. They were particularly popular during the 18th dynasty. They first appear in Europe in the Late Neolithic and Early Bronze Ages; a few spherical beads of plain opaque blue glass have been found in southern Spain, France, the Scilly Isles and Brittany. A green glass bead was found in a Megalithic chambered tomb at Loughcrew in Ireland. The origin of these beads is unknown.

Eye Beads.—Beads of opaque glass with impressed circlets of glass of a different colour came to Britain and western Europe in the Late Bronze Age. Their precise origin is unknown, but they probably were manufactured in the Mediterranean. There are four chief varieties: (1) spot eye beads, in which simple spots of coloured glass are stuck into a matrix of a different colour; (2) beads with small circlets, usually white, pressed into the surface of a spherical glass bead of (usually) blue glass; (3) stratified eye beads, in which a spot was pressed into the matrix bead, a second spot pressed into the first, and so on; (4) inserted cane eye beads, in which pieces of a glass cane or rod with the required pattern in it were broken off and pressed into the matrix. Types (1) to (3) are known from 1300 B.C. onward, and type (2) in particular is found in the Late Bronze Age graves of Europe, often accompanied by beads of a blue glass matrix with an encircling sinuous line of white glass pressed into it. Type (2) becomes commonest, however, in the 9th century B.C., particularly in the late Villanovan and early Etruscan graves of Italy. These varieties probably were introduced by oriental traders and later copied locally. A spherical blue glass bead with multiple impressed white circlets was manufactured in quantities on the Syrian coast and exported to Asia Minor, south Russia, Italy and southern Spain, with occasional examples reaching Brittany and Britain. Only this type is at present known to be an import and not a local manufacture. Large quantities of eye beads were manufactured in Phoenicia and Carthage, whence they were exported to Sardinia, Ibiza (Balearic Islands) and southern Spain. It is probably from this source that blue glass beads were introduced for trading to the natives of the west African coast.

Phoenician workshops at Carthage and in the Egyptian delta made fancy beads in the form of comic human faces and animal heads. These were made by fastening small spirals of molten glass onto a white or yellow glass matrix or by impressing coloured blobs to form the required design. Some of the Phoenician and deltaic beads are barrel-shaped with medial "eyes" of blue spots surrounded by white rings and terminal rows of blobs (matrix usually yellow glass and blobs blue). Beads of this type were current in Hallstatt Europe; oriental traders probably introduced them to the north of the Adriatic, where many local copies were made. Eye beads of essentially these techniques were made during Roman and Saxon times: often the Anglo-Saxon beads have a dull red matrix and yellow impressions or vice versa; these colours are never found in glass beads before the Roman period. There is a class of blue and red glass biconical beads with lines of white inlaid glass (found in southern France, Spain and occasionally in Britain) that appears to be Visigothic in origin.

The most elaborate cane beads of type (4) were manufactured in Syria, probably in the caravan cities of the interior, and have

sections of millefiori canes, *i.e.*, canes made of multiple coloured strands, embedded in a glass matrix usually red and of biconical shape. In the most attractive of these the cane patterns are made up into small human faces. They were manufactured until about the 8th century A.D., and are essentially the same in technique as the 7th–9th-century beads from viking graves, which are much larger and covered with elaborate checker patterns. These last are not generally found in graves of the same period in other parts of Europe, but specimens are known from a Crimean grave and from Syria.

American Beads.—Among the Indians of North and South America, a great quantity of stone and shell beads commonly were worn, the latter being either complete shells or shaped out of shells, but on the whole, except in the classical Inca civilizations of Peru, beads of fine stone are rather more rare. Some, of a curious shape that suggests a double ax, are mostly Peruvian, but there are elaborate Aztec and Inca beads of jadeite and other coloured stones in the shape of frogs, human skulls, etc., and a number of sites in Peru, Guiana and the Honduras have yielded elaborate tubular gold filigree beads.

Trade Beads.—Since the middle ages, beads have been used on an extensive scale for trade and barter. Explorers have at all times found them invaluable as gifts to primitive peoples, and during the 17th and 18th centuries this trade in beads was enormous. Their importance was well known to the Spanish conquistadors, and Renaissance glass beads manufactured in Venice are said to have been worn until recent times by primitive peoples of Brazil and the Amazon. (WM. C.)

BEADWORK

Beadwork is mostly either woven or sewn. In woven work the weft is threaded with beads before weaving in, and a loom should be used. It occurs in America in the form of braid, belts and aprons. The so-called "bias weave" of North America is technically plaiting, although it looks like weaving. Most beadwork, though sewn, closely resembles woven work; usually not more than one to five beads can be threaded at a time. Various types are: couched bead strings (lazy stitch); netlike mesh; designs sewn onto a fibre, fabric or skin base; or beadfabric made by stitching in rows of individually sewn beads.

Europe.—Beadwork as an extension of embroidery has been practised in Europe for many centuries. All kinds of articles may be decorated with embroidery and, when a particularly rich effect is desired, beads, bugles, seed pearls, sequins, pieces of mica, metal thread (often gold or silver gilt) and even small pieces of straw may be included in the decorative scheme. During the middle ages, when embroidery was regarded as an important art form, beads sometimes were used in the finest embroidered work. A notable example of this is provided by the magnificent Butler-Bowden cope (of English workmanship) in the Victoria and Albert museum, London, dating from about 1330. This had numerous details embellished with seed pearls and green beads, some of which still can be seen in the best-preserved part of the cope. Late medieval German embroideries often have details similarly worked with beads and seed pearls.

The term beadwork may be applied more correctly to certain small pictures showing heads of apostles and executed entirely with coloured beads stitched to a vellum backing, which also are preserved in the Victoria and Albert museum. These are believed to have come from Halberstadt cathedral, in Germany, and to date from the 13th century. Such work, although made with needle and thread, may owe its inspiration to the contemporary small-scale mosaics, the finest of which came from Byzantium.

During the Renaissance pearls and beads often were sewn in patterns on the clothing of those who could afford such luxuries. In England, a great deal of excellent embroidery was worked during the Elizabethan period. Purses and other small objects often were liberally and charmingly adorned with gilt thread, beads and seed pearls. By the third quarter of the 17th century, beadwork had become so popular in England that many articles—chiefly fancy boxes, small pictures, and a particular form of basket—were decorated all over with beads. In every other respect, these objects resemble the contemporary embroidery executed with coloured silks and gilt thread. Beadwork was not in great favour during the 18th century in England. Elsewhere in Europe beads sometimes were used to produce fantastic effects, as in the case of a vase and stand in the Victoria and Albert museum, standing about 4½ ft. high, the entire surface of which is embedded with coloured beads. Such freaks are related to the grottoes and follies of the period and have nothing to do with needlework. In southern Italy and Sicily a bold form of decoration with gilt thread and coral beads was produced, apparently in considerable quantity, during the 17th century and presumably later.

Beadwork again came into favour all over Europe during the 19th century. Every imaginable object in the house that could be decorated with embroidery frequently was, and beads often played a prominent part. As with all embroidery, the final effect much depended on the skill and taste of the embroiderer. Purses knitted with bead-threaded cotton were particularly popular shortly after 1800, and throughout the 19th century small articles such as gloves, mittens, belts, garters, stockings, parasol covers, etc., frequently were decorated with beads. At the same period a great many women's dresses were richly ornamented with beads of all kinds disposed in artful compositions. Beads were again a notable feature of dress decoration during the 1920s. (P. K. T.)

New World.—The simplest and earliest American Indian beadwork may have been a string made from bone, shell or seeds. The introduction of glass trade beads by Europeans between the 15th and 19th centuries stimulated more complex designs. The commonest beads were glass seed beads, about $\frac{1}{10}$ in. in diameter, sold by the string or by weight.

Among the North American Plains Indians beadwork designs originally were geometrical, similar to the old porcupine-quill or moose-hair embroidery, and were placed on skin clothing, bags, etc. In the 19th century, under French-Canadian influence, pastel-coloured or transparent beads were used as well as the original black, white and primary-coloured beads, and floral designs became popular. In South America aprons represent the best-known form of beadwork since the 19th century; the designs are geometrical. The Eskimos of Greenland and North America use beadwork to ornament thigh-boots and tunics; the women achieve a magnificent cape effect with mesh beadwork.

Africa.—In Africa beadwork is used to ornament ceremonial headdresses, leggings and bags and, among the Yoruba of Nigeria, in the making of human or animal figures on a cloth core. It is also used to cover calabash vessels (Nigeria, Cameroons, eastern and southern Africa); in the making of aprons (Angola and southern Africa), and in the covering of tribal masks (Cameroons and Congo). A notable example of west African beadwork is the regalia (headdress, tunic and flywhisk) of the *oba* (ruler) of Benin, which was made of red coral, carnelian or jasper. The Zulu of southern Africa formerly used beadwork motifs to convey love messages, while the beadwork collars, aprons, etc., of the Ndebele constitute a tourist attraction.

Asia.—Trade beads are used over most of southeast Asia, mainly as dress and weapon ornaments. Borneo beadwork, exceptionally, uses curvilinear zoomorphic ornament, mostly in black, yellow and red. Oceanic beadwork is simpler and, except in Melanesia, tends to rely on natural materials. (M. A. C.)

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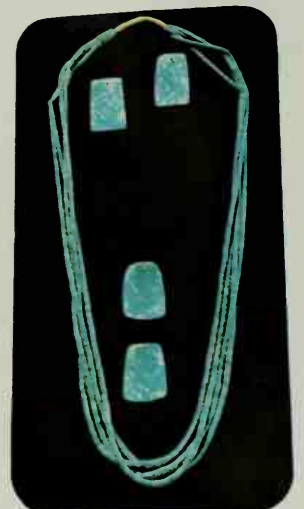
Collar of inlaid gold and faïence beads with hawk-head terminals (restored). Reign of Thutmose III, Tomb of Three Ladies, Thebes; Egyptian, 18th dynasty

Anglo-Saxon glass beads from Kent, Berkshire and Cambridgeshire

Necklace of about 200 gold beads and seven granulated pendants. Second millennium B.C.; Mesopotamian



Necklace and ear pendants consisting of 2,500 hand-drilled turquoise beads, North American Indian; c. A.D. 1000. Found in Chaco canyon near Pueblo Bonito, N.M.

Girdle and armlet of Princess Sat-Hathor-iunut; gold and varied beads, including carnelian and turquoise. From Lahun; Egyptian, 12th dynasty

String of glass beads with inlaid double eyes, 3rd–1st century B.C. Late Phoenician

ANCIENT BEADS

BY COURTESY OF (CENTRE RIGHT) NATIONAL GEOGRAPHIC SOCIETY, © NATIONAL GEOGRAPHIC SOCIETY, (TOP RIGHT) ASHMOLEAN MUSEUM, OXFORD, (OTHERS) THE METROPOLITAN MUSEUM OF ART, NEW YORK CITY. (TOP LEFT) FLETCHER FUND AND FUNDS FROM THE HUNTLEY BEQUEST, 1926. (CENTRE LEFT) FLETCHER FUND, 1947. (BOTTOM RIGHT) THE CESNOLA COLLECTION, PURCHASED BY SUBSCRIPTION, 1874–76. (BOTTOM LEFT) ROGERS FUND AND A CONTRIBUTION FROM HENRY WALTERS, 1916

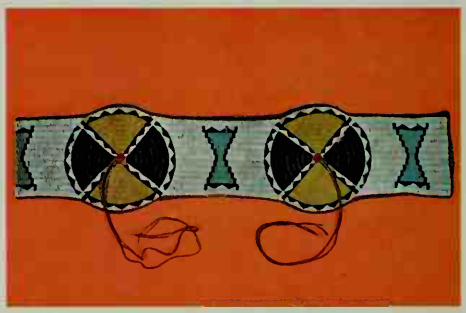
BEADS

Beadwork breast ornament. Length 18 in. Zulu people, South Africa

Apron of beads strung on leather thongs, the pendants ending in copper plates. Width 8½ in. North American Indian

Rattan carrying basket ornamented with beadwork. Height 22 in. Kayan people, Borneo

Beadwork belt. Length 31 in. M'Pongwe people, Gabon, Africa



Skin belt covered with beads in "lazy stitch." Width at roundels 7 in. North American Plains Indian

Sleeve end of black cloth embroidered with floral design in pastel-coloured beadwork showing French-Canadian influence. Width 9 in. North American Plains Indian

Basket or tray of beadwork inscribed "Sarah Gurnall, August 24 ANNO 1659"; now in the Victoria and Albert museum, London

BEADWORK

BY COURTESY OF (BOTTOM RIGHT) VICTORIA AND ALBERT MUSEUM; (OTHERS) THE TRUSTEES OF THE BRITISH MUSEUM; PHOTOGRAPHS, (ALL) FOR ENCYCLOPÆDIA BRITANNICA INC.; BY (BOTTOM RIGHT) E. H. CANNINGS; (OTHERS) JOHN R. FREEMAN & CO. LTD., LONDON

BEALE, DOROTHEA (1831–1906), English pioneer of secondary education for girls and principal of the Ladies' college, Cheltenham, was born in London on March 21, 1831. In 1848 she studied under F. D. Maurice at the newly opened Queen's College for Ladies, London, and in 1857 became head teacher of the school pilloried in Charlotte Brontë's *Jane Eyre* as "Lowood"—the Clergy Daughters' school at Casterton, Westmorland. She succeeded Miss Adelaide Procter as principal of the Ladies' college in 1858, at a critical time in its history. Under her management it developed rapidly.

As a witness before the Schools Inquiry commission in 1865, Miss Beale pleaded the cause of secondary education for girls, and, realizing the necessity for trained teachers for this purpose, she opened in 1885 the residential training college of St. Hilda, Cheltenham, followed in 1893 by St. Hilda's hall, Oxford, for women students. She was president of the Headmistresses' association from 1895 to 1897, and in 1898 established St. Hilda's East in London as a centre for social study and for the training of workers. Miss Beale died at Cheltenham on Nov. 9, 1906.

See Elizabeth Raikes, *Dorothea Beale of Cheltenham* (1908); Amy Key Clarke, *A History of the Cheltenham Ladies' College* (1953).
(S. J. C.)

BEAM, originally, a solid piece of timber, as a beam of a house, of a plow, a loom or a balance. In structural engineering a beam is a horizontal member spanning an opening and carrying a load. This load may be a brick or stone wall above the opening, in which case the beam is often called a lintel or a lintel beam. The load may be a floor or roof load in a building and then the beam is usually called a floor joist or a roof joist. In a bridge floor the lightly loaded beams are the stringers and the heavier ones are called floor beams. Large beams that carry the end reactions of other beams (perpendicular thereto) are usually called girders. Beams may be of stone, wood, steel or other metals, reinforced concrete, plastics and even brickwork with steel rods in the bond between bricks. For weight reduction, beams of metal are formed as an I or other shape having a thin vertical web and thicker horizontal flanges where the metal is most useful. *See* ARCHITECTURE: *Techniques.* (L. E. G.; X.)

BEAN, the seed or pod of certain leguminous plants, chiefly of the tribe Phaseoleae. Originally bean referred to the seed or pod of *Vicia faba,* an old world species called Windsor bean, broad bean and horse bean. All beans named in this article were grown for food in prehistoric times. They are seed-propagated as annuals.

The dry mature seeds of the principal beans used for food, except soybeans, are rather similar in composition although they differ widely in eating quality. Broad beans, common American beans (*Phaseolus vulgaris*), lima beans (*P. lunatus*), mung beans (*P. aureus*) and cowpeas (*Vigna sinensis*) contain from 21% to 25% protein, 58% to 64% carbohydrate and about 1½% fat. Soybeans (*Glycine soja*) are distinctive for their high protein, 35%, low carbohydrate, 35%, and high fat content, 18%. Both mature and immature seeds of most of these types of beans are eaten, as are the immature pods of a few. The bonavist, or hyacinth bean (*Dolichos lablab*) and the scarlet runner, or white runner bean (*P. coccineus*) are eaten in the immature stage but not commonly when mature.

The soybean (*q.v.*) is the world's most important bean. Of Chinese origin, it has been a major source of food and oil in China and Japan for thousands of years but was virtually unknown in Europe and America until 1900. In the orient many different food products long ago were developed from soybeans, including beverages, sauces and preparations superficially resembling milk and cheese. Most of the soybeans produced in the United States are made into oil and meal. The oil is used principally for food, although important quantities are used in paint, chemical and other industries. The meal is used mainly for animal feed but its use for human consumption and for industrial purposes is large and growing. More than 100 different products and uses are commercially important, ranging from adhesives and plastics to fire fighting foam and waterproofing preparations. The United States and China (with Manchuria) produce most of the world's supply.

The common bean of Central American and South American origin is the world's second most important bean. Unknown to the old world before Columbus, it is now grown the world over. It is called French bean, haricot bean and kidney bean in various countries; in the United States, however, kidney bean refers to a specific type that is definitely kidney-shaped and red, dark red or white. Some varieties are grown only for the dry seeds, some only for the edible immature pods, and others for the seeds, either immature or mature. Brazil, China and the United States produce more than half of the world's supply of this bean in the mature state.

The growth habit of most varieties of common bean is either an erect bush one to two and one-half feet tall or a climbing plant four to seven feet long, but a few important kinds are of intermediate form. Dwarf and semiclimbers are grown most extensively. When the climbing type is grown for its immature pods, artificial supports are necessary to facilitate harvesting. Varieties differ greatly in size, shape, colour and fibrousness or tenderness of the immature pods. In general, varieties grown for dry mature seeds produce pods that are too fibrous to be eaten at any state of development. Most edible-podded kinds produce relatively low yields of mature seeds or seeds that are of low eating quality. Seed colours range from white through green, yellow, tan, pink, red, brown and purple to black in solid colours and countless contrasting patterns. Seed shapes range from nearly spherical to flattened, elongated and kidney-shaped. Pods are of various shades of green, yellow, red and purple, and splashed with red or purple; pod shapes range from flat to round, smooth to irregular and straight to sharply curved; and length ranges from three to eight inches or more.

Common beans are frost-tender and most varieties are harmed by extremely hot weather. Varieties grown for the dry seeds are limited by weather and soil conditions to definite regions or districts within which they are grown profitably. Most edible-podded varieties can be grown over wide ranges of territory if they are planted at suitable times. The edible-podded varieties are popular in many countries, especially in Europe and the temperate zones of the Americas. In the United States the edible-podded bean is variously called snap bean, stringless bean and green bean. Most of the acreage and production involve varieties of the bush habit but the highest yields are obtained with Blue Lake beans, of climbing habit, in the Pacific northwest states.

The Windsor or broad bean is the world's third most important bean and is the principal bean of Europe although little known in the United States. The large-seeded form originated in the Mediterranean region and the small-seeded, possibly older, form originated in the middle-eastern region to the west of the Himalayas.

(LEFT) L. W. BROWNELL, (RIGHT) J. HORACE MCFARLAND CO.

(LEFT) COMMON BEANS (PHASEOLUS VULGARIS) AND (RIGHT) BUSH LIMA BEANS (P. LUNATUS)

China was the leading producer in the 1950s. The broad bean will not tolerate hot weather; it is grown in summer only in the cool parts of the temperate zones and during the winter in the warmer parts. Unlike other beans described, it tolerates slight freezing. The plant is erect, from two to five feet tall and bears few branches; the stem and branches are crowded with short-petioled leaves; the pods are nearly erect in clusters in the axils of the leaves; the seeds are large and irregularly flattened.

The lima bean, of Central American origin, is of commercial importance in few countries outside the Americas. From the origin the small-seeded forms evolved to the north and east, and the large-seeded form to the south. The Caribbean (eastern) type has a tendency to develop harmful quantities of hydrocyanic acid in the seeds under adverse conditions, but the small-seeded North American and large-seeded South American types do not show that tendency. Grown only for food, dry mature lima beans are produced in California. They constitute approximately one-tenth of the total dry bean production in the United States. About two-thirds of these are the standard lima, grown only for dry beans, and one-third the baby lima, also grown for its immature seeds.

Both bush and climbing forms of lima bean plant occur. There is a wide range of pod size and shape and in seed size, shape, thickness and colour. Pods are wide, flat and slightly curved. The seeds of most commercial varieties are white or pale green but a few have red or purple patterns. Countless seed shape and colour combinations occur. The lima bean is readily distinguished by the characteristic fine ridges in the seed coat that radiate from the "eye." The lima bean is a perennial in the tropics but is normally grown as an annual; it requires a longer season and warmer weather than most varieties of common American bean.

The cowpea, despite its name, is more akin to the beans named in this article than to the pea (*Pisum*). It is native to India; a very long-podded form (two to three feet) called asparagus bean is native to China. The dry seeds of the edible variety black-eye bean are marketed in the United States as a class of bean, causing confusion among those accustomed to calling them cowpeas. As grown in the southern United States, cowpeas are called peas, field peas or southern peas. They grow well only in warm climates.

The scarlet runner bean is native to tropical America. Naturally a perennial, it is grown to a small extent in temperate climates as an annual. It is a vigorous climbing plant with very showy racemes of scarlet flowers, large coarse pods and large, coloured seeds; it is one of the few plants that twines from right to left. A white-flowered, white-seeded form, the White Dutch runner was formerly grown to a small extent in the United States; the dry mature seeds were sold under the name of Oregon lima or butternut bean. Both scarlet and white forms are grown in Great Britain and Europe for the attractive flowers and the fleshy immature pods.

The mung bean is native to India. The pods and seeds are much the smallest of any of the beans named here. The pods are slender, 3 to 4 in. long, and contain 10 to 14 spherical to oblong seeds about $\frac{1}{8}$ in. in diameter. Extensively grown in the orient for food as bean sprouts and otherwise, the mung bean is little known in Europe and the Americas except for the preparation of sprouts.

The average annual harvested acreage and production of the several commercially important kinds of beans in the U.S. are approximately as follows: soybeans, 21,000,000 ac. and 465,000,000 bu.; common beans, dry, 1,425,000 ac. and 14,300,000 cwt.; snap beans for market, fresh, 40,000 ac. and 1,500,000 cwt.; snap beans for freezing, 33,000 ac. and 85,000 tons; snap beans for canning and other processing, 115,000 ac. and 250,000 tons; lima beans, dry, 122,000 ac. and 1,800,000 cwt.; lima beans for market, fresh, 15,000 ac. and 375,000 cwt.; lima beans for freezing, 65,000 ac. and 70,000 tons; lima beans for canning and other processing, 35,000 ac. and 30,000 tons; mung beans, 20,000 to 30,000 ac. and 75,000 cwt.; about 725,000 cwt. of dry black-eye beans (cowpeas) are produced annually.

The horse gram (*Dolichos biflorus*) and the bonavist bean, native to India, are related, large, tropical climbing plants, the immature seeds of which are commonly used for food in Asia. The dry seeds are large, dark to black, nearly round to slightly flattened and elongated, with distinctive and prominent hilum and raphe of contrasting white. *See* also special headings such as CALABAR BEAN; CAROB; SOYBEAN.

See W. W. Robbins, *Botany of Crop Plants,* 3rd ed. (1931); U. P. Hedrick, *Vegetables of New York,* vol. i, part ii (1928). (V. R. B.)

BEAR, any of the large mammals of the family Ursidae, order Carnivora. They are most closely related to the dog, raccoon and weasel families: the four families are grouped in the superfamily Canoidea. Bears have massive bodies and very short tails. Their ears are short and rounded and their five-toed feet have powerful, nonretractile claws by means of which nearly all the bears can climb at least fairly well. The fur is coarse and shaggy. In colour bears range from almost pure white to black; only a few kinds (for example, the Asiatic black bear) have conspicuous markings. In size they range from about 4 ft. long (the Malay bear) to more than 9 ft. (the giant grizzly of southwestern Alaska —especially Kodiak Island).

Natural History.—Bears walk with the forefeet turned slightly inward; they can run as fast as 30 miles per hour. They walk or run with their feet placed flat upon the ground. The run is a light, undulating gallop. All bears swim well, especially the polar bear. Most bears are omnivorous; the teeth indicate the varied diet, the molars being more of the crushing type than the shearing type typical of carnivores. Because of their addiction to sweets, bears are one of the few kinds of wild animals that suffer from tooth cavities. Bears have keen senses of smell and hearing but a less well developed sense of sight, the polar bear being an exception to the latter.

Bears are not true hibernators, but those that live in cold climates, except the polar bear, become fat with the onset of cold weather and spend most of the winter asleep, rousing at irregular intervals. When they emerge from the den in early spring, their intestinal tract is partially collapsed and they eat sparingly for a few days. The one to four young are usually born during the winter dormant period after a gestation period of six to eight months: they are blind and naked and usually weigh less than 1 lb. A cave, hole under a tree or a windfall of timber is used as the winter den. The polar bear, however, gives birth to its young in a cave in snow. Bears are solitary, the male and female separating after mating. The young are reared by the mother until they are more than half grown—in about two years. The mother is very protective of her cubs even against male animals and is likely to be dangerous to humans if the cubs seem to be threatened. Otherwise bears generally avoid humans. The grizzly and its close relatives seem more prone to attack without apparent provocation than other kinds, but even among grizzlies this is not common. In attacking large prey or fighting each other, bears strike with the forefeet, often from an erect position. A medium-sized bear is easily able to break the neck of an ox with a single blow. The jaws are used only secondarily.

Distribution and Classification.—Bears occur widely over the northern hemisphere and parts of South America but are being reduced in numbers because they often prey on domestic livestock and are much sought as trophies.

Of the 14 genera of the Ursidae, 6 are of living bears: *Ursus, Tremarctos, Selenarctos, Thalarctos, Helarctos* and *Melursus.* Eight other genera are known only as fossils from all the major land masses except Africa. The best known of the extinct species in *Ursus spelaeus,* the giant cave bear which occurred in central Europe and Asia contemporaneously with early man during the Ice Age. It was larger than any living species. Bears of the genus *Ursavus* are first known as fossils from the Middle Miocene deposits of Europe (about 20,000,000 years ago).

American Black and Brown Bears.—The commonest bear of temperate North America is the black bear, *Ursus americanus* and its relatives. In eastern North America it is almost invariably black. In the west it may be black, brown or cinnamon, cubs of different colours occurring in the same litter. More than 85 "species" of this bear have been described but all are probably no more than subspecies (varieties; geographic races) of the one species *Ursus americanus.*

The American black bear (brown bear, cinnamon bear, according

to the colour phase) has been known in historic times to occur from northern Alaska almost to central Mexico. It is now gone from most of this region, being found mainly in wilderness areas. It is a forest dweller and in the wild, like its Eurasian counterpart, *U. arctos*, is shy and retiring; but in national parks and similar areas, where it is protected and in constant contact with humans, it loses its timidity and often becomes a nuisance. It appears to be tame but in fact remains a powerful and potentially dangerous wild animal. Its food consists of a wide variety of small and large animals (including occasional domestic livestock), berries and fish. It evinces a marked predilection for cured meats and sweets, to the dismay of campers. It hunts larger prey by stalking and then making a quick charge. In seeking smaller animals it digs out their burrows, overturns rocks and tears apart rotten logs. Except in the mating season, in early summer, the adults live apart. The affectionate courtship, during which the mates often fondly caress each other, lasts a month and a female breeds every second year.

Grizzly Bears.—The huge, long-clawed grizzly bear (*Ursus horribilis* and its relatives) is quite different. Primarily a denizen of open country, it is notoriously fierce and untractable, and cannot tolerate the presence of humans. More than 90 "species" have been described but their validity is doubtful. All bears show great individual variation and this is especially so among the grizzlies. Owing to the lack of specimens the classification of the grizzly bears probably can never be solved satisfactorily: Some of the better known bears of the grizzly group are the giant "brownies" of southwestern Alaska, the southern grizzly, the plains grizzly and the Canadian grizzly. The largest living land carnivore is a variety of grizzly from Kodiak Island; this bear may attain a length of more than 9 ft. and a weight in excess of 1,500 lb.

In the month-long mating season, the males fight for a female's favour, the defeated animal usually being driven away rather than killed. Because of its size, ferocity and the remoteness of its habitat the grizzly is considered by sportsmen to be one of the most desirable of big game trophies. For the same reasons it is the subject of many of the North American Indians' legends, and in some primitive religions is accorded the role of a deity, usually an avenging or malevolent one. To kill a grizzly was a mark of manhood to early American Indians, who wore bear-claw necklaces with pride.

Eurasian Brown Bear.—The brown bear of Eurasia (*Ursus arctos*) is found over the temperate region of the northern hemisphere from Spain to islands off the Alaskan coast, and in Japan and the Kurile Islands. It is variable in size. The European variety measures 4–5 ft. long and weighs about 300 lb. The race from eastern Siberia is almost as large as the largest of the grizzly group from Alaska. In colour the old world brown bear varies from almost yellowish through brown to black. Although individually variable, certain colour phases are more common in certain regions.

Ursus arctos is commonly found in zoos. It can be trained and becomes quite tractable. Formerly it was frequently trained to move rhythmically to music—the so-called "dancing bear" common in carnivals and festivals in European cities. Varieties of this species are the "blue bears" of Tibet and Kansu province, China; the Manchurian, or Mongolian, black bear; the huge Siberian brown bear; and the Japanese brown bear.

H. ARMSTRONG ROBERTS

POLAR BEAR (THALARCTOS MARITIMUS)

Himalayan Bear.—The Asiatic black bear (*Selenarctos thibetanus*)—also called Himalayan, Tibetan, or moon, bear—is found from northern China and Manchuria south into Burma and the Himalayas, also in Japan and Formosa. This species is the size of the American black bear, which it resembles in colour except for a conspicuous inverted V-shaped whitish blaze on the chest. It weighs about 250 lb. The hair of the neck and shoulders is especially coarse and long, forming a mane. Gestation requires six months; usually two cubs are born.

W. SUSCHITZKY

MALAY BEAR OR SUN BEAR (HELARCTOS)

Malay Bear.—The Malay bear (*Helarctos malayensis*)—also called sun bear, or bruang—is small, measuring about 3½ ft. long and weighing about 100 lb. It is found in the Malay peninsula and in Sumatra and Borneo. It is black with a gray-tan muzzle. The hair is prominently whorled on each side of the chest and on the shoulders. The head is short and flat; the ears very small; and the teeth often reduced in number.

Sloth Bear.—The sloth, or honey, bear (*Melursus ursinus*) is about 5 ft. long and weighs about 230 lb. The fur is long, coarse and black except for a pale-coloured blaze, or splash, on the chest. Although most bears have somewhat protrusible lips, this characteristic is especially pronounced in the sloth bear. These animals are found in India, Assam and Ceylon, inhabiting rocky places in jungles. Seemingly they prefer a more vegetarian diet than other bears, but relish insects, especially termites.

Spectacled Bear.—The spectacled bear (*Tremarctos ornatus*) lives in the Andes from southern Venezuela to northern Chile. It is about 4 ft. long. The body is black or almost so. Usually a narrow white stripe passes on each side of the muzzle from behind the eye forward nearly to the bridge of the nose, then downward across the cheek to the throat and backward to the chest. It is this feature that gives the animal its common name. *Tremarctos* has never been common in historic times and is now rare. Curiously, in some parts of its geographic range it seems to prefer the most arid, cactus-covered areas; elsewhere it inhabits the dense forest. It lives mainly on vegetation including fruit, nuts and tender palm buds.

Polar Bear.—The polar bear (*Thalarctos maritimus*)—also called white, or ice, bear—is a denizen of the circumpolar Arctic. Almost as large as the giant brown bears, it is slenderer in build and has, for a bear, a rather long, flexible neck. It lives on the ice floes of the open ocean—many individuals probably never come to land. The soles of the feet are heavily insulated with fur. The polar bear is solitary and a wanderer, traveling great distances in search of food. Its diet consists mainly of seals but it also feeds on fish, birds, young walruses and an occasional stranded whale. Polar bears swim very well and are often found many miles from land or ice packs. Sometimes they follow migrating seals southward as far as the Gulf of St. Lawrence in America and the mouth of the Amur river in Asia. Mating takes place in alternate summers. Two two-pound cubs are born in mid-winter. The mother and cubs emerge from the den in March and the cubs stay with the mother for about 17 months. Polar bears are usually shy, but are dangerous when attacked. They are much sought as trophies. Although the flesh is tasty, the liver, because of its extremely high concentration of vitamin A, may prove toxic. The hide is an important source of clothing to Eskimos.

See also Index references under "Bear" in the Index volume.

(K. R. Kn.)

BEARBAITING and a similar sport, bullbaiting, were popular for hundreds of years in England but were permanently outlawed by act of parliament in 1835 because of their cruelty. The exhibitions took place usually on Sunday at theatrelike arenas popularly called bear gardens. There crowds of all classes gathered

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BEARBAITING IN THE 14TH CENTURY. FROM THE LOUTERELL PSALTER

to delight in the bloody spectacle of a bear or bull chained by the leg or neck to a stake and harassed by dogs.

Many large groups of bears were kept expressly for the purpose. For a baiting attended by Queen Elizabeth I in 1575, 13 bears were provided. Of it Robert Laneham (*c.* 1575) wrote that it was "very pleasant to see," especially "the nimbleness and wait of the dog to take his advantage"; and the bear, tearing himself free, shaking his ears "with the blood and the slaver hanging about his physiognomy."

When a bull was baited, often its nose was blown full of pepper to further arouse it. Specially trained dogs might be loosed singly, each attempting to seize the tethered animal's nose. Often a hole in the ground was provided, into which the bull might thrust this vulnerable part. A successful dog was said to have pinned the bull.

Many variations, usually refinements of brutality, stemmed from traditional baiting procedures: the whipping of a blinded bear; the baiting of a pony with an ape tied to its back. A Spanish nobleman entertained by the latter said "to see the animal kicking amongst the dogs, with the screaming of the ape, beholding the curs hanging from the ears and neck of the pony, is very laughable." Dogfighting and cockfighting were companion diversions.

A sport called bull-running also developed in some towns as an annual affair. Butchers provided the bull, and the townspeople, armed with clubs, chased it until all were exhausted, when the bull was killed.

Baiting and its variations declined, although very slowly, from the late 17th century onward. The conscience of cultivated people seems finally to have been touched. The Puritans agitated for an end to animal baiting. Allied activities had scattered revivals in the U.S. frontier; for example, fighting dogs were matched against badgers; a chained bull in an arena was matched against a grizzly bear. The battle ended, in each case, when one killed the other. (These and similar diversions are described in H. McCracken, *The Beast That Walks Like Man* [1955].) Prohibitive legislation followed the progress of civilization; as U.S. frontiers disappeared, so did such brutal pastimes. (B. W. Da.)

BEARBERRY (*Arctostaphylos uva-ursi*), a prostrate evergreen shrub of the heath family (Ericaceae) native to dry, sandy or rocky soil and widely distributed in high northern regions. In North America it is found on rocks and bare hills from Labrador and Alaska south to Virginia, Colorado and California; in the British Isles it grows on stony alpine heaths. The trailing, much branched stems, often somewhat matted on the ground, bear leathery, entire leaves, small heathlike white flowers and smooth, red, insipid, berrylike fruits (drupes) about a third of an inch in diameter. It is one of the finest evergreen ground covers found in the native flora, brilliantly green in summer and bronzy in winter. It is difficult to grow unless started from rooted cuttings in peaty, acid sand. It can be dug from the wild only by taking frozen clumps in midwinter. The alpine bearberry (*A. alpina*), a smaller depressed-prostrate shrub with veiny, toothed leaves, withering in winter but persistent, and black, juicy, edible fruit, grows from arctic America south in high altitudes to British Columbia, Colorado and northern New England and on high mountain heaths in the British Isles. *See* also Manzanita.

(N. Tr.)

BEARD, CHARLES AUSTIN (1874–1948), U.S. historian, political scientist and educator, was born near Knightstown, Ind., on Nov. 27, 1874. His father was a landowner and prosperous businessman. After graduation from DePauw university, Greencastle, Ind., in 1898 Beard spent four years abroad, chiefly in England. He received the Ph.D. degree in 1904 from Columbia university, and served with great distinction as a member of the faculty there from 1907 to 1917, resigning in protest against what he considered an infringement of academic freedom. For several years, beginning in 1917, he was director of the Training School for Public Service in New York. His teaching was characterized by understanding, tolerance and realism.

Beard was one of the intellectual leaders of the progressive era, 1900–17, and of American liberalism; he was also a leader in movements for improvement in municipal government and administration and in national planning. He wrote voluminously in several fields and served at different times as president of the American Historical association and the American Political Science association.

His early interest was in European history as is indicated by such works as *The Office of Justice of the Peace in England* (1904), and (with J. H. Robinson) *The Development of Modern Europe* (1907). The latter work emphasized the "new" history, stressing economic and social forces, and the development of ideas. *The Economic Basis of Politics* (1922, 1945), indicated the close relationship between economic forces and political action. He wrote several successful textbooks in the fields of history and political science. His works in the American field stimulated thought and aroused prolonged controversy. Several of the basic factors in the formative period of U.S. government are brilliantly analyzed in *The Supreme Court and the Constitution* (1912), *An Economic Interpretation of the Constitution of the United States* (1913) and *The Economic Origins of Jeffersonian Democracy* (1915). He was not an economic determinist, but insisted upon the importance of economic groups and motives in political and governmental action. In later life he gave more attention to noneconomic forces and to the power of the military establishment in determining public policy. He and his wife, Mary R. Beard, produced in four volumes a monumental synthesis of the U.S. entitled *The Rise of American Civilization*, two volumes (1927), *America in Midpassage* (1939) and *The American Spirit* (1942). The position of the American citizen in relation to his government is discussed in *The Republic* (1943).

In the 1930s and 1940s Beard's interests turned to the history and problems of U.S. foreign policy. He collaborated with G. H. E. Smith to write *The Idea of National Interest* (1934) and *The Open Door at Home* (1934). Beard supported the entrance of the U.S. into World War I but was disillusioned by its aftermath. He profoundly distrusted the foreign policies of F. D. Roosevelt whom he regarded as untrustworthy and irresponsible. In two books, *American Foreign Policy in the Making, 1932–1940* (1946) and *President Roosevelt and the Coming of the War 1941* (1948), he charged Roosevelt with mendaciously undermining U.S. constitutional government. He was criticized as an isolationist but was generally recognized as one of the great figures of American scholarship.

Beard died on Sept. 1, 1948. (T. S. By.)

BEARD, DANIEL CARTER (1850–1941), a pioneer leader of the Boy Scouts of America, was born in Cincinnati, O., June 21, 1850. Because of his interest in outdoor life he wrote *American Boys' Handy Book* in 1882 and later organized the Sons of Daniel Boone. After Robert Baden-Powell founded the Boy Scout movement in England and the U.S. branch was incorporated in 1910 as the Boy Scouts of America, the Sons of Daniel Boone joined with the Boys Scouts of America and Dan Beard became a national officer. A talented painter and illustrator, he was the author of about 20 books for boys on various aspects of scouting and served as an associate editor of *Boys' Life* magazine. He died at Suffern, N.Y., on June 11, 1941. (L. R. Lu.)

BEARD, in modern usage, refers to the hair grown upon a man's

chin and cheek; "mustache" or "moustache," singular or plural, refers to the hair on the upper lip. The term whiskers has been used to refer to a mustache or beard or both, or to what hair remains on a shaven face; "whisker" refers to a single facial hair. In the past the words have had less exact meaning. Beard has stood for all these things, and whisker signified what is now called mustache. "Mustache" sometimes referred to a hanging curl on the side of the head.

The bearded races of mankind have commonly held the beard in high honour. It is the sign of full manhood; the lad or the eunuch is beardless, and the bearded woman is reckoned a witch. The future King John gave deadly offense to the chieftains when visiting Ireland in 1185, by plucking at their flowing beards. The oath on the beard is as old as history, as when a man swears "by his chin." Adam, the primal man, and the deity and prophets of many faiths have been traditionally pictured with beards, as were kings and nobles and dignitaries. Beards have assumed all shapes and lengths, some being cultivated to lengths exceeding a man's height. Islamic peoples still hold the beard in high esteem.

The earliest records indicate that the Egyptians grew hair on their chins. They frizzed, dyed or hennaed, and sometimes plaited this beard with interwoven gold thread. Later, a metal, false beard or *postiche,* which was a sign of sovereignty, was worn by queens as well as kings. This was held in place by a ribbon tied over the head and attached to a gold chin strap, a fashion existing from about 3000 B.C. to 1580 B.C.

The Mesopotamian civilizations (Chaldean, Babylonian, Assyrian, Median and ancient Persian) devoted great care to oiling and dressing their beards, using tongs or curling irons to create elaborate ringlets and frizzles, in a tiered effect. Assyrians resorted to a black dye for eyebrows, hair and beard, while the Persians used henna which produced an orange-red colour, a style which existed from 1900 B.C. Gold dust, gold thread and scented yellow starch were sometimes used in the hair and beard for festive occasions. In ancient India and Turkey, the beard was allowed to grow long, a symbol of dignity and wisdom. To cut the beard was infamy among the Turks; slaves were shaved as a mark of servility.

Patriarchs of the tribes of Israel grew luxuriant beards embellished by a hanging earlock (*peyot*); the *peyot* is still worn by some very pious orthodox Jews. Beards predominated among the Greeks until 323 B.C., at which time Alexander the Great ordered his soldiers clean shaven, fearing their beards might serve as handles to the enemy. Grecian beards were frequently curled with tongs to create hanging curls. The Etruscans of northern Italy (*c.* 1000 B.C.) favoured the Asian fashion of the long beard, which was eventually handed on to the Romans. The Romans frowned on the curled beard of the Greeks, feeling that it was effeminate, and preferred a trim, well-groomed shape. The use of the razor was encouraged in Rome by Lucius Tarquinius Priscus (616–578 B.C.), in an effort toward hygienic reform. However, shaving did not become general until about 454 B.C., when a group of Greek Sicilian barbers came to the mainland from Sicily. Barber shops were situated on the main streets, but were patronized only by those who could not afford slaves. Scipio Africanus, according to Pliny, was the first Roman to shave daily. Philosophers, however, still retained their beards. A beard at this time also signified mourning. The ancient Celts, as described by Polybius, wore extremely long mustaches but otherwise were clean shaven, as were the Britons observed by Julius Caesar. The Byzantine civilization favoured beards and mustaches, and the hair moderately short, a combination of oriental and Roman origin, which later influenced medieval and Renaissance Europe. From the 7th to 16th centuries, the beards of Byzantium were curled, split on the centre of the chin, square cut or pointed and some were extremely long. By the end of the 12th century, the Greek, Roman and oriental influences disappeared, and the cities of Florence and Venice began to set the mode for the courts of Europe.

Until the advent of Christianity in the 7th century, all Anglo-Saxons wore beards; members of the clergy were then compelled by law to shave. English princes wore mustaches until William I (1066–87) compelled them to cut them off in accordance with the Norman fashion. The Crusades were perhaps accountable for the

BEARDS FROM 3000 B.C. TO THE 19TH CENTURY

(A) Egyptian *postiche* or false beard, 3000 to 1580 B.C.; (B) Mesopotamian, *c.* 1917 B.C.; (C) Jewish patriarchal; (D) Grecian curled, 323 B.C.; (E) Roman, *c.* 234 B.C.; (F) Saracenic or Moorish, 7th to 16th century; (G) English, Henry VIII (1535); (H) Vandyke, 17th century; (I) French and Dutch "la mouche," 17th century; (J) Napoleonic "imperial," 19th century; (K) Austrian "Franz Josef," 19th century; (L) "mutton chop" side whiskers, 19th century; (M) "slugger," "neck warmer" or "chin curtain," 19th century; (N) mustache and sideburns, late 19th century; (O) Indian Sikh rolled beard

return of beards, and for more than four centuries great diversity was allowed: beards, mustaches and shaven faces all were found. Of the English kings, Henry II (1154–89) was close shaven; Henry III (1216–72) was long bearded; Edward II (1307–27) curled his beard in three ringlets; Edward III (1327–77) had a long forked beard which flowed in patriarchal style; Richard II (1377–99) wore a little tuft on each side of his chin; Henry IV (1399–1413) wore two curled locks on his chin. The mid-13th and 14th centuries were a period of many shapes and varieties of beards. Henry V (1413–22) was clean shaven and thereafter beards were rare, except in older men, until the 16th century.

The Renaissance fashion in Europe included both clean-shaven faces and beards varying in shape and length. In the middle of the 16th century the Spanish style of cropped pointed beard and trimmed mustache took over. Many men starched their beards in the 1560s. In England Henry VIII (1509–47) brought the beard back into favour in 1535, after which beards of all shapes and lengths were worn. The Flemish painter Sir Anthony Vandyke (1599–1641) painted so many aristocrats with a pointed type of beard that it became known as the Vandyke beard. They were dressed with pomade or wax, applied with a tiny brush and comb. Other gadgets were used to keep the mustache and beard in shape while sleeping. In 1637, Louis XIII triumphed over the Spanish influence when he amused himself by shaving his courtiers, leaving only a tiny lip beard "à la royale" or "la mouche," a custom adopted by the French and Dutch cavaliers. This vogue led to the creation of the Corporation of Barber-Hairdressers. In the 1640s and 1650s Frenchmen were typically clean-shaven. The mustache when it was worn became so diminutive that its later disappearance was hardly noticed.

Peter the Great of Russia in 1705 proclaimed: "The beard is a useless embarrassment"; he ordered them cut off and levied a tax on those who refused to comply. The empress Catherine later repealed the law.

With the adoption of the powdered wig in 18th-century Europe, the facial growth once again disappeared, and it was not until the 1800s that it returned. In the early part of the 18th century Americans showed a general preference for English fashion but from 1760 until 1780, French fashion was also followed, the tendency of both being toward the clean-shaven face. The French military from 1800 to 1806 wore mustaches, as did the Prussian guard. Hussars affected a distinct, ferocious mustache with long drooping ends. Small side whiskers became the order for the British army in 1808 and lasted until 1860.

During the Victorian period, from about 1840 to 1870, London set the fashion for the world. Side whiskers attained a longer, more luxuriant growth and were sometimes referred to as "mutton chops" or "Piccadilly weepers." In the United States they were called "dundrearys" after Lord Dundreary, a character in the play *Our American Cousin*. The name "burnsides" or "sideburns" came from the name of the U.S. Civil War general, Ambrose Burnside. The "imperial," a pointed tuft of whiskers on the chin, was named in honour of Napoleon III. Long side whiskers merging into a mustache became known as the "Franz Josef" in honour of the emperor of Austria. In the 1880s the trend was toward the clean-shaven, although beards and mustaches were retained by older and professional men. In the British army the "walrus" mustache became popular; it was forbidden to shave the upper lip. In the U.S., a mustache that curled upward at the ends, called a "handle bar," found great favour. Professional men favoured the Vandyke. Eventually, whiskers became a distinguishing mark of butlers and footmen, who wore them into the 20th century. Small mustaches were generally popular until the 1920s, although many continued to wear them after that.

Beards became popular among the British troops serving in South Africa early in the 20th century and again among the men on desert patrols during World War II. British naval personnel were allowed to wear mustaches or beards; only mustaches were permitted in the marines. United States army regulations, corrected to 1917, stated that hair must be kept short and the beard must be neatly trimmed. In the second half of the 20th century there was a renewed interest in chin whiskers, though they were worn only by a small minority of men.

In the far east many ancient traditions continued to be practised. Indian Sikhs let their hair and beards grow long. The beard is twisted and rolled tightly to the chin; the ends are tied over the head. The Japanese, having broken with their ancient custom of shaving, often wear short beards or mustaches.

See Ruth Turner Wilcox, *Mode in Hats and Headdress* (1945).

(W. J. T.)

BEARDSLEY, AUBREY VINCENT (1872–1898), English artist in black and white, whose ornate style typified *fin de siècle* English arts and letters, was born at Brighton on Aug. 24, 1872. In 1883 his family settled in London, and in the following year he appeared in public as an "infant musical phenomenon." In 1888 he obtained a position in an architect's office. In 1891, under the advice of Sir Edward Burne-Jones and Puvis de Chavannes, he took up art as a profession and attended classes at the Westminster School of Art. From 1893 until his death, at Menton, France, on March 16, 1898, his work met with a storm of criticism. Beardsley had an unswerving tendency toward the fantastic; he deliberately ignored proportion and perspective, and the freedom from convention which he displayed caused his work to be judged with harshness. In certain phases of technique he excelled, and his earlier methods of dealing with the single line in conjunction with masses of black are in their way unsurpassed, except in the art of Japan. He was always an ornamentalist rather than an illustrator; his work must be judged from that point of view. His frontispiece to *Volpone* is held by some to be, from this purely technical standpoint, one of the best pen drawings of the age. His posters for the Avenue theatre and for T. Fisher Unwin were among the first of the modern cult of poster art, then regarded by few as true art.

BY COURTESY OF FOGG ART MUSEUM, HARVARD UNIVERSITY, GRENVILLE L. WINTHROP BEQUEST

"THE PEACOCK SKIRT" FOR SALOMÉ BY AUBREY BEARDSLEY, 1894

The following are the chief works which are illustrated with drawings by Beardsley: the *Bon Mot Library; The Pall Mall Budget; The Studio* (1893); Sir Thomas Malory's *Morte d'Arthur* (1893–94); Oscar Wilde's *Salomé* (1894); *The Yellow Book* (1894–95); *The Savoy Magazine* (1896); *The Rape of the Lock* (1896); and *Volpone* (1898).

See A. Symons, *Aubrey Beardsley* (1898; new ed., 1949); A. E. Gallatin, *Aubrey Beardsley; a Catalogue of Drawings and Bibliography* (1945); R. A. Walker (ed.), *Best of Beardsley* (1948).

BEARER SECURITIES, one of the forms in which stocks and shares can be held by the proprietor. The bond to bearer is a document stating upon its face that the bearer of it is entitled to a specified amount of stock in the loan, debenture, share or other security which that bond represents; bearer securities are not registered and full title is transferred merely by delivery of the document. The instrument may be for a British government stock, such as a consol or war loan; for foreign government loans; for shares in a rubber, oil, mining or other such company. The interest or dividend payments are met by the provision of coupons which are small pieces of paper, numbered and, as a rule, dated, which must be presented to named bankers when the payments become due, and which, after a few days for examination, will be exchanged for checks in payment of interest or dividend due on the bearer's holdings.

Bearer securities are regarded as being more liable to loss than are registered or inscribed stocks and shares, for the latter must be dealt with by a deed of transfer, involving signatures and witnesses, whereas bearer securities can be passed from hand to hand like a bank note. Generally speaking, British investors prefer registered or inscribed stocks and shares, but French, Belgian and other European investors often prefer bearer securities.

In the United States a combination of bearer-and-registered security is common. While the bonds of U.S. railroads are generally bearer securities, for example, the share capital is represented often by certificates made out in the name of an individual or a firm who, when selling, will sign the certificates on the back and pass them on to buyers who frequently treat the certificates as bearer securities, leaving the stock or share in the names of the original holders as stated on the face of the certificate. The certificates pass from hand to hand in the same way as a bearer security, although any holder can have the stock registered, if he desires it, in his own or another name. Dividends, as they fall due, are claimed and collected by the holder at the time the payments fall due: if the registered proprietor does not want to be troubled with such claims, he merely gives notice of his desire, and the actual proprietor will then put the shares into his own or some other name. Various companies issue registered bonds, but these securities are not to bearer. The risk of loss entailed by the holding of a bearer security is the reason why many proprietors deposit such bonds with their bankers, who will detach coupons when they fall due, present them for payment to the proper agents and credit the interest or dividend to the proprietors' bank accounts.

BEAR GRASS (*Xerophyllum tenax*), a North American plant of the lily family (Liliaceae), called also elk grass, squaw grass, fire lily and turkey beard, native to mountainous districts from northern California to British Columbia and eastward to Montana. It is a smooth light-green perennial with a stout, unbranched stem, from two to six feet high, which rises from a woody, tuberlike rootstock with cordlike roots. At the base the stem bears a dense tuft of very narrow, grasslike, rough-edged leaves, from one-half to one-fourth inch wide and from two to three feet long; the leaves of the upper part of the stem are similar but much smaller. At flowering, which occurs only once in from five to seven years, the top of the stem develops a large showy cluster, 6 in. to 18 in. long, of very numerous small creamy white flowers, each on a slender stock 1 in. to 2 in. long. In many parts of its range the plant is very common on dry hillsides. When in bloom it is a striking feature of the vegetation of mountain slopes. Because of its attractive appearance it is a favourite with tourists who visit alpine resorts within its range, being especially abundant in Mt. Rainier and Glacier National parks. Hupas and other northwestern Indians used the fibres of the leaves in making garments and baskets and roasted the bulbous rootstocks for food. The turkey beard (*X. asphodeloides*) of the southern United States, found in dry pine barrens from New Jersey to Florida, is similar but with less showy flowers.

In the southern and southwestern United States the name bear grass is given to various kinds of yucca, especially to *Yucca filamentosa* and *Y. glauca;* also to the camas (*Camassia scilloides*) and the aloelike *Dasylirion texanum,* all of which have grasslike leaves.

BEARING METALS. In a theoretically perfect bearing the load should be carried on a film of oil between the axle and bearing, and the nature of the bearing metal should therefore be immaterial.

In actual practice, however, such perfection is not attained and it becomes necessary to select a metal which will minimize as far as possible the inevitable mechanical errors of adjustment and alignment. The properties which a good bearing metal should possess are, first, a low coefficient of friction and, secondly, sufficient plasticity to allow the axle to bed down combined with sufficient compressive strength to carry the total load.

The selection of a bearing metal depends on the various requirements of the application (*see* BEARINGS).

PROPERTIES REQUIRED IN BEARING METALS

Antiseizure Properties.—This quality, the resistance of the surfaces to weld together when they are in rubbing contact, is always desirable in bearing metals and can be most important. If the surfaces were always separated by a fluid film, there never would be metal-to-metal contact. But starting, stopping, deflections of shaft and housing, heavy loads and poor lubrication require varying antiseizure properties. Formerly it was believed that a bearing metal required two constituents, namely hard particles in a soft matrix. Experience has disproved this theory through the effective use of pure soft metals (tin, lead and cadmium) and compositions of soft particles in a hard matrix (copper-lead and certain bronzes).

In general, the order of decreasing antiseizure quality is: white metals (tin, lead and cadmium alloys), copper-lead, aluminum alloys, silver, leaded bronzes and bronzes.

Compressive Strength.—This is important when unidirectional loads are supported. To prevent extrusion, the metal must have sufficient strength to support the load. For white metals the strength is increased by reducing operating temperatures whereas harder materials are relatively unaffected. The effective strength of white metals and copper-lead compositions can be increased by reducing their thickness and by bonding them to a strong backing shell of steel.

The strength of white metals can be increased by alloying metals which develop hard particles; the wear resistance is also improved. The order of increasing compressive strength is: white metals, copper-lead, thin babbitt overlays, aluminum alloys, silver, leaded bronzes and bronzes.

Fatigue Strength.—This is necessary for bearings subjected to dynamic loads as obtained in crankshaft bearings. If the allowable load is exceeded, cracks develop and loosen small areas of metal. These areas, or "tiles," increase in number until insufficient surface remains to carry the load, and a burned-out bearing occurs. The effective fatigue strength of white metals, copper-lead and aluminum alloys can be highly improved by bonding thin layers to a steel back.

For example, the fatigue life of babbitt can be increased six fold by a reduction in babbitt thickness from 0.016 in. to 0.003 in. White metals are extremely sensitive to temperature; a 40° F. rise can halve the fatigue life. The order of increasing fatigue strength is the same as for compressive strength.

Corrosion Resistance.—Resistance of the bearing metal against attack by the lubricating oil can be necessary. In such problems it is necessary to consider (1) the lubricant; and (2) the metal. If the oil becomes acid by oxidation (a time and temperature effect accelerated by metal catalysis) or if organic acids are deliberately added (such as lard oil to increase "oiliness"), the liquid may attack lead, cadmium and copper.

Modern oils for environments where undesirable oxidation may occur are inhibited by chemical additives against acid formation. Active sulfur compounds can be another source of corrosion. These are present either naturally or as chemical additives and may attack copper or silver. These corrosive actions can range from mild to extremely severe, in which the bearing metal is rapidly dissolved, depending on the temperature and combination of oil and metal. Tin base babbitt and aluminum are the most resistant alloys.

Embedability.—This property is the tolerance of a bearing metal to dirt particles. If the material has a high degree of embedability, the dirt is easily pushed below the surface preventing damage. But if the dirt is difficult to embed, it will cause scoring and wear, especially of the shaft. In general, white metals have the highest tolerance to dirt particles. As the metal becomes harder, there is less tolerance so that finally the hard bronzes require clean lubricants. However, under slow speed, extremely dirty environments and limited lubrication, a hard bronze and a hard shaft can develop the least wear.

CHARACTERISTICS OF TYPICAL BEARING METALS

White Metals.—This classification covers tin base alloys, lead base alloys and cadmium base alloys. The alloys of tin and lead are referred to as babbitt's metal after Isaac Babbitt who patented the bonding of such alloys to a strong backing material. They are also referred to as antifriction metals. Many compositions exist but typical ones are shown in Table I.

The additives to each of the base metals harden and strengthen the alloy, thereby improving the compressive and fatigue strengths. The lead alloys are cheaper than the tin alloys and can give as

TABLE I.—*Typical White Metal Alloys*
(Compositions in %)

Alloy	Tin	Antimony	Copper	Lead	Arsenic	Cadmium	Nickel
Tin base	91	4.5	4.5	...	...	...	...
Alloy	89	8	3	...	...	...	...
Lead base	4	10	...	86	...	...	...
Alloy	1	15	...	83	1	...	...
Cadmium base alloy	...	...	...	...	...	98.4*	1.5

*Minimum

good service, especially when the layer is thin (under .010 in.). Cadmium alloys are relatively expensive; they are used only where their slightly improved fatigue resistance is necessary. Tin alloys do not corrode.

Lead alloys must have over 3% tin (or equivalent in other effective metals) in order to resist attack by organic acids. Cadmium alloys are made noncorrodible by the addition of small amounts of indium. Although all of these alloys have low strength, they can be made to sustain loads up to 5,000 lb. per square inch if they are used as a layer between .001 to .003 in.

Copper-Lead.—These bearing materials are essentially a matrix of copper filled with lead. The lead content is 25% to 35% with as much as 5% silver added to increase strength in special cases. The metal is cast on a steel back.

Copper-lead bearings have approximately 50% greater strength than white metals but there is a considerable loss in antiscore quality and embedability.

Aluminum Alloys.—These metals are used where increased load-carrying capacity and complete resistance to corrosion are desired. Since their antiseizure and embedability qualities are only moderately good, thin babbitt overlays may be necessary. Typical compositions are (1) 6½% tin, 1% copper, 1% nickel, balance aluminum; and (2) 4% silicon, 1.2% cadmium, balance aluminum.

The first composition is used as a casting of thick, single metal while the latter is rolled into thin sheets for bonding to steel. The high thermal expansion of the cast aluminum may cause malfunctioning if it is placed in a ferrous housing and too high an operating temperature is reached.

Silver.—This is one bearing metal which is used in its pure form, by electroplating or by soldering a pure sheet onto a steel backing to give maximum support. Silver bearings sustaining 8,000 lb. per square inch were developed for heavy loads in high output engines. The antiseizure and embedability qualities of the silver are poor and an overlay of noncorrosive lead is added by electroplating, to aid in "running-in" and dirt tolerance. The cost of silver bearings is very high.

Bronzes.—There is a tremendous variety of these alloys but they can be classified according to lead content. When the lead content is high with a small percentage of tin and zinc, the bearing metals have good load-carrying capacity and fair antiseizure properties. Such materials are used for medium-speed bushings that are loaded too high to permit the use of babbitts.

As the lead content is reduced, the bronze is strengthened by the addition of tin and zinc. However, the antiseizure quality is decreased; consequently a tin bronze can be used only at low surface speeds such as in a linkage bushing. When the alloy consists of copper and tin, it is termed a tin bronze and is used in applications requiring high loads (up to 10,000 lb. per square inch) with low surface speeds.

Tin bronzes are used as a backing material. They provide the necessary strength and can serve as a bearing metal if the babbitt is worn through. Aluminum bronze is hard and has high load-carrying capacity with poor antiseizure properties.

Bronzes are relatively cheap and easy to install. Corrosive resistance is improved by the additions of larger quantities of tin and zinc. A popular variation is the porous, sintered bronze bushing which is impregnated with lubricant to carry oil over extended periods. (A. F. Ud.)

TABLE II.—*Typical Bronze Bearings Alloys*
(Compositions in %)

Alloy	Copper	Tin	Zinc	Lead	Aluminum	Iron
I	72	8	...	20	...	...
II	80	10	...	10	...	...
III	88	10	2	...	...	...
IV	86	...	...	...	2–12	2

BEARINGS. In some operations friction is essential; in many other cases, however, it is most desirable to keep it at a minimum. The device interposed between two surfaces, moving relative to each other, to reduce friction is called a bearing.

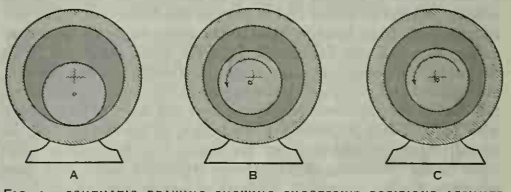


FIG. 1.—SCHEMATIC DRAWING SHOWING SUCCESSIVE POSITIONS ASSUMED BY JOURNAL: (A) AT REST; (B) STARTING; (C) RUNNING AT FULL SPEED

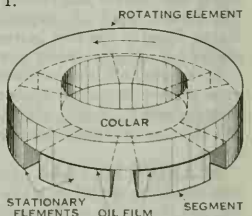
Bearings take many forms. They vary from a thin band (bushing) of low-friction material to a complex assembly of rollers, races and retainers.

There are three general classes of bearings: hydrodynamic or slider bearings, hydrostatic or externally pressurized bearings, and rolling bearings. The usefulness of a bearing was probably first noticed when prehistoric man accidentally discovered the reduced effort required to move a cart after some animal fat was placed between the axle and the wheel. On the other hand, the rolling type of bearing was invented sometime later, although prehistoric man again first utilized the principle when he placed a length of branch under a heavy tree trunk to reduce the effort needed to move the trunk. Fruitful, scientific analyses of each of the three types of bearings were not initiated, however, until late in the 19th century.

HYDRODYNAMIC BEARINGS

When an oil film is interposed between a shaft and the outer member surrounding the shaft an important phenomenon occurs as the shaft begins to turn. This phenomenon, the wedge effect, results in self-generated pressure sufficiently high to support the load on the shaft, as shown in fig. 1.

A bearing supporting a load in this way is identified as hydrodynamic, because pressure is generated by the flow of a fluid through a wedge-shaped passage. The friction, a direct function of the viscosity of the lubricant, is small because metal-to-metal contact does not exist.

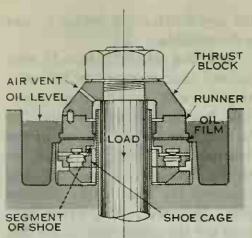


FROM SAMUEL J. DERARD, EVERETT O. WATERS AND CHARLES E. PHELPS, "PRINCIPLES OF MACHINE DESIGN," THE RONALD PRESS COMPANY (1955)

FIG. 2.—TILTED-PAD THRUST BEARING

History.—The science of hydrodynamic bearings dates back to the period of the great railway expansion. The Institution of Mechanical Engineers in England hired Beauchamp Tower to study friction in railway journal bearings. Results were quite erratic until Tower decided to run the journal in an oil bath. To do this he drilled a hole through the outer housing, the bearing, so the oil could reach the journal. When the test started, oil began to flow back out through the hole. To prevent this, Tower drove a wooden plug into the hole, but when the shaft rotated, the plug was forced out.

A gauge was then substituted for the plug to measure the pressure. Tower reported these observations before a meeting of the institution in 1883. Osborne Reynolds, present at the meeting, later studied the phenomenon analytically and reported his deductions before the same group in 1886. Reynolds proved the principle of hydrodynamic action and pointed out its dependence upon lubricant viscosity. He is thus recognized as the founder



FROM SAMUEL J. BERARD, EVERETT O. WATERS AND CHARLES E. PHELPS, "PRINCIPLES OF MACHINE DESIGN," THE RONALD PRESS COMPANY (1955)

FIG. 3.—KINGSBURY THRUST BEARING

of the hydrodynamic lubrication theory. Nevertheless it is interesting to note that N. Petroff, a Russian, working independently at about the same time, also recognized the phenomenon of hydrodynamic action. Many other investigators have made and continue to make important contributions to the analysis and design of hydrodynamic bearings.

These bearings may be typed as slider bearings, in which the surfaces translate relative to each other, and journal bearings, in which a shaft—the journal—rotates inside the sleeved bearing.

Slider Bearings.—Slider bearings generally consist of two plane members. The runner or moving member translates while the shoe or pad is stationary but slightly out of parallel with the moving member. In practice the shoe is usually mechanically pivoted so it can assume the proper wedge angle when the runner begins to move. Oil or other lubricant fills the very thin space between the two members.

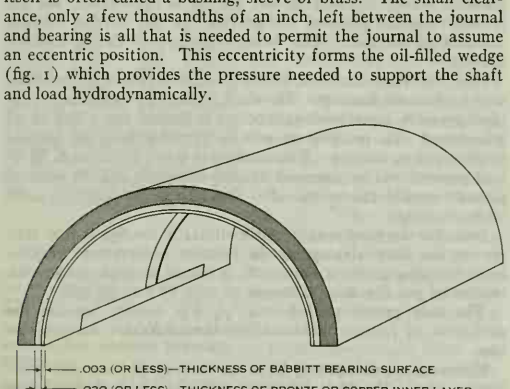
By far the greatest use of the slider principle has been made in the tilted-pad thrust bearing, schematically sketched in fig. 2 with an application illustrated in fig. 3.

Albert Kingsbury of the United States and A. G. M. Michell of Australia independently invented the tilted-pad bearing. A collar, the runner, to which the shaft is attached rides on segmental pads resting on slightly rounded supports to permit rocking. The entire unit may be submerged in a lubricant or, if operating in a horizontal position, the runner may be made to dip into an oil bath, pulling the oil up between the pad and runner. The pad, of course, tilts to form the necessary wedge. Three to eight pads may be used. Pressures as high as 1,000 lb. per square inch are generated, supporting loads at coefficients of friction as low as 0.001.

In a test conducted by the Kingsbury Machine works on a twin-screw steamship, a loss in friction of only 6.2 h.p. was measured on a tilted-pad supported shaft as compared to a loss of 109 h.p. on a collar-supported shaft.

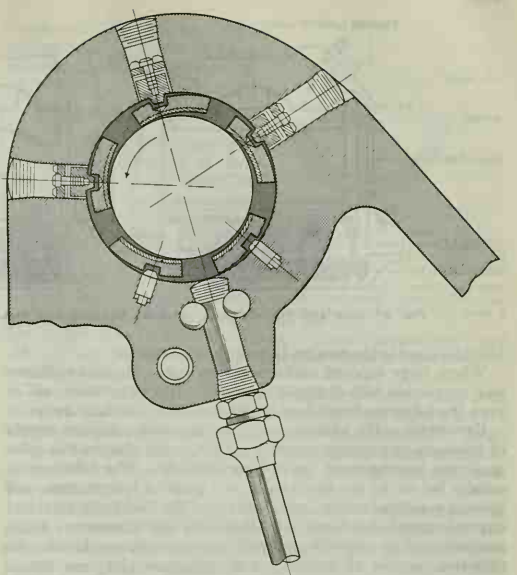
Journal Bearings.—The journal bearing consists of a shaft, transversely loaded, rotating within a cylindrical shell. The portion of the shaft within the shell, having a finer finish, is the journal.

The shell, made of a low-friction material and surrounded by or pressed into a stronger housing, is the bearing (fig. 4). The shell itself is often called a bushing, sleeve or brass. The small clearance, only a few thousandths of an inch, left between the journal and bearing is all that is needed to permit the journal to assume an eccentric position. This eccentricity forms the oil-filled wedge (fig. 1) which provides the pressure needed to support the shaft and load hydrodynamically.



BY COURTESY OF SAE JOURNAL

FIG. 4.—AUTOMOTIVE BEARING CONTAINING THIN BABBITT METAL BACKED BY STEEL AND HELD IN POSITION BY BRONZE OR COPPER LAYER



BY COURTESY OF THE CINCINNATI MILLING MACHINE CO.

FIG. 5.—FILMATIC BEARING, WITH PIVOTED-PADS AROUND THE JOURNAL

In some applications, as in a ship in rough water, heavy loads and unusual distortions in the supporting structure require a bearing of relatively low rigidity. The pivoted-pad design is incorporated in the journal bearings in such cases. This permits self-alignment of the shaft as well as a reduction in shaft stress which would otherwise result. Pivoted-pad journal bearings are also used with high-speed spindles where radial displacement within the bearing must be at a minimum. The bearing in fig. 5 is one example of such design.

Because minor disturbances can cause discontinuities in the film pressure generated around the journal, partial journal bearings have been developed. The bearing shell circles the journal only partly, 60°, 90° and 120° angular spans being most often used. The railway axle bearing (fig. 6) is an example of a partial bearing.

Lubricants.—Lubricants may be liquid, semisolid (plastic) or solid. If air is considered, and it should be because it has proved useful as a lubricant, the gaseous state must also be included.

Petroleum-base oils are most representative of liquid lubricants. For operation at unusual speeds or temperatures synthetic oils have been used. Greases made of mineral oils and saponified fats are the semisolids most useful in some highly loaded bearings.

Examples of solid lubricants are graphite, talc and soapstone. At temperatures several hundred degrees above ordinary bearing conditions, at very high unit pressures, or in meeting other demanding requirements, inert, layer-lattice or laminar solids are used. Molybdenum disulfide, synthetic waxes and solid fatty acids are typical examples.

Viscosity at operating temperature is the most important single property of a hydrodynamic lubricant. It governs the lubricant's fluid friction and thus the power loss suffered in the bearing. Obviously there are other requirements to be satisfied, and to meet these, many additives are compounded into the oil base. For instance, inhibitors are added to improve the viscosity index, polar hydrocarbons to increase oiliness and organic compounds of sulfur, phosphorus or nitrogen to minimize oxidation.

Thermal Equilibrium.—Though the coefficient of friction is very small in a well-designed bearing, some frictional heat still is generated. Unless this heat is dissipated, the lubricant will begin to decompose. Therefore a satisfactory temperature must

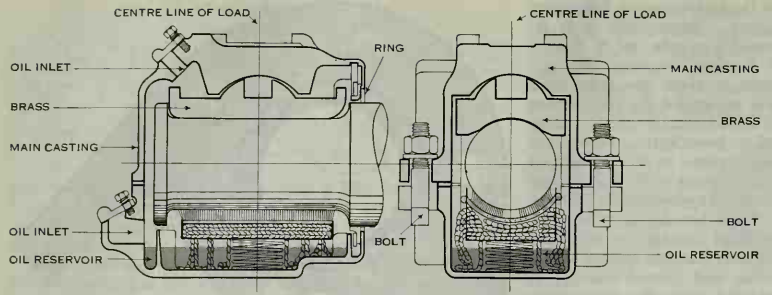


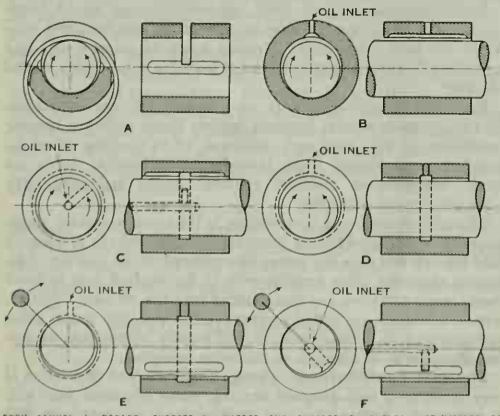
FIG. 6.—SIDE AND END VIEWS OF JOURNAL BEARING FOR RAILWAY FREIGHT CAR AXLES

be maintained in the bearing by proper heat balance.

Where large exposed surfaces are available, natural radiation and convection will dissipate the heat; otherwise, water, air or even the lubricant itself may be used to carry the heat away.

Grooving.—The hydrodynamic bearing needs a copious supply of lubricant to function properly. Though the clearance is quite small the bearing must be full continuously. The lubricant is usually fed to the bearing opening at a point of low pressure, and grooves machined on the inside surface of the bushing in axial and circumferential directions help distribute the lubricant. These grooves must be properly designed and carefully machined. An excessive number of grooves, or an improper plan, can reduce capacity, increase friction losses and eventually cause bearing failure. A selection of grooving schemes is shown in fig. 7.

Lubricating Devices.—Various methods are used to carry lubricant to the bearing; a few of these are illustrated in fig. 8. In order of increasing efficiency, the various lubrication methods may be arranged as follows: (1) hand feed, in which oil is poured directly onto the bearing through a hole in the frame or onto a felt plug or cotton waste inserted in the oil hole; (2) wick feed, whereby oil is transferred by capillary action from a reservoir to the bearing; (3) grease lubrication, in which grease is forced into the bearing by means of a compression cup fixed to the frame; (4) drop feed, in which lubricant drips slowly from a visible level oil cup; (5) ring oiling, by means of which lubricant is raised from a sump beneath the journal by a ring fitting loosely around the shaft; (6) splash lubrication, in which lubricant is distributed by shaft rotation in a fully enclosed bearing; (7) flooding, in which journal and bearing are partly submerged in an oil bath; and (8) forced lubrication, with the oil pumped under pressure to the bearing. Probably the most important requirement



FROM SAMUEL J. BERARD, EVERETT O. WATERS AND CHARLES E. PHELPS, "PRINCIPLES OF MACHINE DESIGN," THE RONALD PRESS COMPANY (1958)

FIG. 7.—TYPICAL GROOVINGS USED IN JOURNAL BEARINGS

for any lubricating device is that it be reliable.

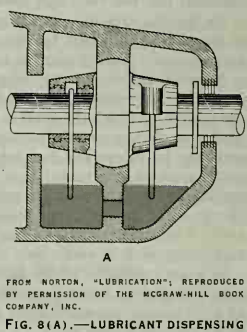
Bearing Materials.—It may appear that strength is the only requirement for bearing materials, but this is far from true. To be sure, the major portion of the bearing, the housing, must be strong enough to support and transmit the load to the foundation. However, of greater concern are the properties of the thin inner lining, the sleeve or bushing.

The material of which this lining is made must be low in dry friction because during starting and stopping, as well as during occasional periods of overload, metal-to-metal contact occurs. It must be score-resistant because abrasive foreign particles may damage it. It must be corrosion-resistant because acids form when lubricants "wear." It should have high heat conductivity to help maintain proper running temperatures.

A single material possessing all these characteristics at desirable levels is yet to be developed. Instead, bearing materials always represent a compromise: in one application, corrosion resistance may be the prime requirement, while in another it may be fatigue strength. (*See* BEARING METALS.)

HYDROSTATIC BEARINGS

The need for combating fluid friction under heavy loads and at low speeds was effectively illustrated by an amusing creation exhibited at the Paris Industrial exposition in 1878. A bulky mass mounted on four lionlike feet rested solidly on a flat plate. When oil was pumped to the contacting surfaces through each foot with just sufficient pressure to begin raising the mass, the heavy block could be moved with surprising ease.



FROM NORTON, "LUBRICATION"; REPRODUCED BY PERMISSION OF THE MCGRAW-HILL BOOK COMPANY, INC.

FIG. 8(A).—LUBRICANT DISPENSING DEVICES
(A) Oil-ring bearing

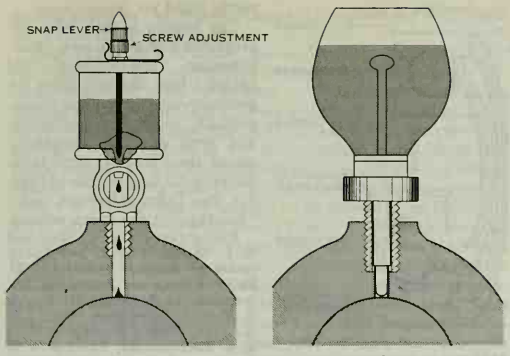
This illustrated the principle of the hydrostatic or externally pressurized bearing. When loads are too high or speeds too low, pressure within the bearing will not be self-generated, but externally supplied pressure can provide the film needed between the moving surfaces. This is the function of the hydrostatic bearing.

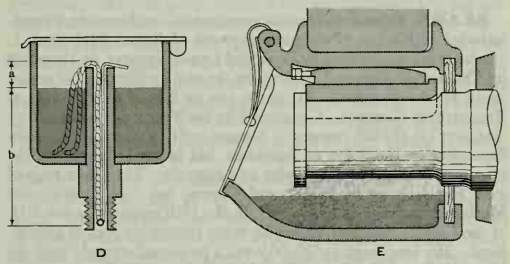
Heavy rotating machines, like large turbines, are often provided with hydrostatic bearings. The shaft is floated by externally supplied pressure, metal-to-metal contact is broken and a film of oil substituted. The machine can now be started without any damage to the shaft or bearing. When sufficient speed is attained, lubricant pressure will be generated hydrodynamically and the external pressure supply can be cut off. The reverse procedure is used when stopping.

Probably the most spectacular hydrostatic bearing is that supporting the Hale telescope at the Palomar observatory. Equipment weighing almost 1,000,000 lb. is turned through one smooth revolution per day using a torque of only 50 foot-pounds.

The only power needed is a $\frac{1}{2}$ h.p. motor, because the coefficient of friction measures less than 0.000004 for the system.

Hydrostatic bearings may be in the form of oil pads, step bearings or lifts. The Hale telescope uses oil-pad bearings. Large vertical turbogenerators are supported on step bearings, as are centrifuges running at speeds as high as 90,000 r.p.m. Oil lifts are used, as already stated, during the starting and stopping of large turbines.

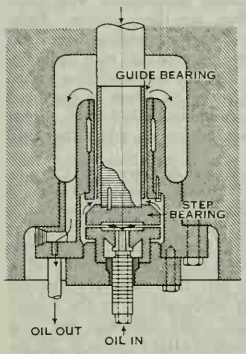




FROM NORTON, "LUBRICATION"; REPRODUCED BY PERMISSION OF THE MCGRAW-HILL BOOK COMPANY, INC.

FIG. B(B-E).—LUBRICANT DISPENSING DEVICES
(B) drop-feed oiler; (C) bottle oiler; (D) wick-feed oiler; (E) waste-packed bearing

Oil Pads.—The oil pad is nothing more than a shallow recess in the bearing which is kept filled with oil under high pressure. The oil leaks out slowly, so a slight replacement flow must be maintained. The total area of all pads in a bearing must be sufficient to develop forces which equal the load being supported. Oil enters at the centre of each pad, flows outward in all directions, is collected, filtered and recirculated. Though pressures needed may be several thousand pounds per square inch, the volume of oil flowing through the bearing is only a few cubic inches per second. If the dimensions, number and arrangement of pads are carefully selected, friction losses remain extremely small.

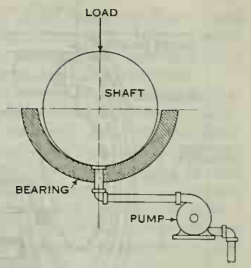


FROM DUDLEY D. FULLER, "THEORY AND PRACTICE OF LUBRICATION FOR ENGINEERS"; REPRODUCED BY PERMISSION OF JOHN WILEY & SONS, INC.

FIG. 9.—STEP TYPE HYDROSTATIC BEARING FOR VERTICAL TURBOGENERATOR

Step Bearings.—This type of bearing is often used to support thrust loads. Oil under pressure is pumped into a shallow circular recess at the end of the shaft (*see* fig. 9). The supply varies logarithmically between the edge of the recess and the outside of the shaft in all radial directions. A sufficient flow must be maintained to support the existing thrust load.

Lifts.—Hydrostatic lifts are used to displace shafts radially away from the bearing. Thus separated, the shaft can be safely rotated, as explained previously. Were this not done, in the case of a heavily loaded shaft, the resulting friction would overheat the bearing material and permit it to tear or pit. Once sufficient speed is attained hydrodynamic pressure takes over; thus the lift supplements the ordinary journal bearing. A schematic diagram of a lift is presented in fig. 10.



FROM DUDLEY D. FULLER, "THEORY AND PRACTICE OF LUBRICATION FOR ENGINEERS"; REPRODUCED BY PERMISSION OF JOHN WILEY & SONS, INC.

FIG. 10.—A HYDROSTATIC LIFT BEARING SHOWN SCHEMATICALLY

ROLLING BEARINGS

The modern rolling bearing is an assembly consisting of four parts: the inner ring or race; the outer ring or race; the rolling element—a ball or a roller; and the separator or cage or retainer (*see* fig. 11).

The rollers may be cylindrical, tapered, barrel-shaped (convex) or hourglass-shaped (concave). The hollow spiral roller bearing (Hyatt) and the small-diameter needle bearing are special types.

There are several functionally different ball bearings and even roller bearings manufactured. The unsymmetrical, angular-groove bearing is designed to carry an axial as well as a radial load. Some ball bearings contain spherical races which permit slight lateral rotation between inner and outer rings, thus allowing for a small misalignment of the shaft.

In addition, some may contain a single row of rolling elements, others two rows. The Conrad type contains fewer balls than the notch-filled type because the side notch permits more balls to be passed into the raceways. Because bearings are sometimes used in inaccessible places or in dusty atmospheres, the lubricant must be applied prior to installation. These bearings are therefore provided with metal or felt shields between the inner and outer rings.

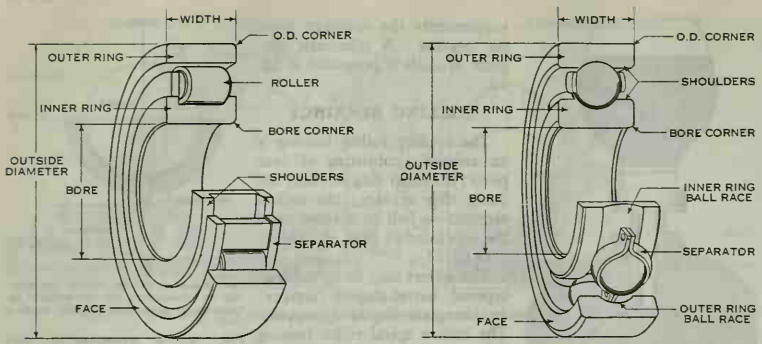
Rolling bearings are also designed to carry axial loads only. Such bearings contain a row of balls or rollers, held properly spaced by a retainer, between two rings having flat or grooved raceways. Although made primarily for one-way thrust, the addition of a third ring, mounted on the shaft between the two identical outer rings, permits thrust in either direction.

Load Capacity.—In 1881 Heinrich Hertz investigated the deformations that occur when elastic bodies are contact under pressure. Although his theoretical deductions were based on assumptions not fully applicable to the operation of rolling bearings, subsequent bearing investigations proceeded from his findings. The first systematic study applying directly to ball bearings was performed by Stribeck around 1900. He found the bearing capacity to depend on the square of the ball diameter as well as on the number of balls in the bearing. He proved also that balls running in curvilinear grooves can support higher loads than those running in cylindrical grooves.

Bearing Materials.—Materials for rolling bearing components must meet rigid specifications. A bearing assembly is subjected to intense unit stresses as it transfers the load from the frame to the shaft, and these stresses may vary widely in magnitude, thus subjecting each component to fatigue or even impact conditions.

In addition, much heat may be generated. Consequently, optimum performance depends not only upon good design and close fabrication tolerances but upon the wise choice of high-quality materials as well. Materials having tensile strengths of over 200,000 lb. per square inch and hardnesses of over 600 on the Brinell scale are needed. The limited availability of extremely high-strength materials is probably the one single factor which retarded the development of rolling bearings. High-carbon steels alloyed with chromium, nickel, molybdenum and other constituents are used. Quality must be carefully controlled; bearing components must be carefully fabricated and properly heat-treated for strength and hardness.

Lubrication.—Rolling bearings depend on rolling action rather than lubrication to achieve low friction losses. Thus the coefficient of friction is determined by the finish and, particularly, the hardness of the bearing material rather than by the viscosity of the lubricant, as in other types of bearings. Nevertheless, some



BY COURTESY OF ANTI-FRICTION BEARING MANUFACTURERS ASSOC., INC.

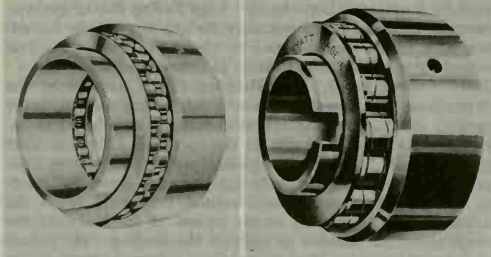
FIG. 11.—PARTS OF BALL ROLLER AND CYLINDRICAL BEARINGS

lubrication is needed, although in relatively small amounts. The primary function of the lubricant is to protect the highly polished bearing surfaces from corrosion and abrasion, and it must also assist in dissipating whatever frictional heat may be generated.

If some sliding should occur between cage and rolling elements, the lubricant present should reduce the friction. Pure mineral oils or grease added in controlled amounts are best. At low speeds the greases serve well, while at high speeds oils are preferred.

OILLESS BEARINGS

Another kind of bearing that cannot properly be included in any



BY COURTESY OF (LEFT) ORANGE ROLLER BEARING CO., (RIGHT) HYATT BEARINGS DIVISION, GENERAL MOTORS CORP.

FIG. 12.—STAGGERED ROLLER BEARING AND SPIRAL ROLLER BEARING

of the three major categories is the sintered or oilless bearing, designed for use in places inaccessible for lubrication. Powdered metals are mixed in desired proportions and then bonded under high pressure into the required shape. This compacted mass is heated to a temperature just below the melting point of the mixture. The particles unite during this sintering process into a partly fused yet porous mass.

The bearing is then fully impregnated with a lubricant. Nongumming, low-oxidizing oils having a high viscosity index are generally used, as well as grease, graphite, molybdenum disulfide and even wax. If completely sealed, these bearings serve satisfactorily for long periods of time. *See* also Index references under "Bearings" in the Index volume.

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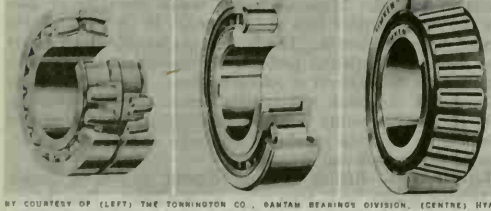

BY COURTESY OF (LEFT) THE TORRINGTON CO., BANTAM BEARINGS DIVISION, (CENTRE) HYATT BEARINGS DIVISION, GENERAL MOTORS CORP., (RIGHT) THE TIMKEN ROLLER BEARING COMPANY

FIG. 13.—TYPICAL ROLLER BEARINGS
Spherical (left), cylindrical (centre), tapered (right)

BÉARN, an ancient frontier province of southwestern France, included within the modern *département* of Basses-Pyrénées. It was bounded on the west by Soule and Lower Navarre, on the north by Chalosse, Tursan and Astarac, on the east by Bigorre and on the south by the Pyrenees. Its name can be traced to the town of Beneharnum (Lescar). Conquered by the Vascones (*see* BASQUE; GASCONY) in the 6th century, it became in 819 a viscounty feudally dependent on the dukes of Aquitaine, but in the 11th century the viscounts ceased to acknowledge any suzerain. They then reigned over the dioceses of Lescar and Oloron, but their capital was Morlaas, where they had a mint. In the 13th century Gaston VII, of the Catalan house of Moncade, made Orthez his seat of government. His long reign (1229–90) was a perpetual struggle with the kings of France and England, each anxious to assert his suzerainty over Béarn.

As Gaston left only daughters, the viscounty passed at his death to the counts of Foix (*q.v.*), from whom it was transmitted through the house of Grailly to the kings of Navarre. When Henry III of Navarre (known before his mother's death as prince de Béarn) became Henry IV of France, Béarn passed to the French crown.

From the 11th century onward the Béarnais were governed by their own special customs or *fors*. Moreover, from the 12th century they had a kind of representative government, with *cours plénières* composed of deputies from the three estates. From 1220 onward the judiciary powers of these assemblies were exercised by a *cour majour* of 12 *barons jurats* charged with maintaining the integrity of the *fors*. When Gaston Phoebus of Foix wished to establish an annual hearth tax (*fouage*) in Béarn, he convoked the deputies of the three estates in assemblies called *états*. These acquired extensive political and financial powers, which they held till 1789.

See P. Courteault, *Histoire de Gascogne et de Béarn* (1938).

BEAS (BIAS, ancient Greek HYPHASIS, Sanskrit VIPASA), a river of India, is one of the five giving the Punjab its name (*panch,* "five"; *ab,* "waters"). It rises 13,326 ft. above sea level in the snowy Rohtang pass north of Kulu (Kangra district). It flows southward for about 70 mi. along the Kulu valley, receiving tributary torrents from the crests to the east, then turns west through the Kangra valley for 100 mi. It debouches on to the Punjab plains some 20 mi. E. of Gurdaspur, turns southwest and joins the Sutlej (*q.v.*) 25 mi. N.E. of Ferozepur after a course of 290 mi. and a descent of 12,500 ft. The Beas is the only Punjab river not cut by the Indo-Pakistan border frontier; but it was involved in the Punjab waters dispute between the two countries in 1947–60 because of its contribution to the flow of the Sutlej. At Jogindernagar in Mandi district (Himachal Pradesh) the upper Beas operates a hydroelectric station supplying Lahore, Amritsar and Jullundur. (L. D. S.)

BEATIFICATION, in the Roman Catholic Church, is the second stage in the process of canonization. The beatified person is called "blessed," and a limited cult is authorized. A similar

process exists in the Russian church for authorizing local cults. *See* CANONIZATION.

BEATITUDES, a name, derived from the Latin *beatitudo,* referring specifically to the nine blessings (Matt. v, 3–12), which in the Vulgate all begin "*beati sunt* . . . ," at the beginning of the Sermon on the Mount (*q.v.*). Four of them have parallels (Luke vi, 20–23) in the Sermon on the Plain, where their simpler form and their direct address in the second person stamp these four as the original nucleus of the expanded nine. Of the five others, Matt v, 5 could be a later interpolation because it often precedes verse 4 in ancient texts; it appears to be derived from Ps. xxxvii, 11, as Matt. v, 8 seems to be from Ps. xxiv, 4. Nevertheless both of these as well as the remaining three may at some time have been formulated by Jesus himself. The compiler of the Sermon on the Mount or his source seems to have brought the nine together by association of form and to have softened Jesus' paradoxical blessings upon actually needy, suffering people by transposing them into a more spiritual key. Luke's beatitudes are immediately followed by four exactly parallel maledictions, each beginning, "Woe to you . . . ." They are probably not old tradition but a literary reflex of the four beatitudes. (KE. G.)

BEATON (BETHUNE), **DAVID** (*c.* 1494–1546), Scottish cardinal and statesman, who was a promoter of the French alliance and an implacable opponent of the Reformation in Scotland, was the third son of a Fife laird, John Beaton of Balfour. He entered St. Andrews university in 1509, moved to Glasgow university in 1511 and thereafter studied in Paris and Rouen, before returning to Scotland in 1521.

Beaton's career as a churchman began when he was presented to the chancellorship of Glasgow cathedral before 1519, by his uncle, James Beaton (*see* below), who resigned the abbacy of Arbroath in his favour in 1524. From 1522 Beaton was extensively engaged in diplomatic missions, the most important of which were the negotiations leading to the marriages of James V of Scotland to Madeleine, daughter of Francis I of France, in 1537, and to Mary of Lorraine, in 1538. At Francis' request he was provided to the French bishopric of Mirepoix in Dec. 1537. A year later he became the first Scotsman to be raised to the cardinalate. He was appointed coadjutor to the archbishopric of St. Andrews in 1537, and succeeded his uncle as archbishop in 1539. Pope Paul III refused to make him papal legate in Scotland until Jan. 30, 1544.

Beaton's career as a statesman commenced with his appointment as keeper of the privy seal (Jan. 3, 1529), which marked the beginning of his ascendancy as the most trusted counselor of James V, whom he dissuaded from following the religious policy of the English king Henry VIII. When James was dying, Beaton probably tried to get himself nominated one of the governors of the kingdom for James's infant daughter Mary Stuart, but there is no proof of the story that he forged the king's will. The earl of Arran, who was proclaimed protector and governor on Jan. 3, 1543, imprisoned Beaton later that month, ostensibly for treason. He was released in April, however, and led the opposition to Arran's pro-English policies. Arran changed sides and submitted to Beaton in Sept. 1543, being absolved by the cardinal at Stirling, where both took part in Mary's coronation. In Dec. 1543 Beaton resumed the office of chancellor which he had been given in January. Having thus re-established his ascendancy he reversed Arran's former policies. In place of half-hearted encouragement of Protestantism came suppression of heresy which earned him the reputation of a cruel persecutor. In foreign affairs he showed determination in opposing and thwarting Henry VIII's plans for the subjugation of Scotland by the marriage of Mary to the future Edward VI of England, declaring void the treaty which had arranged the marriage. His policy led to war with England in 1544, and Henry saw in him an enemy whose removal would be welcome, and gave his approval to plots to assassinate Beaton.

The trial and execution (March 1, 1546) of the reformer George Wishart (*q.v.*) encouraged Beaton's enemies to take action. He showed no fear, taking part in the wedding of his illegitimate daughter, Margaret, with the earl of Crawford's heir and attending meetings of the privy council. But on May 29, 1546, a band of conspirators, including Norman Leslie, master of Rothes, and William Kirkcaldy of Grange, surprised him in St. Andrews castle and murdered him. His body lay unburied for several months while the murderers held the castle against the government.

Beaton was a man of worldly ambitions and was neither scholar nor patron of learning albeit a benefactor of St. Mary's college, which his uncle had founded at St. Andrews. Although John Knox and others have exaggerated his cruelty and immorality, both were harmful to the Roman Catholic Church in Scotland, which he tried to preserve by repression rather than by reform. As a statesman his actions were governed by ecclesiastical considerations, as a churchman by self-interest. After his death the French alliance, on which he had based his policies, threatened to lead to the complete subjection of Scotland to France.

JAMES BEATON (d. 1539), the cardinal's uncle, was abbot of Dunfermline, Kilwinning and Arbroath, and successively, archbishop of Glasgow (1509–22) and of St. Andrews (1522–39). He was treasurer of Scotland (1505–09) and chancellor (1513–26). As one of the regents during James V's minority, he supported the French alliance.

JAMES BEATON (*c.* 1524–1603), the cardinal's nephew, was an adviser of Mary of Lorraine and a determined opponent of the reformers. He became the last Roman Catholic archbishop of Glasgow in 1552, but in 1560 he went to France, where he spent the rest of his life, serving as ambassador there for Mary Stuart and for James VI.

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BEATTIE, JAMES (1735–1803), Scottish poet and writer on philosophy whose once popular poem *The Minstrel* heralded the Romantic revival, was born at Laurencekirk, Kincardine, Oct. 25 (old style; new style, Nov. 5, as given on Beattie's tombstone), 1735. A farmer's son, he graduated from Marischal college, Aberdeen, and after some years of teaching in a rural school became professor of moral philosophy there.

His *Original Poems and Translations* (1760) already showed a Romantic attitude toward Nature. It was, however, with his *Essay on the Nature and Immutability of Truth, in Opposition to Sophistry and Scepticism* (1770) that he achieved fame. A vigorous defense of orthodoxy against the rationalism of David Hume, it is based on social rather than metaphysical arguments and enjoyed wide popularity. The next year he published the first part of *The Minstrel,* a poem in the Spenserian stanza tracing the development of a poet's mind under the influence of Nature. The second part was published in 1774. Although the setting is artificial and the moralizing tedious, it reflects the author's gentleness and sensitivity to natural beauty. To his generation it was a revelation, and it influenced Burns, Scott, Byron and Tennyson. This double success opened all doors. Hailed as the defender of Christianity and the poet of a new era, Beattie was welcomed into Samuel Johnson's circle, sat to Reynolds, and was given a life pension by George III. He spent the summer of 1773 in London, and his diary of the visit gives a vivid picture of the literary life of the day.

Success brought little happiness. His wife became insane, and his sons died young. Beattie, who published the elder boy's writings with a memoir in 1794 (*Essays and Fragments in Prose and Verse, by James Hay Beattie*), was overwhelmed by the death of the younger and never recovered his health. He died at Aberdeen, Aug. 18, 1803.

His *Poetical Works* were edited with a memoir by A. Dyce (1866). His *London Diary, 1773* (1946) and *Day-Book, 1773–1798* (1948) were edited by R. S. Walker.

See M. Forbes, *Beattie and his Friends* (1904).

BEATTY, SIR (ALFRED) CHESTER (1875–), naturalized British mining engineer and director of many companies, distinguished for the part he played in developing the central African copper deposits, was born in New York on Feb. 7, 1875, the son of J. Cuming Beatty, a banker. He was educated at Westminster school, Dobbs Ferry, N.Y., at the Columbia School

of Mines and at Princeton university, gaining the M.E. degree in 1898. He was professionally engaged in the development of the porphyry copper ores of the United States, first as consulting engineer to the Utah Copper company and later as a director of the Nevada Consolidated, the Ray Consolidated and the Chino Copper companies. In 1913 he relinquished his U.S. mining interests and settled in Great Britain, becoming a naturalized British subject in 1933. In 1914 he largely financed the original Selection Trust, Ltd., and formed, in 1921, a small syndicate known as Copper Ventures Ltd., a prospecting company that, by acquiring the Nkana and Rhodesian Congo Border concessions, initiated the development of the so-called "copper belt" of Northern Rhodesia and led to the eventual formation of two large copper groups, Rhokana corporation and Rhodesian Selection Trust.

For his services to the copper mining industry, Beatty was knighted in 1954. He was also honoured with foreign decorations and with medals and awards from learned and technical institutions. (C. W. D.)

BEATTY, DAVID BEATTY, 1ST EARL, OF THE NORTH SEA AND OF BROOKSBY (1871–1936), British admiral of the fleet, who commanded Britain's battle cruisers in the battle of Jutland, was born on Jan. 17, 1871, second son of Capt. David Longfield Beatty of County Meath, Ire. He entered the training ship "Britannia" as a naval cadet in 1884. From 1896 to 1898 he served with the naval brigade in Egypt and the Sudan, for which he obtained the distinguished service order and early promotion to commander. He served with distinction in China during the Boxer rebellion in 1900, and was promoted to captain at the early age of 29. In 1911, as a rear admiral, he became naval secretary to the first lord of the admiralty, then Winston Churchill, and in 1913 was appointed to command the battle cruiser squadron.

Soon after the outbreak of World War I in Aug. 1914 Beatty's naval force made a raid into the Heligoland bight and sank three cruisers and one destroyer without loss. A few months later he intercepted the German squadron under Admiral von Hipper in its third attempt on the English coastal towns. In a running fight, the rear German battle cruiser "Blücher" was sunk by British gunfire. Further damage to the enemy would probably have been inflicted but for the fact that the flagship "Lion" was disabled and that Beatty's second in command misunderstood his signal to renew the engagement, which was broken off. This action was known as the battle of the Dogger bank.

In the battle of Jutland (*q.v.*) on May 31, 1916, the battle cruiser fleet under Beatty was heavily engaged in a running fight with the German battle cruisers in the van under Hipper. Although Beatty's battle cruisers had the advantage of numbers, they were handicapped by conditions of light, and the ships themselves proved unable to sustain the gunfire of the German battle cruisers, with the result that the "Indefatigable" and "Queen Mary" were sunk. The fifth battle squadron, which was also part of Beatty's command, having failed to follow Beatty's change of course on account of defective signaling, was unable to render the powerful support it could have given during the early part of the engagement. Nevertheless, Beatty succeeded in his main object of drawing the combined high sea fleet to the northward, whence Admiral Jellicoe, with the whole British grand fleet, was hastening to meet and engage it. In Dec. 1916, on Jellicoe's being appointed first sea lord, Beatty became commander in chief of the grand fleet.

From 1919 to 1927 he served as first sea lord, having to deal with the creation of a much smaller, modernized peacetime navy. In 1921 he was a British delegate at the Washington conference on the limitation of armaments. He received the knight commander of the Bath in 1914, and in 1919 the order of merit, when he was created Earl Beatty. In May 1901 he married Ethel (d. Jan. 13, 1932), daughter of Marshall Field of Chicago, and had two sons. He died in London, March 11, 1936.

See W. S. Chalmers, *The Life and Letters of David, Earl Beatty* (1951).

BEAU BASSIN-ROSE HILL, a town of the British island colony of Mauritius, lies on the western slope of the central tableland 6½ mi. S. of Port Louis (*q.v.*), the capital. Beau Bassin and Rose Hill were originally separate communities of approximately equal size. Beau Bassin lies at 700 ft. and Rose Hill 900 ft. above sea level. Pop. (1952) 28,690.

The town, which has no industries, is almost exclusively a residential area for people who commute daily to and from Port Louis and other parts of the island. It has preserved much of its original rural character with separate villas or bungalows, each with a garden and trees, and large blocks of apartments are few. The colony's education department and central statistical office are there; and there are a town hall combined with a theatre and reception hall, a public library, public gardens and sports grounds and an attractive little public park known as Balfour gardens. There are four churches, law courts and the Queen Elizabeth college for girls, founded in 1954.

The town is a junction point for both railways and roads, the main road from Port Louis to the south of the island and that to the east meeting at Rose Hill. Bus routes radiate to all parts of the island. About 2 mi. N.E. of Rose Hill is the governor's residence, Le Reduit. (M. V. M. H.)

BEAUCAIRE, a town of southeastern France in the *département* of Gard, lies on the Rhône opposite Tarascon and 15 mi. E. of Nimes by road. Pop. (1954) 7,862. Beaucaire is linked to Tarascon by a suspension bridge (rebuilt in 1959) and a railway bridge. Beaucaire's outstanding feature is the pine-clad rock rising abruptly from the river. On top of the rock is the castle, the chief remains of which are a triangular keep and small Romanesque chapel (1374–1474). From the garden around the castle there is an extensive view over the Rhône delta, the Camargue. The most important buildings of the old town, at the foot of the castle, are the churches of Saint-Paul (15th century), and the fine hôtel de ville (1683). There are a Roman museum and two art galleries. Bull racing takes place on summer Sundays in the arena. The Beaucaire canal connects with Aigues-Mortes and the Canal du Midi, or Languedoc canal, and the town is an important river port, trading in wine and stone from quarries in the vicinity.

Known in Roman times as Ugernum, its modern name comes from the medieval term Bellum Quadrum, used for the castle rock. In 1125 Beaucaire became the possession of the counts of Toulouse who built the castle and of whom one established the importance of its fairs by the grant of privileges; the July fair is now mainly devoted to leather goods. Beaucaire suffered severely in the religious wars when the town and its castle were destroyed by Richelieu in 1632. During World War II Beaucaire was in German occupation from Nov. 1942 to Aug. 1944.

BEAUCE, a region of northern France, stretching southwest of Paris toward the forest of Orleans. Beauce is a monotonously flat, dry, treeless platform of limestone covered with loam soil which, as the local name of the district indicates, is extremely fertile. It has long been one of the great grain-growing areas of France and wheat and sugar beet dominate the farming. Large villages stand out in the level landscape by reason of their church spires and their water towers; the market towns include Chartres (*q.v.*), Chateaudun, Étampes and Pithiviers. Farther southwest, a tract of similar country between the Loir and Loire rivers is known as Petite Beauce. (AR. E. S.)

BEAUCHAMP, the name of several important English families. The baronial house of Beauchamp of Bedford was descended from HUGH DE BEAUCHAMP, who came to England at the Norman conquest, and whose second son, PAYN, received from William II the barony of Bedford. Payn's son, SIMON, steward to King Stephen, left a daughter, whose husband, Hugh de Beaumont, was created earl of Bedford (1138). But Simon's nephews, MILES and PAYN, refused to hand over Bedford castle, and the barony of Bedford remained in the line of Payn's descendants until the death without issue of JOHN DE BEAUCHAMP who fell fighting in the baronial cause at the battle of Evesham (1265). A younger branch of this family lived at Eaton Socon, Bedfordshire, holding a barony there until the 14th century.

The Beauchamps of Elmley, Worcestershire, from whom were descended the Beauchamp earls of Warwick and the Barons Beauchamp of Abergavenny, of Powick, of Bletsoe, of St. Amand and of Kidderminster, were founded by the marriage, late in the

11th century, of WALTER DE BEAUCHAMP with Emeline, daughter of Urise d'Abetot, by which he acquired the shrievalty of Worcestershire and extensive estates. But the most momentous Beauchamp marriage was undoubtedly that of Walter's descendant, WILLIAM DE BEAUCHAMP, with Isabel, sister and eventually heiress of William Mauduit, 8th earl of Warwick. Their eldest son, WILLIAM DE BEAUCHAMP (d. 1298), succeeded him as 9th earl. His descendants (*see* WARWICK, EARLS OF) were much involved in the wars and constitutional struggles of the late 13th and of the 14th centuries. GUY DE BEAUCHAMP (d. 1315), 10th earl of Warwick, fought against the Scots at the battle of Falkirk (1298) and was one of the lords ordainer who opposed Edward II: his grandson, THOMAS DE BEAUCHAMP (d. 1401), 12th earl, a lord appellant (1388) against the ministers of Richard II, was imprisoned by the king (1397) in the Tower of London (the Beauchamp tower was named after him) and was only released and restored to his titles on the accession (1399) of Henry IV. His grandson, HENRY BEAUCHAMP (1425–45), was made premier earl and created duke of Warwick (1444) by Henry VI. On the death of Anne, his only child, in 1449, his vast inheritance passed to his sister Anne, wife of Richard Neville, earl of Salisbury, who thereupon became earl of Warwick.

WILLIAM DE BEAUCHAMP (d. 1411), a brother of the 12th earl of Warwick, succeeded by entail to the estates of the Lords Bergavenny and was summoned in that barony (1392); his son, RICHARD (d. 1422), was created earl of Worcester (Feb. 1421) but died without male issue.

A younger son of William de Beauchamp and Isabel Mauduit was WALTER DE BEAUCHAMP (d. 1303), founder of the house of Beauchamp of Powick which acquired a barony by writ (1401) and by patent (1447). On the death of RICHARD BEAUCHAMP (1503), without male heirs, the title became extinct. From the Beauchamps of Powick were descended the Beauchamps of Bletsoe: ROGER BEAUCHAMP, Walter's grandson, was the founder of the line, which continued into the 15th century. The Beauchamps Lords St. Amand were descended from Walter's great-grandson, WALTER DE BEAUCHAMP (fl. 1415), whose son, WILLIAM DE BEAUCHAMP (d. 1467), acquired by marriage the St. Amand lands and titles (1449). A famous member of this branch of the family was RICHARD (*c.* 1430–81), bishop of Salisbury, first chancellor of the order of the Garter. This line became extinct in 1508.

Another younger son of William de Beauchamp and Isabel Mauduit was JOHN BEAUCHAMP of Holt (fl. 1297). His grandson, JOHN BEAUCHAMP (d. 1388), steward of the household of Richard II, was created (Oct. 1387) lord de Beauchamp, baron of Kidderminster (the first barony created by patent). He was, however, impeached by the king's enemies a year later, and executed. Although the title was restored (1398) to his son, JOHN (d. 1420), he was forfeited by Henry IV and the barony became extinct.

The Lords Beauchamp of "Hache" (1299–1361), so named from their seat of Hatch Beauchamp in Somerset, were an entirely distinct family, probably descended from Robert surnamed "the constable" or "Fitz-Ivo," who held part of the honour of Mortain, including the Somersetshire lands, from William I's half brother Robert of Mortain. In the 12th century they held directly of the crown. ROBERT DE BEAUCHAMP (d. 1252), appointed a judge by Henry III in 1234, was a member of this family.

The title "Beauchamp of Hache" was revived for the Seymours (relations of Henry VIII's 3rd wife, Jane Seymour) in 1536 and 1559. The title of "Beauchamp of Powyke" was revived as a barony for William Lygon (descended through females from the Beauchamps of Powick), who was created Earl Beauchamp in 1815, and was ancestor of William Lygon (1903–), 8th Earl Beauchamp.

BEAUCHAMP, ALPHONSE DE (1767–1832), French historian, whose many writings are more interesting as compilations than as original works, was born at Monaco in 1767. In 1784 he became an officer in a Sardinian regiment, but after the outbreak of war between Sardinia and the French Republic, he refused to fight in what he considered an unjust cause and was imprisoned. On his release he worked in a government office and, after the fall of Robespierre, was made superintendent of the press. In his *Histoire de la guerre de la Vendée et des Chouans* (1806) he used material to which his position gave him access, and was deprived of his post. He died in Paris on June 1 or 3, 1832.

Among his works dealing with contemporary events, the following are valuable but not completely reliable: *Vie politique, militaire et privée du général Moreau* (1814); *Catastrophe de Murat* (1815); *Histoire de la guerre d'Espagne et de Portugal* (1819); and *Mémoires secrets et inédits pour servir à l'histoire contemporaine* (1825). The *Mémoires* of Fouché which he edited (1824), were also probably revised and completed by him. (P. LY.)

BEAUFORT, the family name of the descendants of John of Gaunt, duke of Lancaster, by his liaison with Catherine Swynford, derived from a lordship lost by Gaunt in 1369, the modern Montmorency-Beaufort near Bar-sur-Aube, France. The four offspring of the union were legitimized, after their parents' subsequent marriage (1396), by the pope in Sept. 1396 and by Richard II in Feb. 1397; they were expressly excluded from succession to the crown by their half brother Henry IV in 1407 but this did not deprive the line of the place assigned to it by its royal blood. (For a genealogical table of the Beauforts, *see* LANCASTER, HOUSE OF.)

In the first generation JOHN (*c.* 1371–1410), the eldest son, through whom the line descended, was a courtier and crusader. He was created earl of Somerset, knight of the Garter and later marquess of Somerset and marquess of Dorset for his services as a lord appellant against Richard II's uncle and enemy Thomas of Woodstock, duke of Gloucester, in 1397. Although reduced to the rank of earl, he remained in favour after Henry IV seized the crown (1399), receiving grants and offices until his death on March 16, 1410. The second son, HENRY (*see* BEAUFORT, HENRY) (*c.* 1374–1447), became cardinal bishop of Winchester. The third and youngest son, THOMAS (d. 1426), also prospered under both Richard II and Henry IV. Though he served as chancellor of England from 1410 to 1411, he was primarily a professional military commander and as the French wars of Henry V progressed, offices, lordships and titles fell upon him. He became earl of Dorset (1412), duke of Exeter (1416) and count of Harcourt in Normandy (1418). On the accession of the infant Henry VI (1422), he continued in the wars and was a rather obscure member of the protectorate council. He died childless and his property remained to his eldest brother's heirs. The sister of John, Henry and Thomas, JOAN (d. 1440), made a suitable second marriage to Sir Ralph Neville (afterward earl of Westmorland).

The next generation saw the family's apogee, its place in politics being assured by Cardinal Henry. Although the Beauforts had but a moderate fortune, much of which was due to royal favour, Henry's ability, his legendary wealth derived from Winchester and his dealings in government finance gave the Beaufort faction a pre-eminence which their control over Henry VI from the mid-1430s assured. There was, however, a shortage of heirs: of John's children, the eldest, HENRY (1401–18), earl of Somerset, died unmarried after a brief career in the wars; the next, JOHN (1404–44), left, besides a legitimate and an illegitimate daughter, only a bastard son. His career was nipped in the bud by the fortunes of war; captive in France from 1421 to 1438, he was created a knight of the Garter about 1440, lieutenant of Guyenne, earl of Kendal, duke of Somerset in 1443, and after an ill-fated expedition to France, died in mysterious circumstances on May 27, 1444. John's third son, EDMUND (*see* SOMERSET, EDMUND BEAUFORT, duke of) (1406–55), was the most notable of the generation. A knight of the Garter before 1436, earl and marquess of Dorset by 1443, lieutenant and governor-general of France, Normandy and Guyenne, he became duke of Somerset in 1448. The sisters of the second generation married well: JOAN (d. 1445) to James I, king of Scotland, and MARGARET (fl. 1421) to Thomas Courtenay, earl of Devon.

After the death of the powerful William de la Pole, duke of Suffolk, in 1450, Edmund, with his possible claim to the throne (though deprived of the cardinal's fortune by the cardinal's tender conscience), became the natural leader of the Lancastrian party in a struggle for power with Richard, duke of York (*q.v.*), which even-

tually led to open conflict in the Wars of the Roses. Edmund was killed at the first battle of St. Albans on May 22, 1455, and although he had three sons and five daughters, the end of the Beauforts came rapidly. His eldest son, HENRY (1436–64), duke of Somerset, marquess of Dorset and titular count of Mortain, a victorious Lancastrian commander at the battles of Wakefield (1460) and of St. Albans (1461), fled to Scotland after the disaster of Towton (1461) and was then attainted and condemned to forfeiture. Failing to get French help, he deserted to the Yorkists in 1463 and was restored to his position; but a further tergiversation brought his attainder, forfeiture and execution on May 15, 1464, the day of his defeat and capture as Lancastrian commander at Hexham. Unmarried, he was survived only by a bastard son. Edmund's second son, EDMUND (*c.* 1439–71), "duke of Somerset" to Lancastrians alone, was attainted in exile in 1465 and, after a brief career as a Lancastrian commander, was captured and beheaded at Tewkesbury on May 6, 1471. He was the last male Beaufort, his younger brother, JOHN, "marquess of Dorset," like his brothers unmarried, having died before him in the battle (May 4, 1471). It was left to his cousin, the legitimate daughter of John, 1st duke of Somerset (*see* above), MARGARET BEAUFORT (*q.v.*) the mother of the future king Henry VII, to continue, in some measure, the fame of a remarkable line.

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BEAUFORT, FRANÇOIS DE VENDÔME, DUC DE (1616–1669), French prince whose popular leadership during the Fronde won him the name of *roi des Halles* ("king of the markets") and who as admiral of France worked for the expansion of French power in the Mediterranean, was born in Paris on Jan. 16, 1616, the second son of César, duc de Vendôme, and his pious but simple-minded wife, Françoise de Lorraine-Mercoeur. He served as a volunteer in Louis XIII's Piedmontese campaign of 1630 (during his father's imprisonment) and won a high reputation in the campaigns against the Spaniards from 1635 to 1640. At the same time, however, he linked himself with the opposition to Cardinal Richelieu and became known as a devoted partisan of the queen, Anne of Austria. In 1642 he fled to England to avoid interrogation about the conspiracy of Cinq-Mars, but on Richelieu's death he promptly returned to France. He then enjoyed Anne's especial confidence, and on Louis XIII's death (May 1643), when she became regent, he hoped to control public affairs. When Jules Mazarin became prime minister, Beaufort, the duchesse de Chevreuse (*q.v.*) and others plotted to supplant him, giving themselves such consequential airs that they were called "les Importants." Convinced that his life was in danger, Mazarin had Beaufort arrested (Sept. 2, 1643).

On May 31, 1648, Beaufort escaped from Vincennes. In Jan. 1649 he presented himself to the rebellious *parlement* of Paris and became one of the generals of the Fronde (*q.v.*). His record, his good looks, his sincerity and his sorties against the royal forces blockading Paris won him the adoration of the populace. From the peace of Rueil (March 1649) to the arrest of the prince de Condé (Jan. 1650) he made common cause with J. F. P. de Gondi, later cardinal de Retz (*q.v.*). Gondi, however, regarded Beaufort and his mistress the duchesse de Montbazon (Marie d'Avaugour) as unfit for serious intrigues and obtained from the court Beaufort's designation as admiral by consenting in his name without his knowledge to the arrest of Condé. After Condé's release and Mazarin's flight from France (Feb. 1651), Beaufort organized the patrols round the Palais-Royal to prevent Anne's taking Louis XIV to join Mazarin. Thereafter Beaufort and Gondi became progressively estranged. When Mazarin returned (Jan. 1652), Beaufort led the troops of Gaston, duc d'Orléans, on Condé's side. On July 30, 1652, he shot his sister Elisabeth's husband, the duc de Nemours (Charles Amédée de Savoie) in a duel. On the collapse of the Fronde he was banished from Paris.

Restored to royal favour in 1658, he concerned himself with his duties as admiral. In 1664 he led the expedition to Djidjelli, the first French attempt on Algeria. Sent as admiral and as "general of the church" to Crete to help the Venetians in Candia against the Turks, he was lost in battle on June 25, 1669. Later generations, believing him to have survived, tried to identify him with the Iron Mask (*q.v.*).

See E. de Lanouvelle, *Gabrielle d'Estrées et les Bourbon-Vendôme* (1936); Isabelle de Broglie, *Le Duc de Beaufort* (1958). (J. G. R.-S.)

BEAUFORT, HENRY (*c.* 1374–1447), English cardinal and bishop of Winchester, who was a dominant figure in English politics during the first half of the 15th century, was the second son of John of Gaunt, duke of Lancaster, by Catherine Swynford. Legitimized with his brothers and sister soon after his parents' marriage in 1396 (*see* BEAUFORT), having studied at the universities of Cambridge and Oxford, and already possessed of livings and royal favour, he became chancellor of Oxford in 1397 and bishop of Lincoln in 1398. The Beauforts moved easily from the reign of their cousin Richard II to that of their half brother Henry IV; and Henry Beaufort began almost at once to play a formidable part in English politics. A member of the royal council and chancellor of England in 1403, he became bishop of Winchester, one of the richest sees in England, in the following year. He resigned the chancellorship in 1405 and led a powerful but moderate opposition group (of which his brothers formed a nucleus and with which the prince of Wales, afterward Henry V, became associated) within the council to the influence and administration of Thomas Arundel (*q.v.*). When the prince's influence was greater (1410–11), Henry was supreme in council and his brother Thomas acted as chancellor; but when the prince went into eclipse Bishop Beaufort went with him. After the accession of Henry V (1413) he again became chancellor. But by 1417 his ambitions flew higher: resigning the chancellorship he departed for the Council of Constance where, having added his weight to the papal side, he was created cardinal and legate *a latere* by the newly elected and grateful Pope Martin V.

The pope was also prudent: the new cardinal legate would be a useful tool in England. Henry V saw the danger clearly and for three years harried his uncle covertly but mercilessly until he resigned his cardinalate and for a time abandoned his Roman ambitions. Overtly his career had continued undisturbed. Under Henry VI his talents had fuller scope. His wealth was legendary; the emoluments of Winchester were multiplied by his judicious financing of an insolvent government, especially after 1422. (One carefully unredeemed loan brought into his possession crown jewels much undervalued; this fraudulent conversion was to add to the deathbed anguish of a surprisingly tender conscience.) Beaufort's generous financing of the state was therefore not wholly disinterested patriotism and his largest loans were made either for financial and political gain or from political necessity. Against the man on whom the government's solvency depended there was little his opponents could do: this was the secret of his resilience in politics and of part of his wealth.

But his desire for power not only in England but as a prince of the church provided armament for his enemies. When Beaufort became cardinal of St. Eusebius and legate in 1426, Humphrey, duke of Gloucester, who had already forced him again to resign the chancellorship which he had held since 1424, made the alleged incompatibility of Roman and English office the excuse for further attack. His legation was questioned in 1428 and his right to hold the see of Winchester as cardinal in 1429; Gloucester tried, on the same grounds, to effect his exclusion from the council early in 1430. But Beaufort survived these and some later onslaughts, and with the support of the young Henry VI he finally displaced Gloucester from leadership in the mid-1430s.

Although never committed to the cause of peace, he conducted fruitless and sometimes nerve-wracking negotiations at Arras in 1435 and at Calais in 1439; these brought a new attack from Gloucester in 1440 but Beaufort retained power until his retirement from politics in 1443. He had led an ineffective crusade against the Hussites in 1427, and two years later attempted to lead another; but the diversion of his troops to the French war brought

him into papal disfavour until 1432 and subsequent pressure at home forced him to abandon his Roman ambitions. But despite this failure, despite his arrogance and self-seeking, his rapacity and his neglect of his diocese, his political and financial acumen enabled Beaufort to dominate English politics for more than 40 years and, though self-interest and loyalty conflicted most cruelly, his career and his record were not unworthy of his talents and of his birth. He died at Winchester on April 11, 1447.

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(P. S. LE.)

BEAUFORT, MARGARET (1443–1509), known as "the Lady Margaret," was the mother of Henry VII of England and foundress of St. John's and Christ's colleges, Cambridge. Born May 31, 1443, she was the daughter and heiress of John Beaufort, 1st duke of Somerset, and was the great-granddaughter of John of Gaunt, duke of Lancaster. Her father died in 1444 and she became the ward of Henry VI's chief minister, William de la Pole, duke of Suffolk; he married her to his son and heir John in 1450, but the marriage was dissolved before March 24, 1453. She married Edmund Tudor, earl of Richmond, half brother to Henry VI, in 1455, but next year became a child-widow, with an infant son, Henry Tudor. She was married again to Sir Henry Stafford, a Lancastrian, by 1464; but he died childless in Oct. 1471. She took as her last husband, before Oct. 1473, Thomas, Lord Stanley, afterward earl of Derby, with whose help her son Henry gained the crown in 1485, her own claims being passed over. She died on June 29, 1509.

Margaret translated various books of devotion and was a valuable patron of the printers William Caxton and Wynkyn de Worde. Under the influence of her confessor John Fisher, later bishop of Rochester, she founded the Lady Margaret professorships of divinity at Oxford and Cambridge in 1502. Also at Fisher's bidding she completed in 1505 the endowment of Christ's college, and in her will left the bulk of her remaining estates to endow St. John's college, for which the charter of foundation was given in 1511.

See C. H. Cooper, *Memoir of Margaret, Countess of Richmond and Derby* (1874); E. M. G. Routh, *Lady Margaret* (1924). (A. R. M.)

BEAUFORT: *see* PORT ROYAL, S.C.

BEAUFORT SCALE, a series of numbers from 0 to 17 to designate the force of the wind. The numbers 0 to 12 were arranged by Adm. Sir Francis Beaufort (1774–1857) in 1806, to indicate the strength of the wind from a calm, force 0, to a hurricane, force 12, "that which no canvas could withstand." The British admiralty accepted the scale for the open sea in 1838 and it was adopted in 1874 by the International Meteorological committee for international use in weather telegraphy.

The Beaufort scale as originally drawn up made no reference to the speed of the wind and various attempts, particularly during the 20th century, have been made to correlate the two. In June 1939 the International Meteorological committee, meeting at Berlin, adopted a table of values referring to an anemometer at a height of six metres (20 ft.). This was not immediately adopted by the official weather services of the United States and Great Britain, where an earlier scale, referring to an elevation of 11 metres (36 ft.), is used. The Beaufort force numbers 13 to 17 were added by the U.S. weather bureau in 1955. The table above shows the wind speed in miles per hour corresponding to each Beaufort number on the two scales, but omits the description of the criteria used in estimating the speed of the wind. The Beaufort wind scale may be used to estimate the wind where there are no wind instruments (*see* ANEMOMETRY).

Beaufort no.	International scale, 1939		British and U.S. scale	
	Descriptive term	Wind speed	Descriptive term*	Wind speed
0	Calm	0–1		less than 1
1	Light air	2–3	Light	1–3
2	Light breeze	4–7		4–7
3	Gentle breeze	8–11	Gentle	8–12
4	Moderate breeze	12–16	Moderate	13–18
5	Fresh breeze	17–21	Fresh	19–24
6	Strong breeze	22–27	Strong	25–31
7	Moderate gale	28–33		32–38
8	Fresh gale	34–40	Gale	39–46
9	Strong gale	41–48		47–54
10	Whole gale	49–56	Whole gale	55–63
11	Storm	57–65		64–72
12	Hurricane	more than 65		73–82
13				83–92
14			Hurricane	93–103
15				104–114
16				115–125
17				126–136

*Terms used by U.S. weather bureau. Other English-speaking countries use slightly different designations.

The Beaufort force numbers 13 to 17 were added by the U.S. weather bureau in 1955. The table above shows the wind speed in miles per hour corresponding to each Beaufort number on the two scales, but omits the description of the criteria used in estimating the speed of the wind. The Beaufort wind scale may be used to estimate the wind where there are no wind instruments (*see* ANEMOMETRY).

(W. E. K. M.; E. M. Bs.)

BEAUFORT SEA is that angle of the Arctic ocean lying north of the 750-mi. Alaska-Canada coast line from Cape Parry west to Point Barrow, and bounded on the east by Banks and Prince Patrick islands.

Coastal navigation is possible only during two or three months of late summer. In the 19th century whaling was carried on extensively. Trading posts have existed at six points, including Barrow and Herschel Island.

There is a clockwise current in Beaufort sea, to which the MacKenzie river and currents through Bering strait contribute. This giant eddy traps ridged and rafted old ice floes, making penetration extremely difficult. Explorations afoot were made by E. de Koven Leffingwell and Vilhjalmur Stefansson, and their colleagues, beginning in 1907. Sir Hubert Wilkins flew over portions as early as 1926. In 1947 the U.S. air force initiated regular weather flights over Beaufort sea and discovered several "ice islands."

The continental shelf underlying Beaufort sea is relatively narrow, seldom exceeding 100 mi. in width. Much of the sea is between 1,500 and 3,000 ft. deep; immediately to the north the bottom drops to about 12,000 ft. To the west is Beaufort basin, where depths of approximately 15,000 ft. have been recorded.

(J. E. CL.)

BEAUGENCY, a town of France in the *département* of Loiret, lies 26 km. (16 mi.) S.W. of Orléans on the Orléans railway. Pop. (1954) 3,250. It is at the foot of vine-clad hills on the right bank of the Loire, crossed there by a bridge of 26 arches dating in part from the 13th century. The château is mainly 13th-century with a massive 11th-century donjon. Portions of the Benedictine abbey remain, including the abbey-church of Notre-Dame, Romanesque but frequently restored. The hôtel-de-ville has a decorated Renaissance façade and the church of St. Étienne is pure Romanesque. The lords of Beaugency were powerful from the 11th to the 13th centuries, when the fief was sold to the crown, afterward passing to the house of Orléans. Joan of Arc defeated the English there in 1429. In 1567 the town was sacked and burned by the Protestants. In Dec. 1870 the German army defeated the French army of the Loire near the river northwest of Beaugency. The town suffered damage in 1940. (AR. E. S.)

BEAUHARNAIS, the name of a French noble family well-known in Orléanais from the 15th century and distinguished in European history from the Napoleonic period. The widow of Jean Jacques de Beauharnais, seigneur de Miramion (d. 1645), was Madame de Miramion (Marie Bonneau; d. 1696) whom Bussy-Rabutin tried to abduct and who in 1661 founded the charitable order for women known as the Miramiones. Claude de Beauharnais (*c.* 1680–1738) was the father of two sons, François (1714–1800) and Claude (1717–84), comte des Roches-Baritaud. François also had two sons, François (1756–1823), marquis de La Ferté-Beauharnais, a deputy in the estates-general of 1789 who emigrated to serve in the royalist army against the Revolution but later adhered to Napoleon; and Alexandre (1760–94), vicomte de Beauharnais, who by his marriage to Josephine Tascher de La Pagerie, the future empress Josephine (*q.v.*), became the father of Eugène de Beauharnais (*q.v.*) and Hortense (*q.v.*), queen of Holland and mother of Napoleon III. Claude, who distinguished himself as a naval officer, married Marie Anne Françoise Mouchard (1738–1813), who as Fanny de Beauharnais kept a literary salon and was the mother of Claude (1756–1819), comte de Beauharnais. This Claude's daughter Stéphanie de Beauharnais (1789–1860)

was adopted by Napoleon I and married in 1806 to Charles Louis, the future grand duke of Baden and is remembered for her conviction that Kaspar Hauser (*q.v.*) was her son. Eugène's two sons, Auguste (1810–35), husband of Maria II of Portugal, and Maximilien (1817–52), husband of the Russian grand duchess Maria Nikolaevna, succeeded in turn to his dukedom of Leuchtenberg. Maximilien's son Nicolas (1843–90) received the Russian title of Prince Romanovski, which remains with his descendants.

BEAUHARNAIS, EUGÈNE DE (1781–1824), French soldier, prince of the empire and viceroy of Italy for his stepfather Napoleon I, was born in Paris, on Sept. 3, 1781. His father, the general Vicomte Alexandre de Beauharnais (1760–94), served in the American Revolutionary War, was deputy for Blois in the estates-general of 1789, commanded the army of the Rhine in May–August 1793, lost Mainz to the Prussians and was guillotined on June 23, 1794. The marriage of the general's widow, Josephine Tascher de la Pagerie (*see* JOSEPHINE), to Napoleon Bonaparte in March 1796 was at first resented by Eugène and his sister Hortense; but their stepfather proved to be no less kind than watchful over their interests. In the Italian campaign (1796–97) and in Egypt (1798–99) Eugène served as aide-de-camp to Bonaparte. The services rendered by Eugène in the *coup d'état* of 18 Brumaire (Nov. 9, 1799) and at the battle of Marengo (1800) established his fortunes. In 1804 he received the title of prince and also was appointed archchancellor of state and colonel-general of the *chasseurs à cheval*.

In 1805, when Napoleon proclaimed himself king of Italy, Eugène became viceroy there with large administrative powers; and in 1806 Napoleon adopted him. Eugène revealed himself a faithful agent, energetic and intelligent. With the help of Giuseppe Prina he reorganized public finances and the civil service, built new roads and introduced the French legal system. At the palaces of Milan and Monza his fine bearing and his benevolent manner won the esteem of the Italian aristocracy.

A soldier by temperament, Eugène took good care of the Italian army. In 1805 Napoleon, mistrusting his capacity as a strategist, had not made Eugène commander of the Italian forces in the war against Austria, but in 1809 he allowed him this honour, appointing Marshal Alexandre Macdonald to supervise him. Defeated at Sacile, Eugène won an important victory at Raab (Gyor) and acquitted himself creditably at Wagram. In 1812 he and his Italian corps distinguished themselves in Russia, at Borodino and at Maloyaroslavets; and in 1813 he fought well in Germany.

In 1814 he held out as long as possible in Italy against the onslaught of the Austrians and Neapolitans, resisting all their attempts to induce him to desert Napoleon. Finally, however, he had to conclude the armistice of Schiarino-Rizzino (April 16). He then retired to Munich, to the court of the king of Bavaria, whose daughter Amelia Augusta he had married in 1806. He resided there with the title duke of Leuchtenberg. He died in Munich on Feb. 21, 1824, leaving two sons and four daughters. There is an edition of his *Mémoires et correspondance* (1858–60) by Baron P. E. A. Du Casse.

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BEAUJEU, an ancient seigniory of France (in the modern *département* of Rhône), which gave its name to the old province of Beaujolais. The seigneurs de Beaujeu gradually enlarged their possessions, from the 10th to the 13th centuries, into a considerable feudal lordship. In 1210 Guichard de Beaujeu was sent by King Philip II Augustus on an embassy to Pope Innocent III; he was present at the French attack on Dover, where he died in 1216. His son Humbert took part in the wars against the Albigenses and became constable of France. Isabeau, daughter of Humbert, married Renaud, comte de Forez; and their second son, Louis, assumed the name and arms of Beaujeu. His son Guichard, called the Great, had a warlike life, fighting for the king of France, for the count of Savoy and on his own account. Guichard's son Édouard I de Beaujeu, marshal of France, fought at Crécy and perished in the battle of Ardres in 1351. His son died without issue in 1374 and was succeeded by his cousin Édouard II, who gave his estates of Beaujolais and Dombes to Louis II, duc de Bourbon, in 1400. Louis's great-grandson Pierre II had the title seigneur de Beaujeu in 1474, when he married Anne (*q.v.*) of France, daughter of Louis XI, that princess being thereafter called "dame de Beaujeu." Louise of Savoy, mother of Francis I, got Beaujolais assigned to herself despite the claims of Anne's son-in-law Charles, the constable duc de Bourbon.

In 1531 the province was united to the French crown, but in 1560 Francis II gave it back to the house of Bourbon-Montpensier, from which it passed to that of Orléans. The title comte de Beaujolais was borne by Louis Charles d'Orléans, youngest son of Philippe Egalité.

BEAULY (a corruption of *Beaulieu*), a village in Inverness-shire, Scot., lies where the Beauly river widens into Beauly firth, 13 mi. W. of Inverness by road. Pop. (1961) 1,112. Of interest are the noble remains of the priory founded about 1230 by John Bisset of the Aird for monks of the Valliscaulian order, and dedicated to the Blessed Virgin Mary and St. John the Baptist. On the right bank of the river stood Lovat castle, long since demolished. Anciently a Bisset possession, it was acquired by Hugh Fraser, forebear of the present Lord Lovat, in the 14th century. The modern castle of Beaufort, 3 mi. S., is the chief seat of the lords of Lovat. There a 13th-century stronghold was successively replaced by several others; of these one, Castle Dounie, was burned by order of the duke of Cumberland in April 1746, after the battle of Culloden. (C. I. F.)

BEAUMANOIR, PHILIPPE DE RÉMI, SIRE DE (*c.* 1250–1296), French administrator, jurist and author of two verse romances; his father, who held the "*beau manoir*" ("fair manor") in the village of Remy, near Compiègne (Oise), became *bailli* of the Gâtinais. Philippe, the second son, traveled in Britain and in 1280 succeeded his brother Girard in the title. He became *bailli* of Clermont (1279–82) and seneschal of Poitou (1284–88) and Saintonge (1287–88); after a mission to Rome (1289), he was successively *bailli* of the Vermandois (1289–91), Touraine (1292) and Senlis (1292–96). He died, Jan. 7, 1296, and was buried at Compiègne.

His romances *La Manekine* and *Jehan et Blonde* are preserved in a single 14th-century manuscript. The dozen lyrics attributed to him by Jeanroy are probably the collective work of a poetic circle in the Beauvaisis. His major work, the *Coutumes de Beauvaisis*, drafted *c.* 1280–83 and continually enlarged and emended, survives in 13 manuscripts, occupying 1,000 pages in the Salmon edition: it is a remarkable early instance of the codification of French customary law which was finally carried through under the later Valois kings.

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BEAUMANOIR, an old Breton seigniory (in the modern French *département* of Côtes-du-Nord), which gave its name to an illustrious family. Jean de Beaumanoir, captain of Josselin and marshal of Brittany for Charles of Blois, is remembered for his share in the battle of the Thirty, celebrated by an unknown trouvère and retold with variations by Jean Froissart. This was an episode in the struggle for the succession to the duchy of Brittany (*q.v.*) between Charles of Blois, supported by the king of France, and John of Montfort, supported by the king of England. John Bramborough, the English captain of Ploërmel, continued his ravages in the district of Josselin in spite of a truce. Beaumanoir sent him a challenge, and on March 27, 1351, a fight took place near Ploërmel, with 30 picked champions, knights and squires, on either side. Beaumanoir's side comprised 30 Bretons, Bramborough's 20 Englishmen, 6 German mercenaries and 4 Brabançons. The battle, fought with lances, swords, daggers and maces, is reminiscent of the last fight of the Burgundians in the *Nibelungenlied*, especially in the advice of Geoffroy du Bois to his wounded

leader, who was asking for water: "Drink your blood, Beaumanoir; that will quench your thirst!" The victory was decided by Guillaume de Montauban, who mounted his horse and overthrew seven of the English champions, the rest being forced to surrender. All the combatants were either dead or seriously wounded, Bramborough being among the slain. The prisoners were well treated and released for a small ransom.

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BEAUMARCHAIS, PIERRE AUGUSTIN CARON DE (1732–1799), one of the two most important French dramatists of the 18th century (the other being Pierre Marivaux), whose comedies, *Le Barbier de Séville* and *Le Mariage de Figaro*, continue to hold and amuse audiences. He was also remarkable for his personality and his adventures.

At Court.—Beaumarchais was born in Paris, Jan. 24, 1732, the son of a watchmaker named Caron. He learned his father's trade and when he was 19 invented an escapement mechanism still used in modern watches. Another watchmaker attempted to steal his invention but Beaumarchais outwitted him: the dispute, settled in his favour, made him famous and led to his introduction at court (1754). He purchased an appointment in the royal household, married a wealthy young widow, Mme Franquet (1756; she died in 1757), and adopted the pseudonym "de Beaumarchais" (from the name of an estate of his wife's). In 1759 he became teacher of the harp to the daughters of Louis XV. He obtained a patent of nobility in 1760 and was able to use his influence with the king to do the financier Joseph Pâris-Duverney a service. Duverney showed his gratitude by enabling Beaumarchais to amass a fortune. While acting as Duverney's agent in Madrid (1764–65), he spent some time trying to persuade one of his sister's Spanish suitors to marry her. The Spanish setting of both "Figaro" plays owes much to this visit. On his return to Paris he made his literary debut.

He had a passion for the theatre, but he attempted a genre which did not suit him—the *drame bourgeois*, a type of serious domestic drama popular at the time. *Eugénie* (Jan. 29, 1767) was only moderately successful. A second *drame bourgeois*, *Les Deux Amis* (Jan. 13, 1770), was a complete failure. He then decided to make a comedy out of a farce he had had privately performed in 1766. This was the beginning of *Le Barbier de Séville*.

The Goëzman Affair.—The play was ready for production when something unexpected happened and led to its postponement for five years. Beaumarchais had not settled all his obligations to Duverney before the latter's death (1770). He was falsely accused of fraud by Duverney's heir, the comte de la Blache; the courts found in Beaumarchais' favour but his opponent lodged an appeal. Meanwhile Beaumarchais was put under house arrest as a result of a fight with the duc de Chaulnes (who was later found guilty of provoking the quarrel). Beaumarchais was imprisoned for breaking house arrest: he was allowed out (under surveillance) to seek audience with his judges, but had to bribe the wife of Louis Goëzman, who was *rapporteur* or secretary to the bench, before he was granted a brief and unsatisfactory interview. Goëzman received a bigger bribe from Beaumarchais' opponent and on his recommendation the judges declared Beaumarchais' financial agreement with Pâris-Duverney void, ordering him to pay the heir a vast sum as well as costs. This ruinous judgment (April 6, 1773) was never implemented. Mme Goëzman had returned most of the bribe given her by Beaumarchais, except for 15 louis which she said had been given to her secretary, but Beaumarchais discovered the secretary had received nothing and opened a public attack on the Goëzmans. An official investigation was ordered. Beaumarchais put his case to the public in a series of brilliant polemical *Mémoires* (1773–74), which won him general sympathy. Although he was sentenced to be officially disgraced (*"condamné au blâme"*), so were his opponents: Goëzman was expelled from the judicature, from which he had earlier been suspended because of another scandal unearthed by Beaumarchais in the course of the pamphlet war. When the verdict was announced (Feb. 26, 1774), the public greeted Beaumarchais as a conquering hero, for he had won a moral victory.

The Secret Agent.—However, the *blâme* deprived him of most of his privileges, including his right to continue sitting as a judge for the Louvre tribunal, a post he had purchased in 1763 and held ever since, and to recover his good name he entered the secret service (March 1774). Sent to London, he stopped the distribution of a scandalous pamphlet about Louis XV's mistress, Mme Du Barry, and returned to Paris. After the accession of Louis XVI (May 1774) he went back to London and then crossed Germany and went as far as Vienna, claiming that he was pursuing the author of a scurrilous libel on the sterility of the marriage of Louis XVI and Marie Antoinette. The empress Maria Theresa was suspicious of his story and had him imprisoned but when he returned to Paris he was well paid and was at last able to have *Le Barbier de Séville* performed (Feb. 23, 1775). It was immensely successful. Though the subject matter was trite, it was a fast-moving play, full of lively dialogue and amusing scenes, and in Figaro he created an original comic character as witty and ingenious as he was himself. It was first made into an opera by Giovanni Paisiello (*q.v.*) in 1782; though very popular, this was superseded by Rossini's version (1816).

For ten years Beaumarchais was involved in many different sorts of activity. He was sent to London (April–Dec. 1775) to recover from another secret agent, the chevalier d'Éon de Beaumont (*see* EON, THE CHEVALIER D') some compromising secret documents, including French plans to invade England. While there he established contact with John Wilkes and the opposition to George III. An ardent supporter of the American revolutionaries, he wrote secretly to Louis XVI and his foreign minister, Vergennes, urging them to intervene in the colonists' favour (Sept. 1775–May 1776). The French government then instructed him to send help to the rebels: he acquired capital, armed and equipped a fleet and dispatched volunteers, stores and provisions (June 1776–81). He was one of the Frenchmen who contributed most to the cause of American independence—he lost a considerable amount of money in the process.

Le Mariage de Figaro.—In 1777 he founded the Société des Auteurs Dramatiques to secure reasonable royalties for playwrights—most of the concessions demanded were secured in three decrees of 1780—and in 1779 he undertook the editing of the complete works of Voltaire (70 vol., 1785–89). At this time he was occupied with *Le Mariage de Figaro*, but it was four years before he saw it performed. Louis XVI disapproved of it but finally consented to its being produced in Paris. The triumphant first night (April 27, 1784) is a memorable date in the history of the French theatre. In *Le Mariage* (published in 1785), the sequel to *Le Barbier*, Figaro was much bolder and mocked both the nobility and absolutism in general; the pre-revolutionary atmosphere gave his attacks extra point. In this play, which was altogether more complex and richer than the previous one, Beaumarchais' comedy reached its peak.

The Coming of the Revolution.—The aftermath of this triumph was less happy. The king, displeased by an attack Beaumarchais had made on the writer of an article hostile to *Le Mariage*, incarcerated him in a prison usually reserved for juvenile delinquents, Saint Lazare, but because of the uproar he was released after a few hours (March 1785). Beaumarchais refused to leave until six days later. In the same year he was attacked by Mirabeau (*q.v.*) for his dealings in a firm he had founded, the Compagnie des Eaux de Paris, and he was libeled in 1786 by a hack employed by Guillaume Kornmann, a minor government official who had been prevented only by Beaumarchais' intervention in 1781 from divorcing and disgracing his young wife in order to obtain her money. In the tedious pamphlet-war that followed, Beaumarchais incurred the enmity of some who were important in the early stages of the revolution. In 1786 he married his third wife, Mlle de Willermaulaz, with whom he had been living (his second wife, whom he married in 1768, had died in 1770); however, he continued to have affairs with other women. From Eugénie, his daughter by his third wife, the present representatives of his family are descended. His opera *Tarare* (1787) was an abortive

work, as was *La Mère coupable* (1792), in which characters from *Le Mariage de Figaro* reappear. He was finishing the construction of a sumptuous mansion on the outskirts of a working-class suburb when the revolution broke out. He endeavoured to mediate, but because of his wealth he was not trusted by the revolutionaries. He was imprisoned and might have perished in the massacres of Sept. 1792 if one of his mistresses had not obtained his release. Nevertheless, he wished to serve the republic and, having secured the post of *commissionaire extraordinaire*, was charged with the task of gaining possession of 60,000 muskets stored in Holland. He was tricked by his enemies, failed (Sept. 1792–Oct. 1794) and once more narrowly escaped the guillotine. In his own defense he wrote *Les Six Époques de ma vie* (1793), an interesting and sometimes brilliant pamphlet. After exile in Hamburg he returned to Paris (July 5, 1796), where his wife, his daughter and his sister were living in poverty in his splendid mansion, which had been ravaged by revolutionary militiamen. He was struggling to restore his fortunes and had again begun literary and political work when he died on May 17, 1799.

Beaumarchais has always had his detractors. He was sometimes unscrupulous, but he loved his family and worked for the common good and for progress. A writer only by chance, he remains a classic of the French theatre. Mozart's opera *Le Nozze di Figaro* (1786) and Rossini's *Il Barbiere di Siviglia* (1816), by isolating the poetic element contained in his two masterpieces, consolidated and increased their renown.

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BEAUMARIS (BIWMARES), a market town and municipal borough in the Isle of Anglesey, Wales, is situated at the northeastern end of the Menai straits 4 mi. from the Menai road bridge to the mainland. Pop. (1961) 1,960. Beaumaris castle, a moated double ring of towered walls built by Edward I in 1295–1323 as a defense against the Welsh, was linked to the sea by canal. The church of St. Mary has an early 14th-century nave. The town, on drained marshland (*beau marais*), was made a borough in 1294 and reached its greatest prosperity in Tudor times. The grammar school dates from 1603 and the assize court from 1614. As county town for Anglesey it continued as a centre for social life, maritime and local trade, until the Industrial Revolution. Beaumaris then became a summer and winter resort and later a yachting centre. Off the easternmost point of Anglesey and 4½ mi. from Beaumaris is Puffin Island (Priestholm) where numerous sea birds breed. There are bus and ferry services between Beaumaris and Bangor. Boats are built locally and slate is quarried in the neighbourhood.

BEAUMONT (BELMONT, DE BELLOMONTE), the name of an Anglo-Norman family descended from ROGER DE BEAUMONT (*c.* 1015–*c.* 1096) of Beaumont-le-Roger in Normandy and his wife Adeline, daughter of Waleran, count of Meulan. Their son, ROBERT DE BEAUMONT (*c.* 1046–1118), count of Meulan and 1st earl of Leicester (?1107), distinguished himself at the battle of Hastings (1066) and was rewarded by William I with lands in Warwickshire, to which he added by inheritance the county of Meulan and the Norman estates of his father. One of the chief advisers of William II, Robert attained even greater prominence in the reign of Henry I, whom he aided in his French wars, commanding a division at the battle of Tinchebrai (1106). His consistent sagacity led Henry of Huntingdon to style him "wisest of all men from here to Jerusalem" (*Historiae Anglorum*, vii, 30). He died at Préaux in Normandy on June 5, 1118.

After his death most of count Robert's French fiefs went to one of his twin sons, WALERAN DE BEAUMONT (1104–66), count of Meulan, while the English fiefs fell to the other twin, ROBERT DE BEAUMONT (1104–68), 2nd earl of Leicester. The landless third son, HUGH (called "the Poor"), received the earldom of Bedford from King Stephen in 1138. Both twin brothers at first supported Stephen and prompted him to imprison the bishops of Salisbury and Lincoln in 1139, thus precipitating the civil war between Stephen and Matilda. Subsequently Robert devoted himself to founding religious houses (notably St. Mary des Prés, better known as Leicester abbey). Waleran profited little from transferring his allegiance to Matilda (1149), but by adhering to Henry Plantagenet (afterward Henry II) when he landed in England in 1153 Robert was taken into the new king's favour. He was appointed in 1155 chief justiciar, a post which he held until his death. While remaining loyal to Henry II in his dispute with Thomas Becket, Robert strove unsuccessfully to reconcile the two. He died on April 5, 1168, and was succeeded by his son, ROBERT DE BEAUMONT (*c.* 1135–90), 3rd earl of Leicester, who joined the rebellion against Henry II in 1173 and for a time lost his English fiefs. He died in Greece in 1190, while on crusade. (For the subsequent history of the earldom, see LEICESTER, EARLS OF.)

Possibly descended from the earlier Beaumonts, LOUIS DE BEAUMONT (d. 1333) was grandson of John of Brienne, king of Jerusalem, and related to Edward II and to his queen, Isabella. Through their intercession he was elected in 1316 to the bishopric of Durham. Before his consecration (1318) Louis was seized by Northumbrian freebooters and, with his brother Henry, was held to ransom. As bishop he did little to defend his troubled diocese against Scottish inroads, instead engaging in quarrelsome litigation, especially with William Melton, archbishop of York. He died in Sept. 1333.

Louis' younger brother, HENRY DE BEAUMONT (*c.* 1283–1340), created Baron Beaumont by writ (1309), was denounced in the Ordinances of 1311 as one of Edward II's favourites. He played a prominent part in the Scottish campaigns of Edward II and Edward III, being present at the battles of Bannockburn (1314), Dupplin (1332) and Halidon Hill (1333) and proving himself a skillful soldier and diplomat. Through his marriage with Alice Comyn, Henry claimed the Scottish earldom of Buchan, and it was under his leadership that Edward Balliol and the "disinherited lords" invaded Scotland in 1332. Accompanying Edward III on his expedition to Flanders, Henry died there on about March 10, 1340. The barony descended in the direct male line to JOHN (1409–60), 6th baron, who was created 1st viscount (1440). At the death of his son WILLIAM (1438–1507), 2nd viscount and 7th baron, the viscountcy expired, and the barony fell into abeyance until 1840 when it was revived in favour of one of the coheirs, MILES THOMAS STAPLETON (1805–54), 8th baron. Miles's granddaughter, MONA JOSEPHINE TEMPEST FITZALAN-HOWARD (1894–), became the 11th holder of the barony. (R. G. Ni.)

BEAUMONT, (JEAN BAPTISTE ARMAND LOUIS LÉONCE) ÉLIE DE (1798–1874), French geologist who prepared, with O. P. A. P. Dufrénoy, the great geological map of France, was born at Canon, Calvados, on Sept. 25, 1798. In 1835 he was appointed professor of geology at the École des Mines. He held the office of engineer-in-chief of mines in France from 1833 until 1847, when he was appointed inspector general; and in 1861 he became vice-president of the Conseil-Général des Mines. He was a member of the Academy of Berlin, of the Academy of Sciences of France and of the Royal Society of London, a senator of France from 1852, and, from 1853, perpetual secretary of the Academy of Sciences. He died at Canon on Sept. 21, 1874.

BEAUMONT, SIR JOHN (1583?–1627), English poet who contributed to the development of the heroic couplet and of a clear and natural poetic style. Elder brother of Francis, the dramatist (*see* BEAUMONT AND FLETCHER), he was a son of Francis Beaumont, justice of the common pleas. After entering Broadgates hall (later Pembroke college), Oxford, in 1597 and the Inner Temple a year later, he inherited Grace-Dieu priory, Charnwood, Leicestershire, in 1605. As a Catholic recusant he forfeited two-thirds of his income and was required to live on his estate, where he entertained Michael Drayton and Ben Jonson. He married

Elizabeth Fortescue and had seven sons and four daughters. Through the duke of Buckingham, whose mother was a Beaumont, he won the favour of James I and Charles I, who made him a baronet in Jan. 1627. He was buried on April 19, 1627, in Westminster abbey, near Chaucer, Spenser and his brother Francis.

Beaumont probably wrote *The Metamorphosis of Tabacco* (1602), a poem on the divine herb which shows his delight in myths from Ovid. It was dedicated to Drayton, who called John and Francis Beaumont "My deare companions whom I freely chose/My bosome friends." His most ambitious poem, "The Crowne of Thornes," in 12 books, was never printed, but it survives in British museum Additional manuscript 33,392, partly in his own handwriting. He mentions this devotional poem in an elegy on Henry, earl of Southampton. In 1625 he wrote a dramatic entertainment for James I, *The Theater of Apollo* (Royal manuscript 18. A. lxx, ed. by W. W. Greg, 1926). *Bosworth-Field, with a Taste of the Variety of Other Poems, Left by Sir John Beaumont* was published in 1629 by his son Sir John, with tributes by Jonson and Drayton. The title poem describes in vigorous verse the battle which took place in Leicestershire in 1485. In every known copy of the book leaf N3 has been cut out, but the censored poem, on the deaths of Catholics in an accident at Blackfriars, is in British museum Stowe manuscript 960. *Bosworth-Field* includes sacred poems such as "In Spirituall Comfort" and "Against Abused Love," poems to James I, Charles I and Buckingham, translations from Horace on quiet country life and elegies on the poet's friends, his brother Francis and his seven-year-old son Gervase, "whose winning love/To me was like a friendship." Further editions appeared in 1710, 1717 and 1790.

Beaumont stood for order and precision in poetry: "Pure phrase, fit Epithets, a sober care/Of Metaphors, descriptions cleare, yet rare." He wrote that James I "leades the lawlesse Poets of our times,/To smoother cadence, to exacter Rimes." Wordsworth praised the "spirit, elegance, and harmony" of Beaumont's verse.

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BEAUMONT, WILLIAM (1785–1853), U.S. army surgeon and physiologist who advanced knowledge of digestion by observing the stomach directly through an external opening into a patient's stomach, was born Nov. 21, 1785, at Lebanon, Conn. He studied medicine with a practitioner and joined the army as surgeon's mate during the War of 1812. In 1819 he was appointed post surgeon at Ft. Mackinac in northern Michigan. There, on June 6, 1822, a Canadian trapper, Alexis St. Martin, was severely wounded in the side by a shotgun discharged at close range. The stomach was lacerated and a permanent fistula (opening) developed. Beaumont saw the opportunity to study digestive processes directly by means of St. Martin's "open stomach." He established the chemical nature of digestion, observed the comparative rates of dissolution of foods, and noted the effect of emotions on gastric secretion. His results were published in 1833 in a classic work, *Experiments and Observations on the Gastric Juice and the Physiology of Digestion*, which was immediately acclaimed in scientific circles. Beaumont died April 25, 1853, at St. Louis, Mo., where he had practiced privately after resigning from the army in 1840.

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BEAUMONT, a city of Texas, U.S., at the head of navigation on the Neches river, 28 mi. from the Gulf of Mexico, 16 mi. by highway N.W. of Port Arthur, and 70 mi. N.E. of Galveston; the seat of Jefferson county. Pop. (1960) city of Beaumont, 119,-175; Beaumont-Port Arthur standard metropolitan statistical area (Jefferson and Orange) 306,016. (For comparative population figures *see* table in TEXAS: *Population*.) Beaumont is a key port of the east Texas petrochemical industry and the second ranking port in Texas. The city was chartered in 1881 and has had a council-manager form of government since 1919.

Before 1800 French and Spanish fur trappers frequented the area. In 1825 Noah Tevis of Tennessee established a town there called Tevis Bluff, and in 1835 he sold 50 ac. of land for a townsite to Henry Millard who allegedly named the place for his brother-in-law, Jefferson Beaumont. The area prospered in the 19th century as a result of the exploitation of the timber growing nearby. The port flourished as a shipping outlet for cotton, sugar cane and cattle, and as an entry point for the illegal African slave trade.

The years after the American Civil War were uneventful until the railroad boom of the 1890s, which eventually brought five lines through the city. When the Spindletop oil well was discovered nearby in 1901, a typical oil boom city sprang up overnight, and the population increased fivefold in 25 years (from less than 10,000 in 1900 to about 50,000 by 1925). Beaumont became the centre of Texas' petrochemical industry which comprises a number of the world's largest oil refineries. The city's industrial activities include ship and barge building, ship repair, the manufacture of drilling and pipeline equipment and the milling of rice products.

Beaumont has its own art museum, a public library and a symphony orchestra. Lamar State College of Technology, a four-year institution with an annual enrollment of more than 6,000 students, was established there in 1923. (E. W. F.)

BEAUMONT AND FLETCHER (fl. *c.* 1607–1625), two English dramatists whose names are associated with a large body of plays most of which were collected in *Fifty Comedies and Tragedies, Written by Francis Beaumont and John Fletcher* (1679). Some they wrote in partnership, some in collaboration with other playwrights and some one or the other wrote unaided: one or two they may have had no share in at all. The plays were popular throughout the 17th century and were a strong influence on Restoration drama. Beaumont and Fletcher were involved either individually or as collaborators in the composition of almost the whole collection, but their individual talents and careers were in some ways markedly different.

FRANCIS BEAUMONT (*c.* 1584–1616) was the son of Francis Beaumont, justice of common pleas, of Grace-Dieu priory, Charnwood forest, Leicestershire. He entered Broadgates Hall (later Pembroke college), Oxford, in 1597 (but took no degree) and the Inner Temple in 1600. There he probably wrote the Ovidian poem *Salmacis and Hermaphroditus* (1602). His career as playwright began *c.* 1606. During collaboration with John Fletcher (*c.* 1607–14; *see* below) he was the dominant partner, mainly responsible for the three best-known plays. "They lived together on the Bankside, not far from the playhouse, both bachelors; lay together; had one wench in the house between them . . . the same clothes and cloak etc." (John Aubrey, *Brief Lives*, *c.* 1680). The partnership apparently ended in 1613 or 1614 when Beaumont married a Kentish heiress. He died in London, March 6, 1616, and was buried in Westminster abbey.

Little is known of the life of JOHN FLETCHER (1579–1625), apart from the records of his plays. He was baptized at Rye, Sussex, on Dec. 20, 1579, the son of Richard Fletcher, who had been president of Bene't (later Corpus Christi) college, Cambridge, and later became bishop of Bristol, of Worcester and (in 1595) of London. The boy may have entered Bene't college in 1591, but probably did not take a degree. He may be the Fletcher whose marriage in 1612 is recorded at St. Saviour's, Southwark, where he is said (by Sir Aston Cokayne in 1658) to have been buried on Aug. 29, 1625, "in the same Grave" as Philip Massinger (*q.v.*), who died 15 years later. It is not known when he started writing plays. His name is first linked with Beaumont's in Ben Jonson's *Volpone* (1607 Quarto), to which both men contributed encomiums. Fletcher began to work with Beaumont probably *c.* 1607 or 1608, at first for the Children of the Queen's Revels and its successor, and then (from *c.* 1609–10 until Beaumont's retirement) mainly for the King's Men at the Globe and Blackfriars theatres. From *c.* 1613 he was often assisted, or his plays were revised, by Massinger, who succeeded him in 1625 as chief playwright of the King's Men; other collaborators included Nathaniel Field and William Rowley (*qq.v.*). Throughout his career he also wrote plays unaided.

The Authorship of the Plays.—The canon of the Beaumont

and Fletcher plays is approximately represented by the 52 plays in the folio *Fifty Comedies and Tragedies* . . . (1679), which had been preceded by a smaller folio in 1647. But any consideration of the canon must omit one play from the 1679 folio (James Shirley's *Coronation*, of which the authorship is fairly conclusively proved by external evidence) and add three not to be found in it (*Henry VIII, Sir John van Olden Barnavelt, A Very Woman*). Of these 54 plays not more than 14 are by Beaumont or Beaumont and Fletcher in collaboration. The other 40 represent Fletcher either unaided or in collaboration with dramatists other than Beaumont, principally Massinger. About a dozen others, including Shakespeare, Jonson, George Chapman, Thomas Middleton and John Webster, have with varying degrees of plausibility been detected, but the chief need is to determine the respective shares of Beaumont, Fletcher and Massinger. Attempts have had to be based on internal stylistic evidence, chiefly through the identification of metrical or linguistic habits sufficiently restricted to one or other of the dramatists in question to be valid as clues. For example, a succession of investigators since 1901 have shown that Fletcher used certain pronominal forms much more freely than the other writers concerned: these include *ye* for *you*, *'em* for *them*, and *'s* for *his*. Since 1874, when F. G. Fleay began his work on the canon (*see* below), metrical tests have shown Fletcher's comparative fondness for feminine endings and his avoidance of rhyme, alexandrines and enjambment. Such tests can be fairly objective, but many readers have also felt able to distinguish differences in tone, choice of material and attitude to life, describing Beaumont, for example, as having greater powers of characterization and deeper feeling than Fletcher, more sentimentality and less indecency and a less mannered style. Full agreement has not been achieved. For a listing of the 54 plays and a summary of modern opinion regarding their authorship and dates, *see* the appendix of this article.

The Major Plays.—For the modern reader the most interesting are the plays written before Beaumont's retirement. Fletcher's *The Faithful Shepherdess* and Beaumont's *The Knight of the Burning Pestle* are very different. *The Knight* has generous humour in its picture of the citizen characters, excellent literary burlesque and a "play within the play" ironically foreshadowing features of the tragicomic romance. *The Faithful Shepherdess* is an attempt to anglicize the pastoral romances of Torquato Tasso and Giovanni Battista Guarini (*qq.v.*); its elaborate patterns achieve that harmony of grave and gay required by tragicomic theory; Fletcher's poetry is here at its freshest, sharing "Dorique delicacy" with Milton's *Comus*, which derives in part from it.

The masterpieces of the collaboration, *Philaster, The Maid's Tragedy, A King and No King*, show, most clearly in the last, the emergence of most of the features that distinguish the Fletcherian mode from Shakespeare, Chapman or Webster: the remote, often pseudohistorical, fairy tale setting; the clear, smooth speech rising to great emotional arias of declamatory rhetoric; the basically sensational or bizarre plot which faces the characters with wild "either–or" choices between extremes and which can be manipulated toward a sad or a happy ending as the playwrights choose; the sacrifice of consistency and plausibility in characterization so that patterns can be made out of constantly shifting emotional states and piquant situations can be prolonged. Specially noteworthy are the long, surprising and wonder-rousing scenes, such as those in the woodland in *Philaster* (act III, scene 3) where Bellario, Arethusa and Philaster are at cross purposes: the harmonies are the helpless pathos of Arethusa, the bitter, bewildered disillusion of Philaster and the pretty self-sacrifice of Bellario, the girl disguised as a pageboy. Scenes similarly orchestrated, though on darker themes, are those in which (*A King and No King*, act III, scene 1) Arbaces discovers that he has a passion for his (supposed) sister Panthea, or in which Amintor (*Maid's Tragedy*, act II, scene 1) realizes that his bride is the king's kept woman, or in which (act III, scene 2) he and his noble friend Melantius face each other with a series of moral impasses (the dramatists cheating about human nature in order to resolve situations developed to extremes for the sake of theatrical excitement).

Thierry and Theodoret has affinities with the three masterpieces but is more lurid; it is notable for its pseudohistory, for the character of Brunhalt the lustful queen (a favourite Fletcherian type) and for containing what Charles Lamb thought the finest scene in Fletcher (act IV, scene 1), in which Thierry's young wife Ordella, veiled, presents herself to him as a willing sacrificial victim whose death, Thierry has been told, will make it possible for him to have an heir—she unveils and he cannot strike her, profoundly moved by her wish to sacrifice her life for love of him. But the teeth are set on edge by Brunhalt's "comic" paramour Protaldye, an evil braggart. Another interesting play of the collaboration is the lively *Coxcomb*, which combines "comicall satyre" (Fletcher's) with the appalling adventures of the chaste and pathetic Viola (Beaumont's), a character closely resembling the keeper's daughter in the Fletcherian part of *The Two Noble Kinsmen;* it can be contrasted with *Cupid's Revenge* (story from Sir Philip Sidney's *Arcadia*), which is significant in the growth of the tragicomic mode especially for the discontinuity in the main character Leucippus and for the uncertain and unexpected tragic ending.

Of Fletcher's unaided plays, six, as E. M. Waith has shown, illustrate most completely the middle kind which he had perfected: *The Mad Lover, The Loyal Subject, The Humorous Lieutenant, Women Pleased, The Island Princess, A Wife for a Month* (all between *c.* 1616 and *c.* 1624). Each of these is a series of extraordinary situations and extreme attitudes, displayed through intense declamations. Moral codes and the human personality are subjected to dislocating pressures so that a new, exciting design can be fashioned from them; the skilful rhetoric and the timeless, remote settings should help us to accept this operation. The best of the six are perhaps *The Loyal Subject*, extraordinarily consistent in obeying its own nature, and *A Wife for a Month*, a florid and loquacious play, in which a bizarre sexual situation is handled with cunning piquancy and the personages illustrate clearly Fletcher's tendency to make his men and women personifications of vices and virtues rather than individuals. Readers who cannot acquire the taste may be better pleased by *Valentinian*, which ably mingles French and Jacobean courtly codes and "servile royalism" with Roman history and contains Fletcher's most elaborate study (comparable with Amintor and Melantius in *The Maid's Tragedy*) of the important heroic theme of noble friendship; or by *Bonduca* (= Boadicea), a well-articulated costume-panorama of the Roman-British wars, very far from the learned realism of Jonson's Roman plays, but not so remote from *Cymbeline*. The best of Fletcher's comedies, for urbanity and consistency of tone, is probably *The Wild-Goose Chase*, a play of episodes rather than of intricate intrigue, but alive with ironic laughter and easy wit.

Lastly, there are the Fletcherian plays in which others besides Beaumont had a hand. *Wit at Several Weapons* is a comedy that might have been written wholly by Middleton and *The Captain* (to which Beaumont may, however, have contributed) is a lively, complex play of sexual intrigue, with tragic dilemmas too. Of the numerous plays in this group a personal preference may be expressed for *The False One* and *The Beggar's Bush*. The former is an original, incisive and moderately subtle treatment of the story of Caesar and Cleopatra which may well have aided Dryden to compose *All for Love* and for which the greater credit goes to Massinger. The latter is worth reading for its "version of pastoral" which genially persuades us that it is better to be a country beggar than a tyrannical king. But neither of these is representative of those features of the canon which modern criticism has most emphasized.

Theatrical and Literary Repute and Influence.—John Dryden states that *Philaster* was Beaumont and Fletcher's first success. From 1616 to the closing of the playhouse in 1642 their plays were probably much more frequently performed at court by the King's Men than those of any other dramatist. The 1647 folio, with encomiums contributed by many famous Cavalier poets, was a major literary event and the favour expressed ("Shakespeare to thee was dull") now seems astonishing. Known facts and figures all support Dryden's statement (*Essay of Dramatick Poesie*, 1668): "their plays are now the most . . . frequent entertainment of the stage; two of theirs being acted through

the year for one of Shakespeare's or Jonson's." Between 1663 and 1682, 38 of the plays were produced, many frequently, but their popularity waned markedly after 1682 and more frequent use was made of "improved" versions: of these about 20 were prepared, by authors who included Sir William Davenant, Sir John Vanbrugh, George Farquhar, Thomas Betterton and Colley Cibber. By 1700 the plays were being dislodged, Shakespeare (usually altered) drawing level. During the 18th century two or three were staged intermittently (especially *The Chances* and *Rule a Wife*). There was a similar decline in critical esteem. They certainly influenced Restoration drama deeply, both serious and comic. Seventeenth-century criticism customarily ranked them with Shakespeare and Jonson as superior to all other English playwrights. Dryden put them third and in his *Defence of the Epilogue, or An Essay on the Dramatique Poetry of the Last Age* (1672) and the preface to his version of *Troilus and Cressida* (1679) defended them against the neoclassical strictures of Thomas Rymer, made in *Tragedies of the Last Age* (1678), but was himself by no means blind to their faults. In the next century, comparatively ignored by the critics, they achieved three collected editions (in 1711, 1750, 1778). In 1798 Monck Mason wrote of them in his *Comments* on the plays as "totally neglected," but in his edition of Massinger (1805) William Gifford followed tradition in ranking Fletcher with Shakespeare and Jonson.

The Romantic critics' radical revaluations did not derive, as earlier ones had, from neoclassical principles. They constitute in general a just and formidable indictment, which has never been satisfactorily met. Lamb commented in *Specimens of English Dramatic Poets . . . About the Time of Shakspeare* (1808) on Fletcher's fondness for "unnatural and violent situations . . . He seems to have thought that nothing great could be produced in an ordinary way . . . Shakespeare has none of this contortion in his mind, none of that craving after romantic incidents, and flights of strained and improbable virtue, which I think always betrays an imperfect moral sensibility." Coleridge added that the plays are "mere aggregations without unity; in the Shakespearian drama there is a vitality which grows and evolves itself from within." He said (in *Literary Remains*, vol. i, lecture viii, 1836) that "In Beaumont and Fletcher you have descriptions of characters by the poet rather than the characters themselves" and he was echoing Richard Flecknoe's opinion (*A Short Discourse of the English Stage*, 1664) when he affirmed that their women are "when of the light kind, not decent; when heroic, complete viragos." He ranked them below Massinger and Jonson, but heartily praised their overflowing comic wit. William Hazlitt (*Lectures Chiefly on the Dramatic Literature of the Age of Elizabeth*, 1820) admired their descriptive and lyrical facility, their mastery "of melting modulation or sounding pomp" and wide range of material, but thought that they sacrificed too much to contriving "ludicrous distresses," willful and violent surprises and "a catastrophe in every scene." Leigh Hunt objected to the mixture of indecency and "servile royalism" with "poetry of the highest order" and produced a bowdlerized edition (1855). Meanwhile four more collected editions appeared, culminating in Alexander Dyce's in 11 vol. (1843–46). Among Victorian critics, the most notable were Henry Hallam (*Introduction to the Literature of Europe in the Fifteenth and Sixteenth Centuries*, vol. iii, 1839), George Darley (in his edition, 1840), W. B. Donne (*Essays on the Drama*, 1858), Swinburne (in the ninth edition of the *Encyclopædia Britannica*, 1875), G. C. Macaulay in *Francis Beaumont* (1883) and A. W. Ward (*A History of English Dramatic Literature*, rev. ed., 3 vol., 1899). They did not much modify the Romantics' case; but there emerge more understanding of tragicomedy as a "mixed kind" and more discrimination between Fletcher's wit and Beaumont's greater dignity and integrity; Swinburne, like most 19th-century critics, judged the plays as dramatic poems rather than stage plays, but confidently distinguished between the pair ("Beaumont was the twin of heavenlier birth") and heaped flowery praise on both: "there hangs about their memory . . . a music of the morning, a breath and savour of bright early manhood."

Later criticism did not respond to this note, although Ward said that they still ranked second only to Shakespeare, and in an article published in 1910 and reprinted in *Contemporaries of Shakespeare* (1919), pp. 143–65, Swinburne moderated his earlier enthusiasm. Work on the canon was begun by F. G. Fleay ("Fletcher, Beaumont and Massinger," *Transactions of the New Shakespere Society*, vol. i, 1874), R. Boyle ("Beaumont, Fletcher and Massinger," *Englische Studien*, vol. v and vii–ix, 1882–87) and E. H. C. Oliphant (*The Plays of Beaumont and Fletcher*, 1927). Later commentators have continued their work and are also concerned with the sources, stagecraft, social and intellectual milieu and the thesis, first propounded by A. H. Thorndike, that the earlier tragicomedies influenced Shakespeare's last plays, especially *Cymbeline*. All this has made it possible for 20th-century critics to see the dramatists as the chief devisers of English tragicomedy, the play of the "fairy-tale" and the "middle mood" (Ristine and Ellis-Fermor), as "entertainers to the Jacobean gentry" or "Jacobean absolutists" (Wallis and Danby) and as transmitters of the "baroque" taste of their period, whereby their flights, straining and contortions correspond to similar features in Rubens or Bernini (Mincoff). (For the titles of these critical works see *Bibliography*.) This has corrected the Coleridgean stress on poetry and characterization at the expense of stagecraft and the Jacobean milieu, but has not checked the mounting disesteem. Rupert Brooke (*John Webster and the Elizabethan Drama*, 1916) went farther than most in describing Fletcherian tragicomedy as "a sea of saccharine," but many would agree that their plays mark the decline of Stuart drama. They now normally rank below such Stuart contemporaries as Chapman, Middleton, Webster, Cyril Tourneur and even perhaps Ford and Massinger himself. Their sexual licence is now less shocking than their constant devaluing of sex. Dispraise of their psychological improbabilities, sacrifice of characterization to piquant stage thrills and frequently mawkish and superficial verse has strengthened and extended the Romantics' censures. T. S. Eliot wrote in *Selected Essays* ("Jonson," Faber and Faber Ltd., London, 1951) that the "blossoms of Beaumont and Fletcher's imagination draw no sustenance from the soil, but are cut and slightly withered flowers stuck into sand." No one has refuted the view of L. C. Knights (*Drama and Society in the Age of Jonson*, Chatto and Windus Ltd., London, 1937): "In these plays tragedy becomes pathos, and pathos an indulgence . . . Each of the tragedies and tragi-comedies . . . is a series of cunningly contrived situations to exploit, not to explore and express, emotions; and that is decadence."

APPENDIX.—The following lists of the 54 plays attempt only to represent summarily the results of some 20th-century research. They are based mainly on E. K. Chambers, *The Elizabethan Stage*, vol. iii (1923), G. E. Bentley, *The Jacobean and Caroline Stage*, vol. iii (1956), and Cyrus Hoy, "The Shares of Fletcher . . ." in *Studies in Bibliography*, vol. viii, ix and xi–xiv (1956–61). These authorities do not always agree; dates assigned are often highly conjectural. The descriptions of each play are based on those of E. M. Waith, *The Pattern of Tragicomedy in Beaumont and Fletcher* (1952).

I. By Beaumont unaided (1):
1. *The Knight of the Burning Pestle* (1607), parody of the type of popular play based on chivalric romances.

II. By Fletcher unaided (15):
2. *The Faithful Shepherdess* (1608–09), pastoral tragicomedy; 3. *The Woman's Prize* (?1611), comedy of trickery; 4. *Bonduca* (1609–11 or 1613–14), historical tragedy; 5. *Valentinian* (1610–14), pseudohistorical tragedy; 6. *Monsieur Thomas* (1610–16), tragicomedy; 7. *The Mad Lover* (1616), tragicomedy; 8. *The Chances* (?1617), romantic comedy; 9. *The Loyal Subject* (1618), tragicomedy; 10. *Women Pleased* (?1619), tragicomedy; 11. *The Island Princess* (?1619–21), tragicomedy; 12. *The Humorous Lieutenant* (?1619), tragicomedy; 13. *The Wild-Goose Chase* (1621), comedy of trickery; 14. *The Pilgrim* (1621), romantic comedy; 15. *Rule a Wife and Have a Wife* (1624), comedy of trickery; 16. *A Wife for a Month* (1624), tragicomedy.

III. By Beaumont and Fletcher in collaboration (10 in all):
(a) In which Beaumont is dominant but including in varying small proportions some Fletcher (4)—17. *The Woman Hater* (1606), comedy of trickery; 18. *Philaster* (1608–10), tragicomedy; 19. *The Maid's Tragedy* (1608–11), tragedy; 20. *A King and No King* (1611), tragicomedy. (b) In which the shares of Beaumont and Fletcher are approximately equal (3)—21. *The Coxcomb* (1608–10), comedy of trickery; 22. *Cupid's Revenge* (1611), tragedy; 23. *Love's Pilgrimage* (?1616), romantic comedy. (c) In which Fletcher's share is the larger (3)—24. *The Captain* (1609–12), mixed comedy; 25. *The Scornful Lady* (1613–17), comedy of trickery; 26. *The Noble Gentleman* (*c.* 1625; perhaps

a revision by Fletcher of an early play by Beaumont, 1605–06), comedy of trickery.

IV. By Beaumont, Fletcher and Massinger (3):
27. *Thierry and Theodoret* (date of composition unknown; printed 1621), historical tragedy; 28. *The Beggar's Bush* (?1622), romantic comedy; 29. *Love's Cure* (?revived 1625), romantic comedy.

V. By Fletcher and Massinger (12; the shares vary a good deal from play to play, the plays being either direct collaborations between the two writers or revisions by Massinger of plays originally by Fletcher alone):
30. *The Little French Lawyer* (1619–23), comedy of trickery; 31. *Sir John van Olden Barnavelt* (1619), historical tragedy; 32. *The Custom of the Country* (1619), tragicomedy; 33. *The False One* (1620), historical tragedy; 34. *The Double Marriage* (1621), pseudohistorical tragedy; 35. *The Spanish Curate* (1622), romantic comedy; 36. *The Sea Voyage* (1622), romantic comedy; 37. *The Prophetess* (1622), historical tragedy; 38. *The Lover's Progress* (1623–34), pseudohistorical tragedy; 39. *The Elder Brother* (1625), comedy of trickery; 40. *A Very Woman* (1625–34), tragicomedy.

VI. By Fletcher with various other collaborators, including plays written by Fletcher and Massinger together with a third and sometimes a fourth collaborator (13):
(a) With Shakespeare (there is no general agreement here, but these assignments probably represent majority opinion)—41. *Henry VIII* (1613), history play; 42. *The Two Noble Kinsmen* (1613), tragicomedy. (b) With Shirley—43. *The Nightwalker* (1633; Shirley's revision of a play by Fletcher, *c.* 1611), tragicomedy. (c) With Field—44. *Four Plays in One* (?1609–12). (d) With Massinger and Field—45. *The Honest Man's Fortune* (1613), tragicomedy; 46. *The Knight of Malta* (1616–18), tragicomedy; 47. *The Queen of Corinth* (1616–17), tragicomedy. (e) With an unknown reviser—48. *Wit Without Money* (1614), comedy of trickery. (f) With Middleton—49. *The Nice Valour* (?1616), mixed comedy. (g) With Rowley—50. *The Maid in the Mill* (1623), romantic comedy. (h) With John Ford, Massinger and Webster—51. *The Fair Maid of the Inn* (1626), tragicomedy. (i) With Massinger, Jonson and Chapman—52. *Rollo, Duke of Normandy or, The Bloody Brother* (?1617–30), historical tragedy.

VII. Plays to which neither Beaumont nor Fletcher contributed (2):
(a) By Middleton and Rowley—53. *Wit at Several Weapons* (1609), comedy of trickery. (b) By Ford—54. *The Laws of Candy* (?1619), tragicomedy.

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(P. UR.)

BEAUNE, the capital of an *arrondissement* in the *département* of Côte-d'Or, France, lies on the Bouzaise river, in the Burgundian wine country, 37 km. (23 mi.) S.S.W. of Dijon. Pop. (1954) 12,316. The town is circular in shape and parts of its old walls, with 13th-century towers and 16th-century bastions, are still in existence while other parts have been replaced by promenades which separate the old town from the suburbs. Two of the great round towers of the ancient château, dismantled by Henry IV, still stand. The most interesting building is the hospital of St. Esprit, the Hôtel-Dieu (*q.v.*), built in 1443 by Nicolas Rolin, the last chancellor of Burgundy. It is in the Flemish style with high-pitched roofs, covered with coloured tiles, and dormer windows, and in the main courtyard, the Cour d'Honneur, there is an outdoor pulpit and a well with 15th-century ironwork. The hospital is still in use and the patients are looked after by a nursing order; one of the wards is used as a museum to house Rogier Van der Weyden's great altarpiece, "The Last Judgment," painted for Rolin. The chief remaining early church is that of Notre-Dame, begun at the end of the 11th century; it contains a beautiful series of 15th-century tapestries representing the life of the Virgin. In the town are a belfry of 1403, many Gothic and Renaissance houses and numerous vast wine cellars. In the Hôtel des Ducs is a wine museum.

Beaune, which lies on the main railway line from Paris to Marseilles, is the centre of the wine trade of Burgundy and the "Vente des Vins des Hospices" (sale of vintage wines) takes place there each November (*see* WINE: *Regional Classification of Wine: Burgundy*). Livestock, cereals, vegetables, oil and vinegar are marketed.

There was a prehistoric settlement there, near a copious spring; and under the Roman empire it had a prosperity due to stock-breeding, agriculture and viticulture. It was fortified at the time of the Germanic invasions (3rd and 4th centuries A.D.), became the seat of a count in the time of Charlemagne, and later an inalienable part of the patrimony of the Capetian dukes. In 1227 it became the first seat of the Burgundian parliament, or *jours généraux*, and a ducal residence. On the death of Charles the Bold it sided with his daughter, Mary of Burgundy; but in spite of the efforts of her husband, the emperor Maximilian, it was taken by the forces of Louis XI in 1478. During the Wars of Religion the town expelled the partisans of the League, which had occupied it, and welcomed Henry IV, who confirmed its communal privileges. The revocation of the Edict of Nantes in 1685, which resulted in the large-scale emigration of Hugenot artisans, dealt a severe blow to its formerly prosperous cloth and leather industries, and it was its vineyards alone which in the 18th century regained for it some measure of prosperity. It was a centre of monastic life and its communities included Benedictines, Franciscans, Dominicans, Carthusians and Oratorians. (L. PE.; L.-N. L.)

BEAUREGARD, PIERRE GUSTAVE TOUTANT DE (1818–1893), Confederate general, was born near New Orleans, La., on May 28, 1818. After graduation from the U.S. Military academy at West Point, N.Y., in 1838, he was appointed lieutenant of engineers. During the Mexican War (1846–48), he accompanied the expedition against Mexico City commanded by Gen. Winfield Scott. In this campaign, he distinguished himself at Veracruz, Cerro Gordo, Contreras and in the assault upon the western gates of the capital city. Following a seven-year tour of engineering duty (1853–60), Beauregard was appointed superintendent of West Point, a position he held for only a few days. After the secession of his native state in Feb. 1861, Beauregard, resigned from the U.S. army and accepted a commission as brigadier general in the Confederate army. He eventually became one of the eight full generals of the Confederacy and participated in almost every important theatre of the war. Beauregard commanded the forces that bombarded Ft. Sumter, S.C., helped defeat McDowell at first Manassas (Bull Run), assumed tactical command at Shiloh after the death of Albert Sidney Johnston, conducted the defense of Charleston and, toward the end of the war, defended the southern approaches to Richmond. He formally surrendered in April 1865. Though he proved to be a capable combat commander, Beauregard revealed serious deficiencies as a general officer. His penchant for questioning the orders of his superiors smacked of insubordination. Though he frequently displayed sound strategic sense, his specific plans were almost always unworkable because of their detail, complexity and lack of realism. In the immediate postwar era, he considered leaving the United States and accepting a foreign command, but decided to remain in Louisiana. He earned a comfortable fortune as a railroad director, adjutant general of the state and manager of the Louisiana lottery. His last years were marked by bitter verbal quarrels with Joseph E. Johnston, Jefferson Davis and William Preston Johnston over their published accounts of the war and Beauregard's role in it. He died in New Orleans on Feb. 20, 1893. Beauregard was the author of *Principles and Maxims of the Art of War* (1863) and *Report on the Defense of Charleston* (1864). *See* also AMERICAN CIVIL WAR.

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BEAUTY BUSH (*Kolkwitzia amabilis*), a hardy deciduous shrub from China that belongs to the honeysuckle family. The twiggy plant, which grows to a height of five to eight feet, is particularly attractive in bloom with its numerous flattish clusters of pink flowers with yellow throats and white bristly hairs that clothe the flower stalks and sepals. It is easily propagated by green wood cuttings. *See* also CAPRIFOLIACEAE. (J. M. BL.)

BEAUTY CULTURE: *see* COSMETICS AND COSMETOLOGY.

BEAUVAIS, capital of the Oise *département* of northern France, lies at the foot of rolling hills where the Thérain river is joined by the Avelon, 74 km. (46 mi.) N.N.W. of Paris by road. Pop. (1954) 24,645. Heavily damaged by bombardments in 1940, the town was rebuilt on the original plan. It is dominated by the Gothic cathedral of St. Pierre, which consists only of a transept and choir with apse and seven apse-chapels. It is the loftiest choir ever built, about 157 ft. high under the vault. The north and south portals with their wooden doors, the stained glass windows (13th to 16th centuries), tapestry, an astronomical clock and a cloister are other features of interest. The cathedral was founded in 949 but work was interrupted by several collapses, the transept being built 1500–48. The older little Romanesque church of the Basse Oeuvre occupies the site intended for the nave. Nearby is the Palais de Justice (towers 14th century, the rest rebuilt in the 16th century), formerly the bishop's palace. St. Étienne's church has a Romanesque nave and Gothic choir with interesting stained glass windows. The ancient ramparts are now occupied by boulevards. Manufactures include carpets, blankets, felt, brushes, chemical products and tractors. The tapestry factory was destroyed in World War II. There is market gardening. Formerly there was trade in grain and wine. From Tille airport (2 mi. N.E.) air services leave for London.

Capital of the Bellovaci tribe, Beauvais was conquered by Caesar in 52 B.C. and called first Caesaromagus, and later Civitas de Bellovacis. In the 9th century it became a countship, which passed in 1013 to the bishops, who became peers of France. The English besieged it in 1346 and 1433. During the siege by the Burgundians in 1472 an enemy standard was seized by a girl, Jeanne Hachette (*q.v.*). Marshal Foch directed operations from the town hall in 1918. The crash on Oct. 5, 1930, of the British airship R-101 at Allonne (4 mi. S.E.) resulted in the cancellation of all airship activity by the British government. During World War II Beauvais was occupied by the Germans from June 8, 1940, to Aug. 1944. *See* also Index references under "Beauvais" in the Index volume. (RO. L.)

BEAUVOIR, ROGER DE (real name EUGÈNE AUGUSTE ROGER DE BULLY) (1806–1866), French writer, more important for his personality than for his writings. Born in Paris, Nov. 8, 1806, he was intended for the diplomatic service but became a writer and one of the dandies who protested by their manner of living against the bourgeois ideal of the early days of Louis Philippe's reign. In his youth he was good-looking and elegant, a man about town and a member of the exclusive Jockey club, a well-known wit whose epigrams went the round of the *salons*. His house had the honour of being described in *La Mode;* one of its chief features was a Gothic room hung with black velvet. At one time he rented an apartment in the Hôtel Lauzun, the 17th-century palace in the Île Saint Louis, where Baudelaire also lived, and the notorious Club des Haschichins met in his rooms. He was the idol of the young men of his day and was said to resemble a nobleman from a Veronese picture. He had always been passionately fond of the theatre and in 1847 married a beautiful actress from the Comédie Française, Éléonore Léocadie Doze, but they separated after a long and notorious lawsuit, following which his mother-in-law had him imprisoned and fined for a satirical poem, *Mon procès* (1849). The last 20 years of his life were spent in unhappy obscurity. He had spent his money too lavishly, lost his looks, grew stout and bald and, during his last six years, crippled by gout, scarcely stirred from his chair. He died in Paris, Aug. 27, 1866. He wrote in the historical horror style fashionable in the early 1830s, when his works had a great vogue. His *Écolier de Cluny ou le sophisme* (1832) is his best and most characteristic work and is said to have given Dumas the idea for *La Tour de Nesle. Le Chevalier de Saint-Georges,* 4 vol. (1840), considered by some his greatest work, enjoyed immense success as a novel and as a play.

See J. Boulanger, *Les Dandys* (1907). (E. ST.)

BEAUX, CECILIA (1863–1942), U.S. painter, whose academic portraits of women and children were especially popular, was born in Philadelphia, Pa., where she became a pupil of William Sartain. However, her real art training was obtained in Paris, with such painters as J. N. Robert-Fleury, Adolphe Bouguereau and P. A. J. Dagnan-Bouveret. In 1890 she exhibited at the Paris exposition. Returning to Philadelphia, she obtained in 1893 the gold medal of the Philadelphia Art club, the Dodge prize at the New York National academy and the Saltus gold medal of the National Academy of Design in 1913. She won the gold medal of the National Institute of Arts and Letters in 1942. Among her portraits are those of Mrs. Theodore Roosevelt and her daughter. Her "Dorothea and Francesca" and "Ernesta and Her Little Brother" are good examples of her skill in painting children. Her autobiography *Background with Figures* was published in 1930. She died Sept. 17, 1942, in Gloucester, Mass.

BEAUX-ARTS, ÉCOLE DES. The École Nationale des Beaux-Arts of Paris was founded in 1671 by Jean Baptiste Colbert, minister of Louis XIV; to this was soon joined an academy of painting and sculpture formed earlier by Cardinal Mazarin. The purpose is to give instruction in drawing, painting, sculpture, architecture and engraving to a fixed number of students selected by competitive examination. The training consists of lectures on diverse subjects and practice in studios under the direction of eminent artists.

Architectural Training.—Beaux-Arts design consists of making a pleasing composition of well-proportioned elements in a well-proportioned whole that will satisfy all practical requirements. Successful graduates are particularly competent in the aesthetic aspect of building. The purpose of the training is to impart a method of studying any problem in architectural design which may be presented. During the years they remain in the École the students take part in a succession of competitions, culminating in that for the Prix de Rome, considered the highest possible honour.

The method of study depends on the following principles: (1) division into ateliers or groups of students, with competitions between and within the ateliers; (2) a tradition of older pupils helping the younger, who in return do various technical tasks for them; (3) the teaching of design and the judgment of the competitions by practising architects; (4) beginning of the study of design as soon as the student enrolls; (5) the system of the *esquisse.* The *esquisse* is a preliminary sketch showing the main ideas of a student's solution of a problem, or *parti,* done on a small scale in a short and fixed time, without the aid of criticism or documents. He must conform to the main features of this sketch in his *rendu,* or final submission. The purpose is to build mental discipline, the ability to channel thinking in a chosen direction. (*See* ARCHITECTURAL EDUCATION: *France.*)

Influence on the U.S.—Architectural education in the United States was from 1900 to 1935 almost entirely under the tutelage of men trained in the system of the Paris school, including Desirée Despradelle at Massachusetts Institute of Technology (1900), M. Prévôt at Cornell (1901) and Paul Cret at the University of Pennsylvania (1903). Among the first Americans to attend the École were Richard M. Hunt, H. H. Richardson and Charles F. McKim (*qq.v.*). The effect of its influence was an increase in the understanding of classic architectural theory and the evolution of architectural forms. About 1935 this system began to be displaced by an essentially German curriculum stemming from functionalism and machine-inspired theory. *See* ARCHITECTURAL EDUCATION: *The United States;* BAUHAUS.

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BEAVER, any of the large aquatic rodents of the family Castoridae. The beaver is characterized by a thickset body, which may reach three feet and weigh more than 60 lb., and a broad, flattened, scaly tail, about one foot long, which is used as a rudder in the water. The ears are small and rounded, and the legs short. Although the five-toed forefeet are small, the hind feet are large and webbed with the second hind toe cleft. The coat, a dense, fine underfur overlaid with many coarse guard hairs, varies in colour from a glossy tan to dark brown, the lower parts being paler. The long, yellowish incisor teeth are ever-growing and chisellike.

JOHN H. GERARD

AMERICAN BEAVER (CASTOR CANADENSIS) AFTER A SWIM

The new world beaver, *Castor canadensis*, once ranged over all of North America northward from northern Mexico, excluding the arctic coastal plain. Once numerous, it is much reduced in numbers and gone from many former haunts. It differs from the Eurasian species mainly in the form of the nasal bones of the skull.

The old world beaver, *Castor fiber*, formerly occurred in England and all of central and northern Europe and central Asia. Except for Scandinavia, it is now found in Europe only in the Elbe and Rhône drainages. It is extinct in England.

Beavers can dive and swim with ease, having the nose and ears provided with watertight valves. They prefer streams and small rivers but also live around the margins of forest-edged lakes. In streams they build strong dams of sticks, stones and mud that may last for many years, impounding pools sometimes many acres in extent. They are industrious animals, often repairing a damaged dam overnight. Eventually silt fills the pond and produces a meadow; in the western United States these meadows are important additions to livestock grazing lands.

Beavers build dome-shaped island lodges of sticks plastered with mud. The interior may be 6 ft. high. When the mud freezes in winter, the lodge becomes impregnable to predators, but one or more tunnel entrances open below the ice level. In rivers and lakes beavers often burrow into banks.

Food usually consists of tender bark, cambium and buds, mainly of aspens, willows and alders, but a wide variety of plant food is eaten. Saplings, even large trees, are felled by gnawing, cut into portable lengths and dragged or floated through beaver-made canals to the pond. Branches, twigs and small logs are cached for winter food by being anchored in the bottom mud in deep water.

Beavers live in colonies, one or more family groups to a lodge. A family usually consists of a mated pair and two sets of offspring. Breeding takes place in midwinter. Two to eight, usually four, young are born four months later. Of placid disposition, beavers often work co-operatively. When alarmed they immediately seek safety in the water.

Beaver fur is highly prized and some of the early 19th-century explorations of western North America were made by trappers seeking beavers. The hides, trimmed and stretched to a circular shape, were a standard medium of exchange. Both sexes possess musk glands in the lower abdomen that produce a musk-smelling liquid, castoreum, once valued for its alleged medicinal properties, but now used in perfumes (*see* CASTOREUM).

Fossil beavers, some exceeding seven feet in length, are known from the Oligocene epoch; one large beaver, *Trogonotherium*, of the later Pleistocene epoch of Europe was contemporaneous with early man (about 1,000,000 years ago).

See also RODENT. (K. R. KN.)

BEAVERBROOK, WILLIAM MAXWELL AITKEN, 1ST BARON (1879–1964), Canadian-born financier and British newspaper proprietor, who at times exercised considerable political influence, won two fortunes and held the rank of British cabinet minister (1918, 1940–42) in World Wars I and II. The son of the Rev. William Aitken, a Presbyterian minister who had emigrated to Canada from Scotland, he was born at Maple, Ont., on May 25, 1879, and was brought up at Newcastle, N.B. At the age of 12 he sold newspapers to earn pocket money, and at 17 he entered a law office in New Brunswick where he began a lifelong friendship, described in his book *Friends* (1959), with Richard Bedford Bennett (afterward Conservative prime minister of Canada and Viscount Bennett). Aitken's meeting with Bennett began his career as a financier; acting on Bennett's advice, he began to sell bonds and soon abandoned the law. He worked at Halifax, Nova Scotia, at Calgary, Alta., and at Montreal, Que., where in 1907 he set up as a stockbroker. He had arranged the amalgamation of the entire cement industry of Canada and had become a millionaire by 1910, when he moved to England. He remained there, but he retained close ties with Canada, often revisiting that country and from the mid-20th century spent two to three months there each year. He represented (1916) the Canadian government with the Canadian forces in Europe during World War I. He made large gifts to the University of New Brunswick at Fredericton and served it first as its chancellor (1947–53), becoming later honorary life chancellor (1954).

As soon as he reached England, Aitken took up politics. He was elected to parliament as Conservative member for Ashton-under-Lyne, Lancashire, in Dec. 1910, and became private secretary to Andrew Bonar Law who in 1911 succeeded A. J. Balfour as leader of the Conservative party. Aitken was influential rather than successful in politics. He helped Bonar Law to secure the party leadership; he worked with him to install Lloyd George as prime minister in place of H. H. Asquith in Dec. 1916; he assisted in the breakup of the Lloyd George coalition in 1922; and he tried, unsuccessfully, to overthrow Stanley Baldwin as Conservative leader in 1930–31. He tried by all possible means, and particularly through the publicity of his newspapers, to force Conservative governments to adopt in full his doctrine of imperial free trade and to disentangle Great Britain from trade arrangements with foreign countries which, in his view, damaged British Commonwealth interests. In this he never was wholly successful.

Beaverbrook never secured a large following in parliament. He was disappointed of office when the Lloyd George government was formed in 1916, and instead went to the house of lords (1917) as Baron Beaverbrook. Later he was to regret this move which he described as "relegation." He had previously received a knighthood (1911) and a baronetcy (Jan. 1916). The rapidity with which honours were showered upon him offended some Conservative traditionalists and reinforced the charge, frequently leveled at him by opponents, that he was a political adventurer. Nevertheless, during his terms of office in World Wars I and II, his energy and drive produced valuable results. Beaverbrook served as chancellor of the duchy of Lancaster and minister of information (1918), was a member of Winston Churchill's war cabinet (1940–42), minister of aircraft production (1940–41), minister of supply (1941–42) and lord privy seal (1943–45). He was British lend-lease administrator in the U.S. in 1942. Beaverbrook wrote vividly of his political experiences in *Politicians and the Press* (1925), *Politicians and the War* (1928, 2nd ed. 1960) and in *Men and Power: 1917–18* (1956). His advice was also sought by Edward VIII, afterward duke of Windsor, during the constitutional crisis which led to the king's abdication in 1936.

Beaverbrook's third career, that of newspaper proprietor, began in Dec. 1916 when he secured financial control of the *Daily Express;* his active control of that paper dates from the end of 1918. He founded the *Sunday Express* which first appeared on Dec. 29, 1918, and he acquired the *Evening Standard* in 1923. All three papers have been stamped with his idiosyncrasy. His championship of individual enterprise was made plain in his book, *Success* (1921). Holding no regard for position or dignity in themselves, and for those people and institutions he disliked, he proved a formidable opponent. His purposes were furthered by the professional and technical skill of his staff, which secured mass circulation for the *Daily Express* and the *Sunday Express*, and earned Beaverbrook another fortune. He died on June 9, 1964, in Surrey.

See T. Driberg, *Beaverbrook* (1956). (J. F.,B.)

BEAVER FALLS, a city of Beaver county, Pa., U.S., on a plateau 50 ft. above the Beaver river, 4 mi. from its confluence with the Ohio, and about 30 mi. N.W. of Pittsburgh. (For com-

parative population figures, *see* table in PENNSYLVANIA: *Population.*)

Producing cold-drawn steel products, corrugated boxes, drilling and excavating equipment, seamless tubing, castings, cork products, motor coaches, ceramics and enamelware, the city is the primary industrial and trading centre of the county.

Almost all of the original townsite, laid out in 1806, was sold to the Harmonists (a religious sect founded in Germany in the late 18th century) in 1849, but adjoining land was purchased and the settlement retained its identity. Beaver Falls was incorporated as a city in 1868. Geneva college, established in 1849 at Northwood, O., by the Reformed Presbyterian Church, was moved in 1880 to College Hill, which later became part of Beaver Falls. The college enrolls more than 1,000 students annually.

(J. A. KE.)

BEAVER MUSK: *see* CASTOREUM.

BEBEL, AUGUST (1840–1913), cofounder of the German Social Democratic party and its most influential and popular leader for more than 40 years, was born in Deutz near Cologne on Feb. 22, 1840, the son of a Prussian noncommissioned officer. After the early death of his father he grew up in extreme poverty at Wetzlar, where he learned turnery. In 1858, after the completion of his apprenticeship, as was then customary, he began to travel as a journeyman. This took him through southern Germany and Austria and finally, in the spring of 1860, through Thuringia to Leipzig, where he settled and where his political career began.

From an early age Bebel, who was physically weak, showed a strong interest in learning and education. In southern Germany and Austria he had come into contact with Catholic journeymen's circles and, although a Protestant, had joined one since it offered certain educational facilities to working men. In Leipzig in 1861 he joined the workers' education club, which, like many other such associations at that time, was formed through the initiative of members of the liberal-minded *bourgeoisie*. In 1865 Bebel became chairman of the Leipzig association. Political and economic circumstances, however, gave the workers' education movement an increasingly political orientation, and this process, which had nothing to do with the acceptance of any established ideology, was significantly reflected in the development of Bebel's own political views. Like the other young workers in the new associations, Bebel had not yet heard anything of the Communist manifesto, Engels or Marx. "For the young generation of workers," he wrote, "the gap between the events of the end of the '40s and the beginning of the '60s, seemed like a century." Only a small minority, whom Bebel strongly opposed, attempted to form a workers' political movement free from the control of the Liberal Progress party. The spokesman of this group was F. Lassalle, and his Allgemeine Deutsche Arbeiterverein (founded in Leipzig in 1863) was in fact an independent organization of the sort that the minority wanted. By its demand for universal suffrage it showed itself to be altogether at variance with the Liberal Progressives.

If in 1863 Bebel believed that the working classes were not ready for the vote, he was already changing his mind when he began his friendship with Wilhelm Liebknecht, who came to Leipzig from Berlin in 1865. Liebknecht, older than Bebel and a man with university training, became in many respects Bebel's mentor. But the more open-minded Bebel always maintained his independence. The Austro-Prussian conflict (1866), which divided German opinion between the advocates of a "Little Germany" and those of a "Great Germany," drove the Saxon workers' associations into an alliance with the radical anti-Prussian democrats, as Bebel and Liebknecht, the workers' leaders, were implacable opponents of Bismarck. The Sächsische Volkspartei (Saxon People's party) was thus brought into being, and in 1867 Bebel entered the constituent *Reichstag* of the North German confederation as a member for this party. This and similar parties in southern Germany were for the workers' associations only a half-way house to the Sozialdemokratische Arbeiter-Partei Deutschlands (Social Democratic Workers' Party of Germany; S.D.A.P.) which constituted itself in 1869 at a congress at Eisenach. The S.D.A.P. affiliated itself to the International Working Men's association (the First International) in London. The "Great German" Eisenach party and the "Little German" Lassalleans differed principally in their attitudes to the Bismarckian solution of the German problem, but under the pressure of common persecution united in 1875.

Already in 1867, as member of the North German *Reichstag*, Bebel had protested against the Bismarckian "greater Prussia," believing that it meant "turning Germany into one great barracks." In his parliamentary speeches he untiringly continued this protest both before and after the founding of the German empire. He and Liebknecht were the only voices to speak against the war loan voted in the *Reichstag* on July 21, 1870, and their action provoked a vehement outcry. As a result of their unyielding stand they were brought to trial on a charge of high treason at Leipzig in March 1872. The sentence of two years' imprisonment may be regarded as an extreme case of "class justice," since the only real accusation against the two men was their political creed. The period of enforced idleness in prison at Hubertusburg strengthened Bebel's delicate health due to tuberculosis and he finally recovered. Also, he was able at last to give himself a systematic education. He concerned himself not only with Marx, Engels and Lassalle but also with Plato and Aristotle, with Thomas More and Machiavelli, with Eugen Dühring, J. S. Mill and Henry Carey, with Charles Darwin, Ernst Haeckel and Ludwig Büchner. Having taken English and French lessons from Liebknecht, he characteristically tried to put his knowledge to practical use by translating Yves Guyot and Sigismond Lacroix's work on the social doctrines of Christianity—and moreover wrote a critical refutation of it (*Christentum und Sozialismus*, 1875).

Beginning with an earlier sentence in 1869, Bebel suffered a total of nearly five years' imprisonment within less than 20 years, though he never once faced any graver charge than that of "spreading doctrines dangerous to the state," *"lèse-majesté,"* "libel of Bismarck" or "libel of the *Bundesrat.*" These sentences constituted a serious threat to his livelihood—the more so because his activities in the party and in the *Reichstag* anyhow cost him great sacrifices. As the party itself could only afford the most essential expenditure and as a member of the *Reichstag* received no allowances, Bebel continued to rely on his income as a craftsman. He had established himself in Leipzig as a master turner and had soon after married the daughter of a railway worker in 1864. Not until the end of the 1880s was he able to live by his writing.

As a writer Bebel had most success with *Die Frau und der Sozialismus* (1879), which went through many editions and was translated into many languages. This book was the most powerful piece of Social Democratic propaganda for decades. Above all, by its combination of science and prophecy, it became the plan of German social democracy in the conditions produced by Bismarck's emergency laws (1878–90). The book contained a detailed account of the utopian Socialist society of the future and gave the members of the oppressed party the strength to hold to their convictions. Bebel himself never doubted that this period of repression under the emergency laws was anything more than an episode, declaring to his opponents in the *Reichstag:* "Your lances will be shattered in this struggle like glass on granite." It was chiefly because of him that the crisis in the party, apparent in the early years after 1878, did not develop into a catastrophe. His unshakable confidence gave his colleagues the courage to stand firmly together, but he opposed all tendencies within the party toward retaliation by force, since terrorism or attempts at subversion might have endangered the very existence of the party.

These tactics were proved right when the emergency laws were allowed to lapse and when in the elections of Feb. 1890 the Social Democrats received nearly 20% of the vote. Bebel's position at the head of the party was now uncontested, and in the *Reichstag* he was the most prominent opponent of the government. Within the party itself he opposed all the "opportunist" tendencies which, since the ending of the anti-Socialist laws, had come out into the open. According to these, features of the existing social and political structure might be developed gradually until social democracy was attained. At the Erfurt congress of 1891 he reproached the leader of the Bavarian Social Democrats, Georg von Vollmar, with belying the "inspiration" of social democracy, without which "a party such as ours cannot exist." "If we set our fine aims fi

in the future and forever emphasize that they will only be realized by later generations, then the masses will quite justifiably desert us altogether." The struggle against open reformism and the theoretical revisionism advocated by Eduard Bernstein at the end of the 1890s reached its climax at the Dresden congress of 1903. Just as he condemned all deviations from the party's official radical creed, so too was Bebel unwilling to yield to left-wing pressure to indulge in extraparliamentary experiments and thus perhaps to bring repression on the party again. It seemed to him that the correct policy was still to adhere to legal parliamentary methods. In fact, in election after election, the party gained new adherents, and Bebel lived to see the day when, in 1912, it became, with 110 seats, the strongest group in the *Reichstag*. He died at Passug, Switz., on Aug. 13, 1913.

Bebel, as no other, embodied the tradition of the German Social Democratic party. Already in 1882 Engels had described him as "a unique manifestation of the German, indeed of the European working class." Certainly the man under whom the German Social Democratic party developed from very small beginnings to become the strongest, most disciplined and best organized in the Socialist International was a unique personality. A member of the *Reichstag* from 1867 almost continuously until his death, he achieved his most celebrated triumphs as a parliamentarian. Even his opponents could not withhold their respect in the face of his passionate honesty. A shrewd contemporary, Hellmut von Gerlach, suggested that in politics Bebel lived from hand to mouth: "His political aims were for the most distant future or for the immediate present"; he did not concern himself with what might lie between. This is true. Bebel believed that the great cataclysm was coming and that the existing order would collapse of its own accord. He had, however, no really systematized political theory, but held to a simple belief in the inevitability of progress, so that his "revolutionary Marxism" is seen on closer inspection to be based on a "development" that moved toward its goal with the irresistible force of a law of nature. To sum up, for him and for the leading body of Social Democratic thought which he represented, political activity essentially consisted in promoting as effectively as possible the politico-social interests of the working classes. His contradictory combination of futuristic revolutionary sentiment and a social policy rooted in the present reflects the equivocal position of his party under the conditions of the new German empire. Exactly because he embodied in himself all the contradictions of the party, he was idolized by the workers as a man of their own kind. This explains to a great extent both the strength of Bebel's position within the party and the political passivity of German social democracy, already noticeable before his death and fully revealed when, on the fall of the empire, the party had to face its first great political test.

In 1910 Bebel's memoirs up to the year 1892 were published under the title *Aus meinem Leben* (new ed. 1953; Eng. trans. of 1st ed., *My Life*, 1912).

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BEBINGTON, a municipal borough (1937) in the Bebington parliamentary division of Cheshire, Eng., 4 mi. S.S.E. of Birkenhead by road. Pop. (1961) 57,202. On the Wirral peninsula, its frontage on the west bank of the Mersey river forms part of the port of Liverpool. At Storeton are extensive freestone quarries. The Port Sunlight model village in Bebington was founded in 1888 for workers in the soap factory and contains the famous Lady Lever Art gallery. Other industries include margarine, processing of organic chemicals and substances and engineering.

BECCAFICO, a common name (derived from the Italian for "figpecker") for the garden warbler *Sylvia borin* of the old world warbler family Sylviidae, but sometimes applied to other *Sylvia* species. The beccafico, about five and one-half inches long, is buff below and gray-brown above. The bird breeds in Europe and winters in Africa. Though chiefly an insect eater, it fattens in autumn upon berries and fruits, including figs, and is one of the small songbirds prized for eating in the Mediterranean countries of Europe. (A. L. RD.)

BECCAFUMI, DOMENICO (DOMENICO DI PACE, called MECHERINO) (*c.* 1486–1551), Italian painter and sculptor, the leading Sienese Mannerist painter, was the son of a peasant, Giacomo di Pace. He took the name Beccafumi from his father's and his own patron. He was born near Siena and died there in May 1551. A visit to Rome about 1510 brought him into contact with the work of Raphael and Michelangelo and he was profoundly influenced by Sodoma after his return to Siena in 1512. His work showed an original sense of colour and curious, elongated forms. In the later 1520s he became official painter to the Sienese republic and he worked there all his life except for short visits to Pisa and Genoa.

Much of his best work is in the Siena gallery. In addition to painting he designed 35 mosaics for the pavement in the Siena cathedral (1517–46) and two bronze angels for the cathedral (1548). Several of his designs were executed by pupils as chiaroscuro woodcuts. (E. K. WE.)

BECCARIA, CESARE BONESANA, MARCHESE DI (1738–1794), criminologist and economist whose *Dei delitti e delle pene* was the most influential volume on the reform of criminal justice ever produced, was born of a noble Italian family in Milan on March 15, 1738. Although he revealed no outstanding talents while attending the Jesuit college at Parma and the University of Padua, he experienced an intellectual awakening after completion of his formal education when he first read the works of Montesquieu. Beccaria quickly became involved in the main currents of 18th-century thought. He contributed regularly to *Il Caffè*, a periodical modeled on the *Spectator* and dedicated to the causes of enlightenment and reform. He occupied the chair of economics in the Palatine college of Milan from 1768 to 1771 and served in various public offices in Milan from 1771 until his death from apoplexy on Nov. 28, 1794.

His *Dei delitti e delle pene* (1764; Eng. trans., J. A. Farrer, *Crimes and Punishments*, 1880) is all the more remarkable when it is recalled that the book was published when the author was only 26 years of age and had no extensive background of study or experience in jurisprudential matters. Beccaria's argument is founded on the utilitarian concept of "the greatest good for the greatest number." In a rational and systematic fashion he attacked the savage criminal procedures and penalties of his day. He denounced the use of torture and secret proceedings in the judicial process. He was the first modern writer to subject the death penalty to fundamental criticism. He argued for the proportioning of penalties to offenses and urged that certainty of penalties is more efficacious than severity. He asserted that prevention of crime is of greater importance than its punishment.

The significance of Beccaria's work was immediately recognized: it has been translated into 22 languages. In France, Voltaire published a commentary on the work. In England tribute was paid to it by such reformers as Bentham and Samuel Romilly. The book stimulated many practical programs of reform, among the most important being those instituted by Leopold of Tuscany in 1789. Although many of the proposals advanced by Beccaria have since been widely adopted throughout the world, the book still retains much interest and significance.

Beccaria's most important work in economics is his *Elementi di economia pubblica*, published in 1804 after his death. He analyzed the division of labour in economic life, and his discussion of population anticipated some of the ideas of Malthus. He was one of the first to apply mathematics to economic analysis.

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BECCLES, a municipal borough and market town of east Suffolk, Eng., 9 mi. W.S.W. of Lowestoft by road or rail, lies on a ridge on the right bank of the river Waveney, which forms the Norfolk boundary. Pop. (1961) 7,330. Beccles ("the meadow by the water") was originally a fishing village. By the 14th century it had become a wool and agricultural town with a fine Perpendicular

church (the detached tower was built in the 15th century). Beccles was incorporated in 1584 and reincorporated in 1835. The grammar school, founded in 1631, was extended in 1953. Printing and bookbinding, engineering, malting and flour milling are the chief industries. Beccles is a yachting centre with an annual regatta. It has a fine open-air swimming pool and there is good fishing.

BÊCHE-DE-MER, a name applied to certain sea cucumbers, sausage-shaped marine animals of the class Echinodermata (*see* Echinodermata: *Holothuroidea*) and especially to the oriental food product prepared from the body wall of these animals. The French term *bêche-de-mer* is derived from the Portuguese *bicho da mar,* meaning "sea worm"; the Malay name, *těripang* ("trepang"), is also used.

The animals are collected mostly in the Indo-Pacific reef area. About 24 species, ranging in length from six inches to more than two feet, are used. After the sand-filled intestine has been removed, the animals are parboiled, dried and smoked, then sorted and packed for shipment, mostly to China but also throughout eastern Asia, and from Madagascar to Japan. The prepared product is soaked, cut into pieces and made into a soup, not unlike turtle soup in taste.

In some Asian countries the production and protection of these protein-rich animals is supervised by governmental fisheries. Bêche-de-mer, as a canned soup product, has been marketed in western countries as a gourmet item. (El. D.)

BECHER, JOHANN JOACHIM (1635–1682), German chemist, physician, scholar and adventurer, is remembered for his theories on combustion which preceded and influenced the theory of phlogiston as enunciated by G. E. Stahl (*see* Chemistry: *The Phlogiston Theory*). He was born at Spires in 1635. After a hard childhood and youth, in which study was difficult because of the necessity of supporting his mother and brothers, Becher began an extraordinary career in which the publication of learned works alternated with enterprises involving colonization and trade. His first book, an edition of Salzthal's *Tractatus de lapide trismegisto,* appeared in 1654, when he was 19, and was followed by a score of works.

Becher's ideas and experiments on the nature of minerals and other substances are set forth in his *Subterranean Physics* (1669). It was his view that substances are composed of three elements, which he called the vitrifiable, the mercurial and the combustible earths. When a substance was burned he supposed that combustible earth was liberated. This concept is the basis on which G. E. Stahl founded his doctrine of "phlogiston."

Becher was active in a variety of projects, some practical and some impractical. At Munich he suggested to the elector of Bavaria the establishment of colonies in South America and a monopoly of the cloth trade, until he was forced to flee by the anger of the merchants; in 1666 he was in Vienna under the protection of Count Zinzendorf, and after an interval in Bavaria was again in Vienna where he proposed a Rhine-Danube canal and the opening up of trade with the Low Countries, and later was employed in experiments for transmuting the Danube sand into gold. He fell into disgrace with Zinzendorf, fled to Holland and then to England, where he died in 1682.

BECHTEL, FRIEDRICH (1855–1924), German philologist, who received his greatest distinction in the field of Homeric criticism and in Greek dialectology, was born Feb. 2, 1855, in Durlach near Karlsruhe. After receiving his earlier education in Durlach and at the *Gymnasium* in Karlsruhe he attended the University of Heidelberg, but later transferred to Göttingen, where he studied Sanskrit under T. Benfey and the Baltic languages under A. Bezzenberger. It was under August Fick, however, that he was trained in classical philology. Bechtel received the doctorate at Göttingen in June 1876. After several years in Berlin he was appointed professor *extraordinarius* at Göttingen in 1884 and *ordinarius* at Halle in 1895. Of his numerous publications the most important are: *Die griechischen Personennamen nach ihrer Bildung erklärt* (with Fick, 2nd ed., 1894); *Lexilogus zu Homer* (1914); *Sammlung der griechischen Dialektinschriften* (4 vol. ed. in collaboration with H. Collitz, 1884–1915); *Die griechischen Dialekte* (3 vol., 1921–24). He died in Halle on March 9, 1924. (J. W. P.)

BECHUANALAND, a territory in southern Africa named after its principal inhabitants, a group of Bantu tribes of Sotho origin, the Bechuana (properly Batswana or, radically, Tswana). It comprises the Bechuanaland protectorate (222,000 sq.mi.) in the north and British Bechuanaland (52,393 sq.mi.) in the south. The latter was annexed to the Cape colony in 1895 and is part of the Cape Province of the Republic of South Africa.

Physical Features.—The protectorate is bounded on the west by South-West Africa, on the north by the Caprivi strip, on the northeast by Southern Rhodesia, on the east and southeast by the Transvaal and on the south by the Cape Province. The southern boundary is the Molopo river and the Ramathlabama *spruit* (a small stream). The protectorate has a mean altitude of about 3,300 ft. The eastern side, along the Transvaal border, is hilly, but the hills soon slope away westward into the Kalahari desert (*q.v.*). The latter is not a desert in the usual sense, having large areas wooded-like parkland, a good crop of grass after the rains, quantities of a kind of melon called *tsama* and water at various depths under the sand, as well as in "pans" after the rains.

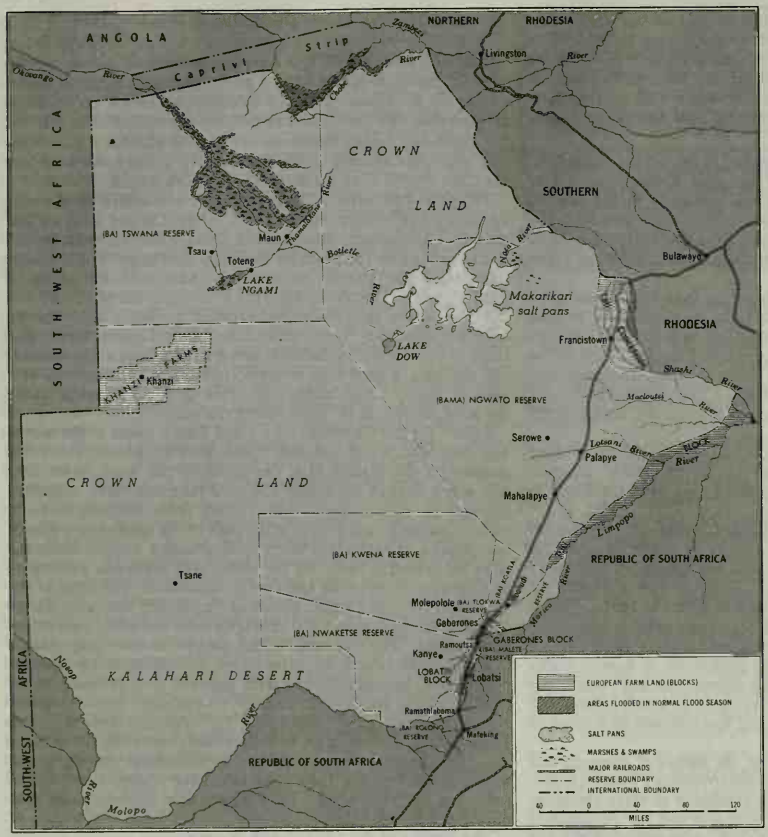
Except for the Okovango (*q.v.*) and Chobe rivers in the northwest, the Marico and Limpopo (Crocodile) on the east and a few streams on the eastern side, the rivers of the protectorate flow only a few days of the year. The need for more water compelled recourse to several expedients. Apart from ordinary wells, a popular means is to dig holes in the beds of the sand rivers; plentiful supplies of water are often thus obtained months after the river has ceased to flow. By the early 1960s there was a considerable program of borehole and dam construction. The delta of the Okovango river, in a region known as Ngamiland, lies in the northwest and differs in aspect and character from any other part of the protectorate. The Okovango enters the protectorate from Angola in a fine broad stream but after 60 mi. of comparatively uninterrupted flow becomes choked with papyrus and dissipates itself in vast swamps which drain into the Thamalakane by a few channels themselves much obstructed by vegetable growth. The Thamalakane discharges in two directions; eastward for 160 mi. along the Botletle river to the great Makarikari salt pans, and southwestward by the Lake river into Lake Ngami (*q.v.*) at the lower end of the swamps. Lake Ngami now receives water only during occasional floods.

The climate of the protectorate is subtropical, varying to temperate. In winter the days are often pleasantly warm and the nights cold, with occasional frosts. The summer is hot. In August, seasonal winds from the west carry sand and dust across the whole country. The average annual rainfall is 18 in., but this varies from 25 in. in the north to 9 in. or less in the western Kalahari. Most of the rain falls between December and the end of April in heavy, short showers.

True forest, except in a large area on the banks of the Chobe, is rare. Much of the territory is covered with savanna woodland, species of *Acacia* predominating. In the northeast, however, mopane (*Colophospermum mopane*), mogonono (*Terminalia sericea*) and mokusi (*Baikiaea plurijuga*) are usually dominant, as morukuru (*Spirostachys africanus*) often is in the middle Kalahari. The Chobe forest consists chiefly of mokwa or bloodwood (*Pterocarpus angolensis*), mokusi and monato or Rhodesian ash (*Burkea africana*). There is much good grazing in the protectorate. Typical grasses are *Aristida, Eragrostis, Panicum, Urochloa, Digitaria, Schmidtia, Cenchrus* and *Setaria.*

The fauna of Bechuanaland consists of various South African animals. Game reserves and bird sanctuaries contain many species of antelope as well as the hippopotamus, giraffe, buffalo, pelican, ostrich, bustard, etc. Crocodiles are found in some of the rivers. The principal fish are the catfish, tiger fish and *Tilapia,* the last two especially in the Okovango and the Chobe rivers. Puff adders, cobras and other poisonous snakes are numerous, as are scorpions, tarantulas and many kinds of spiders, termites, mosquitoes and other insects. (Av. Sy.)

The People.—Bechuanaland is occupied by many peoples of diverse origins and cultures, numbering in all over 300,000. The



BECHUANALAND PROTECTORATE SHOWING THE PATTERN OF SETTLEMENT AND AREAS SUBJECT TO INUNDATION DURING FLOOD SEASON

original inhabitants were Bushmen. The northwestern Bushmen groups, the Naron, Auen, Kung and Heikum, live in Bechuanaland and adjoining parts of South-West Africa, and number about 8,000. They are known as Sarwa (Masarwa) by the Bantu-speaking tribes, who regard them as serfs and inferiors. They perform menial duties and hunting for Bantu, and do not intermarry with them.

The most numerous group is that called Tswana (Batswana or Bechuana) which consists of a cluster of tribes, similar in culture and language, of the western Sotho linguistic grouping of the southern Bantu. The Tswana of Bechuanaland include the tribes known as Rolong, Hurutshe, Kwena (including the Ngwato, Tawana and Ngwaketse), the Kgatla, Tlokwa and Malete. There are other Tswana outside Bechuanaland in South Africa. The first Bantu-speaking tribes to enter Bechuanaland were probably the Kgalagadi, who intermingled with the Bushmen and are usually classed with them. They were followed by the ancestors of the Rolong and the Tlhaping of the Cape Province, and later by the remaining Tswana groups. Tswana tribes were in these regions by A.D. 1600 but were probably not in the modern Bechuanaland before 1700.

During the 19th century there was continual pressure from other Bantu tribes to the east, mainly Nguni-speakers, and many Tswana groups fled into the drier parts of the area, near the Kalahari, forming numerous small splinter groups as they seceded from the originally large clusters. Others followed into Bechuanaland as a consequence of Boer pressure in the Transvaal. Under British administration the main tribes are now independent chiefdoms, each under the rule of a hereditary chief. Most Tswana are at least nominal Christians, missions having worked in Bechuanaland since the early 19th century. Many Tswana find employment outside Bechuanaland, especially in the Transvaal mines.

There are also numbers of European administrators, missionaries and traders living in the protectorate.

For accounts of the culture and social organization of the non-European groups *see* BUSHMAN and TSWANA. (J. F. M. M.)

History.—The Sotho group of peoples, to which the Tswana or Bechuana belong, came into southern Africa at the time of the Bantu migrations (*see* AFRICA: *Ethnography* [*Anthropology*]). In some cases the Tswana have only recently been occupying their present homes. The chiefs of the principal Tswana tribes claim descent from a legendary man named Masilo, supposed to have lived in the 17th century or earlier. Others trace a genealogy to an ancestor even more remote.

A European expedition headed by J. Trüter and W. Somerville visited the Tlhaping of southern Bechuanaland in 1801. These early visitors were followed by the traveler Martin Heinrich (Henry) Lichtenstein and the naturalist W. J. Burchell. The Rev. John Campbell having in 1813 been invited by the chief of the Tlhaping to "send instructors," the London Missionary society established a mission on the Kuruman (properly Kudumane) river. Under Robert Moffat, who took charge in 1821, Kuruman became one of the foremost Protestant missions of southern Africa. About this time the rise of the Zulu power had set up a chain of destructive movement across the continent. Thousands of refugees, fleeing from Chaka's Zulu armies, roamed the countryside pillaging and plundering and in their turn starting fresh waves of migration. In 1823 the Tlhaping, threatened by one such horde, were saved only by Moffat's enlisting the help of Griqua mounted riflemen. In the same year Sebetwane started from the Vaal river and, after fighting his way through Bechuanaland, founded the powerful but short-lived empire of the Makololo in the Zambezi valley.

About 1826 Mzilikazi (Umsilikazi, Mosilikatze), son of Machobane, one of Chaka's captains, after breaking away from his master, settled with his people, the Ndebele, in what is now the western Transvaal. From there he raided extensively into Bechuanaland. These depredations continued even when the Ndebele, after their defeat by the Boers in 1837, had moved to the north. The great trek of the Boers from the Cape Colony (1835 *et seq.*) brought the *voortrekkers* across the Vaal river to the frontiers of Bechuanaland. The Boers disliked the proximity of powerful, independent chiefs; thought that the penetration of Bechuanaland by the missionaries of the London Missionary society and by British traders and hunters would curb Boer expansion northward; and claimed a western boundary that included the "missionaries' road," the highroad from the Cape to the interior, which ran through

Bechuanaland. They came sharply into conflict with David Livingstone (*q.v.*), who had landed in Africa in 1841 and had settled among the Kwena, a senior Tswana tribe, whose chief, Sechele (Setshele), became a Christian. Livingstone sided with the natives in their resistance to the various demands of the Boers, who further suspected him of supplying Sechele with firearms. In 1852 a raid was made on Sechele's town of Dimawe. During the raid Livingstone's mission at Kolobeng, near Dimawe, was ransacked, though by whom was never conclusively proved. The widely publicized raid on Dimawe was only one incident in a struggle that lasted for many years.

In 1867 gold was discovered near the Tati river, in country claimed both by the Ngwato and by the Ndebele. Pres. Marthinius Pretorius of the Transvaal in 1868 proclaimed the annexation of a huge area including the gold fields, but the British government refused to recognize this. At the same time Macheng (Matsheng), chief of the Ngwato, sought without success to persuade the British to occupy the gold fields. In the south the arbitration award of R. W. Keate, lieutenant governor of Natal, in 1871, purporting to define a boundary between the Rolong and the Transvaal, did nothing to abate Boer encroachment. Disorders among the tribes in 1878, quickly suppressed, led to the occupation of southern Bechuanaland by a small police force. On the withdrawal of this force in 1881 the country relapsed into anarchy.

The Pretoria convention of 1881 defined the boundaries of the Transvaal on all sides for the first time but still did not curb Boer encroachment. Quarrelsome chiefs relied on European supporters (not all of them Boers), to whom they promised land and cattle. These so-called "volunteers" then set up the two little republics of Stellaland and Goshen, threatening the "missionaries' road." In 1883 Pres. S. J. P. Kruger of the Transvaal led a deputation to London to seek a revision of the Pretoria convention. The London convention of 1884 conceded to the Boers, among other things, small alterations in the western frontier; but Kruger failed to get the "missionaries' road," though he tried hard to do so. About this time, moreover, German colonization in South-West Africa was causing concern to the British; humanitarians, inspired by John Mackenzie, a successor of Moffat at Kuruman and a vehement campaigner for native rights, were opposing the extension of Boer authority and advocating that the country should be taken under British protection; and Cecil Rhodes (*q.v.*) threw all his weight into a campaign for the annexation of Bechuanaland to the Cape Colony. The British government then decided to establish a protectorate over the territory that later became British Bechuanaland and sent John Mackenzie as the first deputy commissioner. Mackenzie, without men or money, was unable to make much headway against the prevailing anarchy. He was soon superseded by Cecil Rhodes, who did no better. Freebooters from Goshen attacked Mafeking, Kruger annexed the country of the Rolong, the republican flag was hoisted at Mafeking, and the freebooters proceeded to carve up the adjacent native lands. The British government, prompted by these aggressions, sent a strong force under Sir Charles Warren to set matters in order (which he did without firing a shot) and then extended the protectorate northward to the 22nd parallel of south latitude and westward to the 20th degree of east longitude (March 1885). The territory south of the Molopo river was constituted as the crown colony of British Bechuanaland (Sept. 1885; annexed to the Cape Colony, 1895). In 1892 another proclamation considerably enlarged the protectorate by adding thereto the territory between the Shashi and Motloutsi rivers; the Tati district; those territories north of latitude 22° claimed by Khama (Kgama), chief of the Ngwato since 1875; and some vast ill-defined areas lying north and west of Khama's country.

In the early 1890s the protectorate, as Rhodes had intended, became the springboard for the British South Africa company's colonization of Southern Rhodesia. But in 1895 a plan to hand the administration of the protectorate over to the company was frustrated by the action of the three chiefs Khama, Sebele and Bathoen, who, supported by the missionaries, traveled to London and wrung from Joseph Chamberlain an assurance that their people would remain under the protection of the crown. In return they had to surrender strips on the east of their countries for the construction of a railway. The Jameson raid at the end of 1895 completed the ruin of any plans for the company's administration of the protectorate.

In World War I the Tswana supplied a company of the South African native labour contingent. In World War II no fewer than 10,000 Tswana served in the African Pioneer corps in the middle east and in Italy. In June 1946, 1,000 men were recruited to serve for two years in the middle east in the newly formed High Commission Territories corps.

South Africa often expressed the wish that the administration of Bechuanaland (with Basutoland and Swaziland) should be handed to it. The British government's position was made public on June 20, 1935: no transfer was to take place until the inhabitants had been consulted and until parliament had expressed its opinion.

In 1948 Seretse, son of Khama's son Sekgoma II and heir to the Ngwato chiefship, married an Englishwoman, Ruth Williams. For reasons set forth in a White Paper the British government refused to recognize him as chief and excluded him from Bechuanaland. This provoked resentment in the tribe, which culminated in disturbances and bloodshed. Most Ngwato asserted their continued adherence to Seretse and refused to accept or to nominate anyone else as chief. Toward the end of 1956 Seretse was permitted to return to the country, not as chief of the Ngwato, but free to take part in the political life of the tribe.

Population and Settlement.—The African population was 292,755 at the 1946 census; there were 3,173 Europeans, 676 coloureds (of mixed ancestry) and 248 Asians according to the 1956 census. The strips ceded by the chiefs in 1895, now known as the Lobatsi, Gaberones and Tuli blocks, were in 1904 vested in the high commissioner as crown land and, with the exception of certain portions reserved for government purposes, were in 1905 granted to the British South Africa company, which disposed of the land to European settlers. A fourth area of European settlement is the Tati district, around Francistown in the northeast, where the land and mineral rights are owned by the Tati company. The European areas cover about 7,500 sq.mi. Most of the African population lives in the tribal reserves, which occupy about 102,000 sq.mi. and contain towns which are fairly large by African standards. Serowe (*q.v.*), capital of the Ngwato, had a population of at least 30,000 in 1960, and Kanye, capital of the Gwaketse, approaches it in size. There are also sizeable secondary towns in the larger territories. All the land in the protectorate which is not owned by Europeans and is not tribal territory is crown land, comprising an area of about 166,000 sq.mi. A few European farmers of Afrikaner stock farm a block of crown land round Khanzi on the border of South-West Africa.

Administration and Social Conditions.—The protectorate is under the general direction of the high commissioner for Basutoland, the Bechuanaland protectorate and Swaziland, who in turn is responsible to the British government. The protectorate government consists of a resident commissioner and a legislative council with an elected unofficial majority, comprising equal numbers of Europeans and Africans. For administrative purposes the territory is divided into 12 districts, each in charge of a district commissioner.

There are in addition professional and technical officers organized in departments (medical, veterinary, public works, agriculture, education, etc.). The headquarters of the administration were at Mafeking in the Cape Province of the Republic of South Africa, but it was decided to move them to Gaberones inside the protectorate. African affairs are administered through the traditional tribal authorities, who are advised by administrative officers.

Taxation.—The rate of African tax was increased from £1 8*s.* to £2 with effect from Jan. 1, 1958. At the same time it was agreed that tribal treasuries (established in 1938) should receive a rebate of 50% of the tax collected instead of the existing 35%. In addition, after 1949 a tax was levied on Africans which varied according to the property or earnings of the taxpayer. Non-Africans pay a poll tax for every male of 21 years and over, and also income tax.

Living Conditions.—There is little opportunity for wage earning within the protectorate and most of the people live the life of peasant farmers. Housing is generally of the traditional African type though European type housing may sometimes be seen.

There are 9 government hospitals and health centres and more than 30 dispensaries. In addition several hospitals and dispensaries are maintained by missions. Clinics are conducted at outlying villages by both government and mission doctors.

Most social problems are solved according to long established tribal custom of communal responsibility, but destitution is relieved when necessary by public funds.

Justice.—The system of law is South African law, amplified by the Cape statutes promulgated up to June 10, 1891, and by Bechuanaland orders in council, proclamations and high commissioner and government notices subsequently enacted. The courts of justice are the high court (with a judge as president), three classes of subordinate courts (within the jurisdiction of administrative officers) and African courts under the chiefs and their councilors, an appeal lying to the district commissioners.

Education.—There are about 170 primary schools for Africans, 5 secondary schools, a homecraft centre and a teacher training college. Awards or grants are given to enable students to follow post-secondary courses in the protectorate and in South Africa. There are 9 primary schools for Europeans and 5 for Eurafricans.

The Economy.—The economy of the Tswana is based mainly on agriculture and cattle raising, with emphasis on the latter. Because of the lack of industries within the protectorate about 20,000 men a year, recruited by licensed agencies, engage in wage labour in South Africa.

With the scanty rainfall and poor methods, agriculture among the Africans (maize or corn, sorghum, millet, cowpeas, peanuts and tobacco) rarely rises much above the subsistence level. There is an agricultural experimental station at Mahalapye, and extension work is carried out in the reserves. There is also an irrigation scheme at Mogobane. The Tswana are essentially pastoralists. There are more than 1,300,000 cattle in the country, and many sheep and goats. Foot-and-mouth disease is a great danger to livestock and stringent precautions are taken against it.

Trade and Finance.—The principal commercial activity is the export of livestock and livestock products to South Africa, the Rhodesias and the Congo region. The main channel is the abattoir and cold storage at Lobatsi belonging to the Colonial Development corporation. About 62,000 cattle are slaughtered annually for export. There is also a substantial trade in by-products, such as hides, horns and bones.

The chief imports are textiles, general merchandise, vehicles and foodstuffs. The main sources of ordinary revenue, excluding contributions from U.K. Colonial Development and Welfare and grant-in-aid funds, are taxes and duties, postal and telegraph services, and revenues from government property. The protectorate uses the currency of South Africa. The Standard Bank of South Africa Ltd. and Barclays Bank (Dominion, Colonial and Overseas) each have branches at Francistown and Lobatsi and operate agencies from there.

Mining.—There is an old-established gold mining industry in the Tati district. Kyanite, asbestos and manganese are also exported, while occurrences of copper and nickel, and extensive coalfields are known. An important function of the geological survey, financed from Colonial Development and Welfare funds, is the development of the protectorate's underground water resources.

Communications.—With few exceptions the roads of the protectorate are of earth or sand. A good earth road runs through the protectorate beside the railway from south to north, and serviceable roads connect the main road with Kanye (28 mi.), Ramoutsa (3 mi.), Molepolole (36 mi.), Mochudi (3 mi.) and Serowe (42 mi.). The Francistown-Maun road (315 mi.) has been much improved, as also has the Lobatsi-Khanzi road (406 mi.) across the most forbidding part of the Kalahari.

The railway from Cape Town to the Rhodesias runs through the protectorate for 394 mi. on the eastern side. The line (single-track; gauge 3 ft. 6 in.) enters at Ramathlabama on the southern boundary and leaves at Ramaquabane in the Tati district. Formerly owned and operated by the Rhodesia Railways Ltd., the railway was transferred to a statutory body established under the laws of Southern Rhodesia and operating under the laws of Southern Rhodesia, Northern Rhodesia and the Bechuanaland protectorate.

The protectorate has no air service of its own, but there is a chartered air service between Francistown and Khanzi via Maun. There are several airports and landing strips.

A government-owned radio service, controlled by the police, is also available to the public for the transmission of telegrams when there is no other form of telegraphic communication available. At Maun the South African government controls a large radio station providing assistance to civil aviation. (Ay. Sy.)

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BECK, JAKOB SIGISMUND (1761–1840), German philosopher, who was a strong critic of Kantian philosophy and wrote many books on the subject, was born at Marienburg in Prussia on Aug. 6, 1761. Educated at Königsberg, he was appointed professor of philosophy at Halle in 1791 and at Rostock in 1799. He died at Rostock on Aug. 29, 1840.

Beck's major work was a compendium of Kantian philosophy, *Erläuternder Auszug aus den kritischen Schriften des Herrn Prof. Kant*, three volumes (1793–96), of which the third part was entitled *Einzig möglicher Standpunkt, aus welchem die kritische Philosophie beurteilt werden muss*. His contention was that Kant contradicted himself in holding that things in themselves furnish the material of our apprehensions while existing outside the category of causality; this contradiction he explained by saying that Kant's statements about their affective power were to be taken as concessions to popular prejudice. The proper interpretation of Kant's theory, he held, was subjectivist: as knowledge of objects outside the domain of consciousness is impossible, nothing positive is left if we remove the subjective element. God is a symbolic representation of human conscience. Beck also wrote *Grundriss der kritischen Philosophie* (1796), showing the influence of Salomon Maimon; and *Commentar über Kants Metaphysik der Sitten* (1798). Kant disavowed him, and his exegesis came to be neglected as greater attention was paid to Fichte.

BECK, JOZEF (1894–1944), Polish army officer and statesman, was born in Warsaw on Oct. 4, 1894, the son of a lawyer. As a member of the secret military organization headed by Jozef Pilsudski, he fought tsarist Russia as an artillery officer of the Polish legion. After the arrest of Pilsudski by the Germans (July 1917) and the disbanding of the Polish legion, Beck went underground as an officer of the Polish Military organization. On the restoration of Poland, Pilsudski, now head of state, made Beck his liaison officer. From 1922 to 1923 Beck served as military attaché in Paris. After Pilsudski's return to power in 1926, Beck, now a colonel, was the marshal's *chef de cabinet*. On Dec. 6, 1930, he was appointed undersecretary of state in the ministry of foreign affairs and on Nov. 2, 1932, became foreign minister. He followed a policy designed to serve his country's interests mainly by the alliances with France and Rumania and by nonaggression treaties with the U.S.S.R. and Germany. In April 1939 he concluded a Polish-British alliance. After the German-Soviet partition of Poland Beck was interned in Rumania, and was kept under Gestapo guard at Stanesti. He died there of pneumonia on June 6, 1944.

BECKE, FRIEDRICH (1855–1931), Austrian mineralogist and petrologist, whose main contributions were in two fields—in the development of optical methods of research and in the study of a difficult group of metamorphic rocks, the crystalline schists. He was born in Prague, on Dec. 31, 1855, and studied in Vienna, where under the influence of Gustav Tschermak, he took up mineralogy and allied sciences as his life work. He was called to the chair of mineralogy at the University of Vienna in 1898, was appointed rector of the university in 1921, and retired in 1927.

In 1903 he presented to the International Geological congress assembled in Vienna a classic paper on the mineral composition and texture of the crystalline schists, which was published in amplified form in 1913. It contained the first comprehensive theory of metamorphic rocks and proved to be singularly fruitful for further advances in this field. A subsequent contribution on retrogressive metamorphism marked another advance and led to a deeper understanding of many ancient mountain belts.

In 1907 Becke became editor of Tschermak's *Mineralogischen und Petrographischen Mitteilungen.* In 1929 he was awarded the Wollaston medal of the Geological society of London. He died June 18, 1931. (A. Kf.)

BECKENHAM, a municipal borough (1935) of Kent, Eng., which under the London Government Act 1963 was amalgamated on April 1, 1965, with Bromley, Orpington, Penge, and the southern part of Chislehurst and Sidcup to form the new London borough of Bromley (*see* London). Beckenham municipal borough, which includes Shortlands and West Wickham, is residential with a few light industries and lies 10 mi. SE of Charing Cross. Pop. (1961) 77,290. Area 9.3 sq.mi. The parliamentary constituency of Beckenham includes Penge urban district. Beckenham Manor House, reconstructed, is now the Old Council Hall and has a collection of old prints of Beckenham and West Wickham. The parish churches of Beckenham and West Wickham, rebuilt in the 19th century, retain their lych-gates (13th and 15th century respectively). Wickham Court, now Coloma College, was built in 1480 and has some of its original structure. The River Beck flows through Kelsey Park and Cator Park.

BECKER, CARL LOTUS (1873–1945), U.S. historian, was born Sept. 7, 1873, on a farm near Waterloo, Ia. In 1896 he transferred to the University of Wisconsin from Cornell college, Mt. Vernon, Ia., and came under the influence of Frederick Jackson Turner (*q.v.*). Becker received fellowships at Columbia and Wisconsin and took his doctorate at Wisconsin in 1907. He taught at Penn State, Dartmouth, Kansas and Minnesota, and in 1917 settled at Cornell university, Ithaca, N.Y., where he remained for the rest of his life. Ithaca was the ideal environment for Becker. He had time to polish the essays that made him known as a thinker and stylist, and time also to devote to a brilliant group of graduate students. His *Declaration of Independence* (1922) and *Benjamin Franklin* (1946), and his *Heavenly City of the Eighteenth Century Philosophers* (1932) were definite contributions to American and French history, as were also other texts in colonial and modern European history. Becker's presidential address, "Every Man His Own Historian," before the American Historical association in 1931 was a vigorous statement of relativity in the search for historical truth. Despite ill-health, he finished *The Founding of Cornell University,* a congenial subject, before his death at Ithaca on April 10, 1945.

See Charlotte Smith, *Carl Becker: on History and the Climate of Opinion* (1956). (G. S. Fo.)

BECKER, GEORGE FERDINAND (1847–1919), U.S. geologist in charge of the U.S. geological survey for 40 years, was born in New York city on Jan. 5, 1847. He was educated at Harvard university, the University of Heidelberg and the Royal School of Mines, Berlin. Becker taught at the University of California, where he met Clarence King who, in 1879, organized the geological survey to which Becker was one of the first called. His best-known report was the comprehensive *Geology of the Comstock Lode and Washoe District* (1882); his most important theoretical contribution was the *Finite Homogeneous Strain, Flow and Rupture of Rocks* (1893). Becker's chief interest was the study of the interior of the earth. He foresaw that such studies could not be prosecuted successfully without a great body of physical data on the rocks and minerals which compose the earth and established a geophysical laboratory in the geological survey with Carl Barus and William Hallock as physicists.

Becker studied the gold and diamond mines of South Africa in 1896 and was detailed as geologist to the United States army in the Philippines during 1898 and 1899. He died in Washington, D.C., on April 20, 1919. (G. T. Fr.)

BECKER, WILHELM ADOLF (1796–1846), German classical archaeologist, was born in Dresden and was educated at Schulpforta and Leipzig. From 1842 he was professor of classical archaeology at Leipzig. His early studies in the comedies of Plautus had aroused his interest in Roman daily life, and led to his publication of *Gallus* (1838), the story, in 12 scenes, of a Roman youth from Suetonius' *Life of Augustus,* which he embellished to include all aspects of Roman life and customs. The book became a classic in its field, the English translation passing through ten editions between 1844 and 1891. A similar work on the Greek side, *Charikles,* followed in 1840 (8th Eng. ed. rev., 1895). He is also known for his great *Handbuch der römischen Altertümer* ("Handbook of Roman Antiquities," 5 vol., 1843–68), completed after his death by J. Marquardt and T. Mommsen, and works on Roman topography. He died in Meissen on Sept. 30, 1846.

A list of his works is given by Urlichs in *Allgemeine deutsche Biographie.* (M. I. W.)

BECKER-MODERSOHN, PAULA: *see* Modersohn-Becker, Paula.

BECKET, FREDERICK MARK (1875–1942), U.S. inventor and pioneer metallurgist, was born in Montreal, Que., on Jan. 11, 1875. He was graduated from McGill university in 1895 and sought work in the United States in the field of electrical engineering. The next eight years, however, he spent alternating industrial jobs with courses at Columbia university to acquire further knowledge of electrochemistry and metallurgy. In 1903 he helped organize the Niagara Research laboratories, which were acquired in 1906 by the Union Carbide corporation with Becket as chief metallurgist. He became vice-president of the corporation's metallurgical companies and head of its metallurgical research, and served as consultant until his death in 1942. He proposed and developed the process of using silicon, instead of carbon, as a reducing agent in electric furnace metal production—a process that made low-carbon ferroalloys and certain steels practical. He pioneered in the production of electric furnace ferrovanadium, ferromanganese, ferromolybdenum, ferrotungsten and low-carbon ferrochromium—the essential ingredient of stainless steel (*q.v.*). During World War I he made possible tonnage production of previously unavailable ferrozirconium and speeded silicon production for shell steel and aviation use. More than 100 patents, covering a wide range of electric furnace and chemical products, were issued in his name. He died in New York city on Dec. 1, 1942. (A. B. Ki.)

BECKET, THOMAS (À) (1118–1170), by his contemporaries more commonly called Thomas of London, English royal chancellor, archbishop of Canterbury and martyr, was born in London on Dec. 21, 1118. His mother was a native of Caen; his father, Gilbert, belonged to a modest Norman family from the neighbourhood of Rouen, but before Thomas was born he migrated to London, where he prospered in trade, acquired property and was at one time sheriff. Thomas was well educated, first at Merton priory, later at London and Paris, but he never achieved academic distinction. At the age of 21 he was more interested in courtly pursuits (notably hunting) learned from one of his father's friends. After two or three years as clerk to a relative, Osbert Huit-Deniers, about that time justiciar of London, Thomas was brought by clerical friends of his father to the notice of Theobald, archbishop of Canterbury, whose household he joined (*c.* 1142). Among the brilliant young men in Theobald's service he was not at first at ease, though he made some friends; of those by whom he was teased and made to feel inferior Roger of Pont l'Evêque, later archbishop of York and an opponent, is especially mentioned by Thomas' biographers. Thomas was with Theobald when the latter slipped out of the country, defying royal prohibition, to attend

the Council of Reims (1148) and he had a hand in some important negotiations, such as those to prevent the coronation of king Stephen's son, Eustace, in 1152. But his known acts as Theobald's clerk reveal little, if anything, of the man, though the year or more (probably before 1148) that he was allowed—or encouraged—to spend at Bologna and Auxerre on the study of civil and canon law may be thought to have been important for the future. He accumulated the benefices that his position entitled him to expect and became archdeacon of Canterbury, after ordination as deacon in 1154. About the end of that year, on Archbishop Theobald's recommendation, he became Henry II's chancellor.

Chancellor.—In this office Thomas was expected by Theobald and the clerics of his circle to be their friend at court. They were on occasion disappointed. He was reproached in particular for the unusually large financial demands made in 1159 by Henry II on the greater churches of the realm. Two years earlier, in a famous legal case, he energetically supported Battle abbey's claim, in virtue of a royal charter, to exemption from episcopal jurisdiction, though Archbishop Theobald was sympathetic to the bishop's cause (which also had papal support). This was one of his acts as chancellor which as archbishop he felt impelled to try to explain. Yet Thomas' former patron and colleagues continued to expect his co-operation, as in 1160–61, when Theobald was promoting the candidature of Bartholomew, archdeacon of Exeter, to the vacant see of Exeter; Bartholomew was, in the event, elected, though the king had earlier been thought to favour another candidate. Thomas' archidiaconal duties, understandably, do not seem to have received much of his attention after his appointment as chancellor; he resisted the abolition by Theobald of "second aids," an irregular archidiaconal perquisite. In secular matters the chancellor impressed contemporaries by his energy, pomp, administrative ability and diplomatic finesse. An intimate friendship grew between him and the king, about 15 years his junior, who found in him both comrade and counselor. Thomas had a prominent part in Anglo-French diplomacy and war in 1158–60: conducting preliminary negotiations for the betrothal in 1158 of the king's eldest surviving son, Henry, to Marguerite, daughter of Louis VII; organizing the Toulouse campaign of 1159, in the course of which he took the field and is said to have unhorsed a French knight in single combat; and negotiating the ensuing peace.

Archbishop.—Henry's influence secured Thomas' election in 1162 to the see of Canterbury, vacated by the death of Theobald, who may have intended Thomas to succeed him. Thomas was not eager to accept. He was convinced that what he conceived to be his duty as archbishop would inevitably conflict with the king's will. Acceptance would also entail a change in his mode of living that was hard to make. Henry, for his part, confidently expected that Thomas' elevation to Canterbury would not affect their co-operation, except to make it more effective. He was soon undeceived. He expected Thomas to retain the chancellorship; the archbishop insisted on resigning according to custom. Their relations deteriorated rapidly during 1163. At the Council of Woodstock (July 1163) Thomas successfully opposed a proposal to divert to the exchequer a customary payment that was one of the perquisites of the office of sheriff. Nevertheless, the fact that the heir-apparent was left in Thomas' charge suggests that a *modus vivendi* was possible until the great dispute over the customs of the realm began at the Council of Westminster (Oct. 1163). The immediate issue was Henry's claim that clerks convicted of felony in ecclesiastical courts should be punished by the lay power. The archbishop may have contributed something toward making this an issue by tactless handling of a recent case. At Westminster he persuaded his episcopal colleagues to reject the king's claim and to qualify their assent to the ensuing demand that they should observe the customs of the realm. Later some of the bishops wavered (their support may never have been very firm) and Pope Alexander III, confronted by an antipope and conscious of a debt to Henry II for support, urged moderation. In this situation Thomas in Dec. 1163 declared his readiness, after all, to observe the customs of the realm without reservation. What that would mean became plain when the Constitutions of Clarendon (*q.v.*) appeared in the following month. In the main clauses of these constitutions the king sought in terms of custom to define the boundaries between lay and ecclesiastical jurisdictions, to regulate the exercise of excommunication, to control appeals to Rome and to conserve royal rights in episcopal and monastic elections. Most of the constitutions certainly, the others probably, represented (or at least were consonant with) the practice of Henry I's time, as his grandson claimed. To ecclesiastical objectors, including Thomas, this was immaterial; their complaint was that some of the constitutions were in conflict with their reading of canon law. At Clarendon, however, Thomas reluctantly assented to the constitutions, and his colleagues followed him. Henry immediately requested and seemingly expected papal approval of the constitutions; this Alexander III refused. Thomas disregarded his assent given at Clarendon and could plead a papal mandate to do so. The king retaliated in Oct. 1164 by taking measures which evidently had no other object than the ruin of the archbishop. From this intolerable situation Thomas escaped to France in Nov. 1164.

Thomas spent his first two years of exile in the Cistercian abbey of Pontigny and the last four in the Benedictine abbey of Ste. Colombe at Sens, adapting his mode of life to those of his hosts and outdoing them in austerity. He occupied much of his ample leisure in improving his knowledge of the canon law and in corresponding busily with friends and enemies. Negotiations for a settlement continued energetically but were vitiated by the obstinacy of the antagonists. Thomas believed that a papal threat of excommunication and interdict would be immediately effective; Alexander III was reluctant to commit himself to such drastic action. Thomas received from the pope in 1166 wide powers to use ecclesiastical censures and excommunicated a number of prominent English subjects of Henry II, including Richard de Lucy, the justiciar. In 1169 he excommunicated the bishops of London and Salisbury, the former a bitter enemy, the latter hitherto a friend. On both occasions Alexander III intervened to annul the effect of the sentences. Henry II gave further offense in 1170 by causing the archbishop of York to crown the heir-apparent: this was a deliberate infringement of the archbishop of Canterbury's undoubted right to perform the ceremony and it ignored a last-minute papal prohibition. The threat of an interdict immediately produced a reconciliation between king and primate. The matters in dispute were not mentioned, and the unreality of the reconciliation at once became apparent. Thomas suspended, with papal authority, the bishops who had participated in the young king's coronation. These sentences preceded Thomas to England; news of them recrossed the channel to Henry II and provoked him to the rash words that inspired four knights of his household to set out for Canterbury. On Christmas day, 1170, Thomas publicly excommunicated his enemies; four days later, the knights murdered him in his cathedral church.

The murder was a great shock to western Christendom. A cult of the martyr was born at once and quickly spread as far afield as the Holy Land and Iceland (where it had great popularity). Henry II contributed to its dissemination, and his daughters were prominent in introducing it to the lands in which they settled after their marriage. About ten biographies appeared within the decade, and others followed. Miracles wrought by the martyr were officially recorded at Canterbury: within a few years the monks of the cathedral priory were able to present Henry II with a circumstantial record of several hundreds of them. Thomas was canonized in 1173. His shrine at Canterbury long remained a fashionable and popular resort for pilgrims, including the imaginary narrators of Chaucer's *Canterbury Tales*.

Thomas' canonization was a tribute to his posthumous reputation, to the causes he championed and to the circumstances of his death. His personality remains in important respects elusive. His conduct as archbishop is the problem; there are no surprises in his earlier career. His biographers report a stark contrast between his demeanour as archbishop and his earlier behaviour. They may have overdrawn the contrast, influenced by their knowledge of the sequel, but in any case they can scarcely be said to explain it. His ardent defense of the rights of his see is not unexpected; in his defense of the church at large, however, his

attitude is distinguished from that of his few sympathetic colleagues by his refusal to compromise, once he had taken an unequivocal stand in 1164. The stand he took a year earlier on Henry II's proposal for the treatment of felonous clerks was in itself somewhat idiosyncratic in its intransigence. The broad problem that faced him was certainly difficult: to reconcile Henry II's conservative reassertion of the customs of the realm with a developing canon law that was rendering them archaic. A definitive solution was out of the question, but a temporizing agreement might have been possible without injury to conscience. Thomas showed no readiness to negotiate on specific issues; in exile he occupied himself more and more with the general principles governing the relationship of secular to ecclesiastical authority and in this theoretical formulation of the issue he was diverging from his episcopal colleagues. His free use of ecclesiastical censures in 1166, 1169 and 1170 was a stumbling block to agreement. But his intransigence was matched by Henry II's vindictiveness toward the end of 1164 and by his subsequent persistence in trying to vindicate his claims—and the very manner of their formulation at Clarendon had created special difficulties for ecclesiastics. It is difficult to imagine what settlement could have been reached while the archbishop lived. Thomas himself, in his last year of life, came to believe that only by his death could the deadlock be resolved. He did not court death, but he faced it calmly. His removal made possible a compromise which, in practice, secured to Henry II and his successors most of the substance of the Constitutions of Clarendon, yet eliminated those features which Thomas had found most objectionable.

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BECKFORD, WILLIAM (1709–1770), lord mayor of London (1762–63 and 1769–70) and pioneer of the radical movement, was born in Jamaica, W.I., on Dec. 19, 1709, the son of Peter Beckford, speaker of the Jamaican house of assembly. William Beckford was the wealthiest absentee West Indies sugar planter of his generation. He combined business in London with the life of a country gentleman in Wiltshire. Elected to parliament for Shaftesbury in 1747, he became alderman of Billingsgate ward in 1752, and he represented the City in parliament from 1754 until his death. From 1756 he developed a close political connection with William Pitt the elder, and through him important popular city interests, hitherto usually in opposition, were for the first time brought into close alliance with the government. These interests resented the retirement of Pitt and the terms of the peace of Paris, and in 1763 Beckford gave strong support to John Wilkes. From 1761 he had begun criticizing the system of parliamentary representation, and during the crisis of 1769 over Wilkes and the Middlesex election he was a strong supporter of agitation for the abolition of "rotten" boroughs. While Wilkes won popularity for the Wilkite movement, it was Beckford who inspired its leaders and provided a program of reform—shorter parliaments, a place and pension bill and more equal representation of the people. He broke through all court etiquette when presenting a City remonstrance to the king, again on Wilkes' behalf, on May 23, 1770; George III having rejected the petition in a discourteous manner, Beckford appalled the courtiers by answering in a firm but respectful speech, the approximate text of which was engraved on his monument in Guildhall. Beckford died in London on June 21, 1770.

See Lucy S. Sutherland, *The City of London and the Opposition to Government 1768–1774* (1959). (I. R. C.)

BECKFORD, WILLIAM (1760?–1844), the eccentric author of the oriental novel *Vathek*, was probably born on Oct. 1, 1760, at Fonthill Gifford, Wiltshire. His father, William Beckford, who derived a huge income from sugar in Jamaica, was twice lord mayor of London and a friend of the earl of Chatham, who stood godfather to his son. The boy was idolized. At the age of five he received piano lessons from Mozart, then eight years of age. He was taught architecture by Sir William Chambers and drawing by Alexander Cozens, whose romantic reputation as a son of Peter the Great fired his imagination. He was naturally talented, but the adulation he received induced an arrogant and unstable temper in him which dominated his life. In his 11th year his father died, leaving him a large fortune.

In 1777 he went to Geneva and thence made the grand tour. An account of his experiences, called *Dreams, Waking Thoughts, and Incidents*, was published in 1783, but it was so singular a work that he was persuaded to recall all but six copies. He married, in 1783, Lady Margaret Gordon; and although he was dogged by scandals in which he had previously been involved, the marriage was a happy one. But his wife died in 1786, after the birth of their second daughter. Beckford spent many years abroad and published accounts of his travels in *Italy; With Sketches of Spain and Portugal* (1834) and *Recollections of an Excursion to the Monasteries of Alcobaça and Batalha* (1835). From 1796 his energies were devoted to his Gothic "abbey" at Fonthill, his estate in Wiltshire. His architect was James Wyatt, but Beckford himself supervised the planning and building of what became the most extraordinary house in England. He furnished it with works of art and with books that included the entire library of Edward Gibbon, purchased en bloc at Lausanne. He lived at Fonthill as a recluse, with only a few intimates and domestics, from 1807 until 1822, when he sold it. Shortly afterward, the 260-ft. tower fell and laid the house in ruins. Beckford died at Bath on May 2, 1844.

Vathek, the book on which his fame chiefly rests, was written in 1782, in French. He commissioned Samuel Henley to make an English translation, intending to publish the two versions simultaneously. But while Beckford's attention was distracted by his wife's death, Henley published the translation anonymously in 1786, claiming in the preface that it had an Arabic original. Beckford's own text appeared the following year, but he had been robbed of his due acclaim. *Vathek*, the story of a caliph who sold himself to the powers of evil, belongs to the genre, then popular, of the oriental tale. Byron pronounced it superior to Dr. Johnson's *Rasselas*, but his comparison was hardly just, since he admired the detail, not the fable. Nevertheless the book is a masterpiece of fantastic invention, bizarre, colourful and sustained, culminating, with the final hopelessness of the Hall of Eblis, in prose passages of a gloomy and surrealist magnificence unique in its kind.

Among Beckford's other books are *Modern Novel Writing, or the Elegant Enthusiast* (1796) and *Azemia* (1797), burlesques of the novel of sensibility.

The Episodes of Vathek was translated by Sir F. T. Marzials, with French text (1912). Beckford's *Journal* of his travels in Portugal and Spain and *Life at Fonthill, 1807–22* were edited by Boyd Alexander (1954 and 1957).

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BECKLEY, a city of West Virginia, U.S., 72 mi. S.E. of Charleston and the seat of Raleigh county. (For comparative population figures *see* table in WEST VIRGINIA: *Population.*) It is the commercial centre of the New River and Winding Gulf coal fields, often called the Smokeless coal fields. Gen. Alfred Beckley established the first settlement in 1838, but the city's real growth dates from the beginning of coal mining in the region. The first commercial shipment from the mines was made in 1890. Grand View park, a state park overlooking New River gorge, is 10 mi. from the city.

Beckley is the site of several hospitals, including the Raleigh General hospital, the Beckley Memorial hospital (a hospital of the United Mine Workers), the Pinecrest sanitarium (a state tubercular hospital) and a U.S. veterans hospital. At an altitude of 2,438 ft., Beckley is noted for its mild summer climate. Beckley college, an independent junior college, opened in 1933, enrolls several hundred students annually. (K. K. McC.)

BECKMANN, MAX (1884–1950), German Expressionist painter, whose greatest works dealt with the human situation, in the portrayal of which he was unsurpassed by his contemporaries. He was born in Leipzig, Feb. 12, 1884, and was active chiefly in Berlin, Frankfurt and Amsterdam to which he fled in 1937 from Nazi persecution. In 1947 he went to St. Louis, Mo., to teach at Washington university and in 1949 to New York where he taught at the Brooklyn Museum art school. While he had the greatest admiration for Rembrandt, Goya and Munch, the subjective impressionism of Lovis Corinth was the basis of his early style in which epic themes were monumentally conceived. The traumatic impact of World War I profoundly changed his style to one influenced by the expressive distortion of late medieval art and conditioned by his new concept of space design. His commentaries of the early 1920s on life's futility and the bestiality of man were phrased in symbolism of great plastic force, equally evident in his brilliant graphic work and his canvases. About 1930 French influence brought more ample forms and more splendid colour and encouraged primarily formal pictures, such as his inventive still lifes and weighty landscapes. Yet, his work culminated in the psychologically penetrating nine great triptychs of personal iconography created during the last 18 years of his life.

Beckmann is best represented in the Museum of Modern Art, New York, the City Art museum, St. Louis, the Minneapolis Institute of Arts and the Museum of Fine Arts, Boston.

Beckmann died in New York city on Dec. 27, 1950.

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BECKWITH, JAMES CARROLL (1852–1917), U.S. painter, whose portraits in the French academic tradition were representative of the American art of the day, was born at Hannibal, Mo., on Sept. 23, 1852. He studied at the National Academy of Design, New York city, and in Paris (1873–78) under Carolus Duran. Returning to the United States in 1878, he became a prominent figure in U.S. art.

Beckwith took an active part in the formation of the Fine Arts society and was president of the National Free Art league which worked to secure the repeal of the U.S. duty on works of art. Among his portraits are those of W. M. Chase (1882), X. Jordan (1883), Mark Twain, T. A. Janvier, Gen. John Schofield and William Walton. In 1904 he exhibited at St. Louis "The Nautilus" and a portrait of Mrs. Beckwith.

He died in New York city on Oct. 24, 1917.

BECKX, PIERRE JEAN (1795–1887), 22nd general of the Society of Jesus, was born in Zichem, Brabant, Belg., on Feb. 8, 1795. He entered the order in 1819 at Hildesheim, in the Prussian province of Hanover, and was elected general in 1853. His best-known work, *Der Monat Mariä*, was published in English (*The Month of Mary*) in 1883. Beckx's long tenure of office was marked by rapid growth and increased missionary activity, as well as by opposition to the order in Germany, France, Spain and Italy. He died in Rome on March 4, 1887.

See A. M. Verstraeten, *Leven van . . . Petrus Beckx* (1889); C. Sommervogel, *Bibliothèque de la Compagnie de Jésus*, vol. i (1890). (E. J. Bs.)

BECQUE, HENRY FRANÇOIS (1837–1899), French dramatist and critic, born at Neuilly on April 18, 1837, whose play *Les Corbeaux* (1882) marked a turning point in the history of French drama and made of Becque an unwilling *chef d'école*. With it Becque broke with the tradition of the conventional well-made play and offered a public accustomed to Émile Augier, Alexandre Dumas and Victorien Sardou a realistic picture of life: human "carrion crows" are seen despoiling a defenseless widow and her daughters. The performance of this play gave rise to feelings comparable with those provoked by Victor Hugo's *Hernani*. *La Parisienne* (1885), equally outstanding, gives proof of fine stagecraft and keen observation of human nature; it has a gay yet bitter epilogue, the one-act play *Veuve* (1897). *La Navette* (1878), a one-act play is in the same vein as *La Parisienne;* the unfinished *Les Polichinelles*, inspired by Becque's contact with the stock exchange, resembles *Les Corbeaux* in tone and technique.

These plays far outstrip Becque's earlier dramatic works, now forgotten: his opera *Sardanapale* (1867), with music by Victorin Joncières; *L'Enfant prodigue* (1868), an indifferent light comedy performed through Sardou's influence; *Michel Pauper* (1870), a rhetorical piece with socialist leanings; and *L'Enlèvement* (1871), a verbose comedy. Though often called the first of the realists in the *théâtre libre* style, Becque can be considered as continuing the classical tradition from *Les Corbeaux* onward. In his critical writings—*Querelles littéraires* (1890), *Souvenirs d'un auteur dramatique* (1895) and *Conférences* (published posthumously, 1926) —he attempted to wean the theatre from Dumas, Eugène Scribe and Henri Meilhac, and lead it to a conception akin to that of the 17th century. He died in Paris on May 12, 1899. His complete works, in seven volumes, were edited by J. Robaglia (1924–26).

See A. Arnaoutovitch, *Henry Becque*, 3 vol. (1927). (D. Ks.)

BÉCQUER, GUSTAVO ADOLFO (1836–1870), Spanish writer, born in Seville, Feb. 17, 1836, whose fame rests principally on his *Rimas* (1860–61), 76 brief lyrics in assonance which describe his struggle for perfect expression, his joy in love and his anguish in betrayal. Their appeal was universal, but they grew hackneyed from overquotation, until in the 1930s poets recognized their own tendencies in Bécquer's refined sensibility and his pure approach to his art and claimed him as a major influence in their work. The *Cartas literarias a una mujer* and the *Cartas desde mi celda* (1864) are essays in meditative self-analysis, hitherto unfamiliar in Spanish letters. His power to evoke an atmosphere of haunting mystery in the *Leyendas* suggests the influence of Edgar Allan Poe and E. T. Hoffmann, while the bitterness and conciseness of the *Rimas* have led to a belief in the influence of Heine. But Bécquer's originality is to have conveyed in Spanish rhythms all the half tones of emotion and to have given poetic significance to the ephemeral. He died in Madrid on Dec. 22, 1870.

See F. Schneider, *G. A. Bécquer: Leben und Schaffen* (1914); J. P. Díaz, *G. A. Bécquer: Vida y Poesía* (1953). (Ra. E. B.)

BECQUEREL, the name of a French family, several members of which have been distinguished in chemical and physical research.

Antoine César Becquerel (1788–1878), best known for his work in electrochemistry, was born at Châtillon-sur-Loing on March 8, 1788. After passing through the École Polytechnique he became *ingénieur-officier* in 1808 and saw active service with the imperial troops in Spain from 1810 to 1812 and again in France in 1814. He then resigned from the army. His earliest scientific work was in mineralogy but he soon turned his attention to the study of electricity and especially of electrochemistry. In 1837 he received the Copley medal from the Royal society "for his various memoirs on electricity, and particularly for those on the production of metallic sulphurets and sulphur by the long-continued action of electricity of very low tension," which it was hoped would lead to increased knowledge of the "recomposition of crystallized bodies, and the processes which may have been employed by nature in the production of such bodies in the mineral kingdom." In biological chemistry he worked on the problems of animal heat and on the phenomena accompanying the growth of plants, and he also studied meteorological questions and observations. His works include: *Traité d'électricité et du magnétisme* (1834–40), *Traité de physique dans ses rapports avec la chimie* (1842), *Éléments de l'électro-chimie* (1843), *Traité complet du magnétisme* (1845), *Éléments de physique terrestre et de météorologie* (1847), and *Des climats et de l'influence qu'exercent les sols boisés et déboisés* (1853). He died on Jan. 18, 1878, in Paris, where from 1837 he had been professor of physics at the Musée d'Histoire Naturelle.

His son, Alexandre Edmond Becquerel (1820–1891), is remembered for his experiments in light. He was born in Paris on March 24, 1820, and was in turn his father's pupil, assistant and successor at the Musée d'Histoire Naturelle; he was also appointed professor at the short-lived Agronomic institute at Versailles in 1849, and in 1853 received the chair of physics at the Conservatoire des Arts et Métiers. Edmond Becquerel paid special attention to the study of light, investigating the photochemical effects and spectroscopic characters of solar radiation

and the electric light, and the phenomena of phosphorescence, particularly as displayed by the sulfides and by compounds of uranium. In connection with these latter inquiries he devised his phosphoroscope, an apparatus which enabled the interval between exposure to the source of light and observation of the resulting effects to be varied at will and accurately measured. He published in 1867–68 a treatise in two volumes on *La Lumière, ses causes et ses effets*. He also investigated the diamagnetic and paramagnetic properties of substances and the phenomena of electrochemical decomposition and proposed a modified statement of Faraday's law which was intended to cover certain apparent exceptions. He died in Paris on May 11, 1891.

His son, Antoine Henri Becquerel (1852–1908), Nobel prize winner, who succeeded to his father's chair at the Musée d'Histoire Naturelle in 1892, is the discoverer of radioactivity. He was born in Paris on Dec. 15, 1852, studied at the École Polytechnique (where he was appointed a professor in 1895) and in 1875 entered the department *des ponts et chaussées* of which in 1894 he became *ingénieur en chef*. He found in 1896 that uranium (*q.v.*) at ordinary temperatures emits an invisible radiation which in many respects resembles Röntgen rays and can affect a photographic plate after passing through thin plates of metal. For these researches he was in 1903 awarded a Nobel prize jointly with Pierre and Marie Curie. He also engaged in work on magnetism, the polarization of light, phosphorescence and the absorption of light in crystals. He died at Croisic in Brittany on Aug. 25, 1908.

BED, a general term for a resting or sleeping place for men or animals and, in particular, for the piece of domestic furniture used for that purpose; this article deals with the latter. The word also is used by analogy to mean a base or a supporting surface (*e.g.*, of a river or of a billiard table).

Ancient Times.—In ancient times beds were used not merely for sleeping but also, except in Egypt, for reclining when taking meals. They were either solid constructions built into the wall, or lighter objects made of wood or metal, or a combination of both, consisting of a couch supported on four legs with a low headboard at one end. The legs and the headboard might be made of plain wood or finely cast bronze, according to the means of the owner. Egyptian beds were particularly light and elegant. Representations of a bed on an Assyrian bas-relief, on an Etruscan funeral monument and on an Archaic Attic painted vase (all in the Louvre, Paris) show remarkably little variation in design. The Greek bed was the simplest: the wooden frame, inlaid with ivory or mother-of-pearl, was laced across with bands of hide upon which the coverings were placed. The Assyrian and Etruscan beds were more magnificent, with carved or inlaid frames and curved bed heads, upon which numerous cushions were placed. In each case, the many cushions at the bed head provided support for the upper part of the body of the diner. Roman beds were of similar design, the frames of wood or metal sometimes being covered with decorative mounts of bronze, ivory and tortoise shell. The emperor Heliogabalus had a bed made entirely of silver. Roman beds, like the earlier Etruscan, often were arranged for two persons with a board or railing at the back in addition to the raised portion at the head. In the walls of some of the houses at Pompeii there are bed niches, probably closed by curtains or sliding partitions; and classical dining rooms with built-in bed platforms are preserved.

Middle Ages.—In the later middle ages meals were no longer taken in a reclining position and beds were reserved for resting or sleeping. Even princes' beds, as shown on early medieval ivories and miniatures, are of remarkable simplicity. Until the 12th century the frame was constructed of turned wood, the main ornaments being the four balls that formed the lower terminals of the legs. A sloping plane under the mattress or pallet, augmented by head pillows, is often shown, so that a semiupright position had to be assumed and apparently was preferred. The poorer classes slept in large shallow chests on mattresses stuffed with straw. Presumably the peasant usage of built-in bunks, often two tiers high, is medieval in origin.

In 12th-century manuscripts appear much richer bedsteads, with inlaid ornament, carving and painting and with embroidered coverlets and mattresses. To keep out drafts the bed was protected with curtains which constituted small pavilions, enclosing at first not only the bed of the lord and his lady but also of those in their immediate entourage. These curtains were suspended from the ceiling, and until the 15th century beds had neither posts, cornices nor high wooden backs. (*See* also Curtain.) In some Norman manuscripts the occupant of the bed is shown wearing night clothes, but from about the 13th century until the 16th people generally slept naked. More money was spent on the construction and decoration of beds in the middle ages than on any other article of furniture, and in all large houses played an important part in births, marriages, deaths and even the reception of distinguished visitors. Minute descriptions of them are found in early inventories when those of other pieces of furniture are meagre; and in wills, from the 14th century onward, the best bed often heads the list of personal legacies. In the 14th century the wood frame of the bed declined in importance, being entirely covered by rich materials hung immediately over the bed or suspended from rods running around two or three sides of the bed at slightly overhead height.

The tester bed made its first appearance in the 14th century, but it was not until the 15th that it became general among the rich. The tester was slung from the ceiling or fastened to the walls, thus creating a room within a room, shut in by double curtains so as to exclude all drafts. Beds were commonly used as couches and seats in the daytime, and the curtains were drawn and looped up in the form of a bag. At this time, in Italian beds the mattress often was placed on a second level surrounded by an intermediate step platform on three sides. The spaces within were used for storage. Beds with elaborate cantilevered ceilings projecting from the headboards also are known.

In the 15th century, fixed beds were introduced in western Europe. Judging from contemporary pictorial records, the bed often was placed in a corner of the room. It consisted of a paneled back with carved columns at the front corners, supporting the tester, from which hung the curtains (which enclosed the bed posts) of precious fabrics imported from the far east or Italy. These beds, according to the normal medieval construction, were held together by pegs and could be taken apart for transport; noblemen habitually took their furnishings and hangings with them from one to another of their residences, and it was therefore necessary that beds be easily dismantled. The support for the mattress was still a trellis of leather straps nailed to the bed frame. A remarkable feature of 15th-century beds was their size, as much as 7 or 8 ft. by 6 or 7 ft., and it has been suggested that several people slept in them. One of the late 14th-century Apocalypse tapestries in the cathedral of Angers does, in fact, show a bed occupied by four men, and Albrecht Dürer, on his journey to the Low Countries in 1520, claimed to have seen a bed large enough for 50 persons in the Hôtel de Nassau in Brussels. In northern Europe and Russia, particularly in farmhouses, beds were often clustered near or placed on a large tiled stove in one corner of a main living room.

In the middle ages the king of France reclined on a bed known as the *lit de justice* when he was in the presence of *parlement*. The princes of the realm sat on stools, the greater officials stood and lesser ones knelt around him. Louis XI is believed to have introduced the ceremony, which lasted as long as the monarchy. The king and great nobles possessed a state bed or *lit de parade*, used only on formal occasions. The body of the king was laid out on the state bed after his death; the beds of the king and queen were saluted by the courtiers as if they were altars, and none approached them even when there was no railing to prevent it. In the *chambre de parade*, where the state bed was placed, took place the *grand lever*, while the *petit lever* was held in the bedroom where the monarch actually slept.

16th, 17th and 18th Centuries.—During the 16th century beds became more decorative, with much carved work on the bed head and the posts. The inventory description of the bed of Raoul de la Faye, dating from 1544, described the "pillars in the form of wild men," while that of Charles Cornu, dating from 1545, had pillars carved with figures of Hercules. Some of the most elaborate beds ever made date from the 16th century. During

this period the tester, instead of being merely a framework supporting a textile covering, was paneled and adorned with carved moldings like the bed head. In France, the taste for elaborately carved bedsteads hardly survived the beginning of the 17th century, when they disappeared again behind precious fabrics, but in England the carved oak or walnut bedstead with paneled and inlaid bed head and tester continued into the first half of the 17th century. The most famous of the English Elizabethan beds is the great bed of Ware (in the Victoria and Albert museum, London); about 11 ft. square, it was one of the sights of London, and there are many 17th-century literary references to it. Such large beds, however, were not exceptional in the 16th century; the beds of Henry VII and of Henry VIII, which were shown to visitors to Windsor castle in Elizabeth I's reign, were of about the same size, with hangings of gold and silver. During the first half of the 17th century two types of bed were made, one with heavy carved frame and the other with a light framework and elaborate hangings, but by the middle of the century the latter had become prevalent in England and Europe. When the curtains were drawn it looked boxlike and severe, the sole note of fantasy being given by the feathers attached to the ends of the four posts.

About the middle of the century the bed was placed in an alcove, separated from the rest of the bed chamber by a low railing. The second half of the 17th and the early 18th century was a period of magnificent beds. No fewer than 413 were described in the inventory of Louis XIV's palaces, some of great splendour. The great bed at Versailles had crimson velvet curtains on which "The Triumph of Venus" was embroidered with so much gold thread that the velvet scarcely showed, but under the influence of Madame de Maintenon the mythological subject was replaced by a biblical one. At Versailles women received their friends in their beds in any circumstances that were thought deserving of congratulation or condolence, and during the 17th century this curious custom became general among the upper classes, perhaps to avoid the tiresome details of etiquette. The fashions in bed design introduced in the second half of the 17th century originated in Paris. The earliest mention of a new canopy design is in the inventory of Cardinal Mazarin of 1660, consisting of a low couch with a tall headboard up to a canopy suspended from the ceiling. An earlier type, known as a *lit d'ange*, extended over only half the bed, but a later version, the *lit à la duchesse*, covered its whole length. Other forms were the *lit à impériale* and the *lit à dôme*, with canopy formed as a crown and a dome respectively. Another innovation was the day bed, a couch, with low head, supported on six legs with carved stretchers between. Soon after, the sofa or divan, modeled on a Turkish couch for reclining, became fashionable in Europe, and later still was introduced the ottoman, a simple divan without back or arms.

In the 17th century the appearance of the bed was determined by its hangings, but in the 18th the frame came into the open again, appropriately carved and gilded. The curtains became lighter and were made of taffeta or satin instead of the heavy brocades and velvets of the 17th century. The introduction of a less formal style was due to a change in social customs; the bed ceased to be the central point of the residence, visitors were received in the boudoir or the *salon*, and more distinction was drawn between private and public life.

Bed heads previously had been set against a wall of the bed chamber, but about the middle of the 18th century a new fashion in France turned the bed around so that the long side ran parallel to the wall. This construction, called *à la polonaise* in homage to Queen Maria Leszczynska, was surmounted by a more or less elaborate canopy like that of the beds of the first half of the century. The type was not generally introduced in England, where the four-poster construction with tester and curtains all around remained the usual bed until the mid-19th century. Nevertheless, many variations of the four-poster were devised in England, particularly in the Chinese taste with pagodalike japanned tester.

Modern Times.—During the second half of the 19th century, metal bedsteads became common; these were made at first of cast iron, subsequently of brass tubing. Though they had nothing to recommend them beyond their hygienic qualities, they enjoyed some return to fashion in the late 1950s. One of the main features of the 20th century has been the tendency to abandon the traditional double or matrimonial bed in favour of two small single beds. A popular form is the divan, or day bed, which serves as a seat during the day and a bed by night. In reaction against functional starkness, bedsteads with large headboards, either elaborately carved and gilded or covered with quilted satin, were introduced in the 1920s and 1930s. Two types of folding bed—one folding into the wall, the other into the base of a settee—were introduced in an effort to solve the problem of lack of space; indeed such devices had been commonly used in the latter half of the 19th century, when they were built into wardrobes or other massive units of furniture.

Orient.—In the near east it was the custom to make beds simply by piling up rugs on the floor. In both Persian and Indian miniatures lovers are shown reclining on low divan beds, with carved legs at the corners and sometimes a low headboard as well. No sheets or bed coverings are used, but the head is supported on a pillow or bolster. No difference is apparent in the representations of beds in miniatures dating from periods as far apart as the 15th and 19th centuries.

In China, however, beds not unlike those of the Egyptians were used about 2,000 years ago, and replicas of them are found in pottery in the tombs of the Han period (202 B.C.–A.D. 221). Some magnificent specimens executed in carved wood and in lacquers have come to light. During the Ming period (1368–1644) and probably earlier, it became the custom in some sections to enclose the beds with gauze or netting; later the bed was made along the back wall of a small square room with a small antechamber cut off by sliding doors. These beds were covered with matting and were never so soft and voluptuous as those of the near east. The pillows were made of wood, porcelain or stone, carved to fit the neck and lower part of the head of the sleeper.

In Korea and northern China the *gudeul* or floor is made of flat stones, bricks or earth with flues under the top layer; somewhat below the level of the floor is a fireplace. When cooking is going on the heat circulates through the flues in the floor, and sleeping places are arranged on the warm spots.

According to the traditional arrangement, which persisted until well into the 20th century, the Japanese slept on the floor, the bedding being put in a closet in the morning and the room used for eating and general social gatherings. The whole floor was covered with *tatami* or resilient mats covered in woven fibre, the people sleeping between *shikifuton* ("underquilt") and *kakefuton* ("overquilt"). They were warmed during cold weather with a *kotatsu* or little wooden box holding a charcoal burner, but this often caused skin diseases and sometimes started fires. For these reasons it gradually fell into disuse; but whole families used to sleep on the same *tatami*, their feet toward the burner and their bodies radiating from that point like the spokes of a wheel. *See* also FURNITURE. (J. F. H.)

BEDAUX, CHARLES EUGENE (1887–1944), U.S. efficiency engineer who developed the Bedaux plan for measuring and compensating industrial labour. He was born on Oct. 26, 1887, in Charenton, a suburb of Paris, France, migrated to the United States at the age of about 20, and became a naturalized citizen in 1917. During and after World War I he organized management consulting firms in both North America and Europe. Bedaux's wage incentive plan used "Bedaux units" to measure human productivity, one unit indicating the work to be done by one man in one minute. A bonus was paid for work done in excess of 60 units per hour. The Bedaux plan was widely used to improve labour productivity and management efficiency but unions were critical of its complexity and of the speed-up that sometimes resulted from the use of improper standards. In 1937 Bedaux gave up management of his American enterprises, settled in France and collaborated with the Nazis and the Vichy French government during World War II. He was arrested in Algiers during the Allied invasion of north Africa and was returned to the United States where he was charged with treason. He took his own life, dying in Miami, Fla., on Feb. 18, 1944.

See Janet Flanner, "Annals of Collaboration—Equivalism," *New*

Yorker, pp. 28–47 (Sept. 22, 1945), pp. 32–45 (Oct. 6, 1945) and pp. 32–48 (Oct. 13, 1945); Gordon B. Carson (ed.), *Production Handbook*, sec. 15, pp. 50–57 (1958). (F. T. MA.)

BEDBUG (*Cimex lectularius*), a nocturnal insect belonging to the family Cimicidae in the order Hemiptera (*q.v.*). The adult is reddish brown in colour, broad and flat, 4 to 5 mm. long, and apparently wingless, with the body densely covered with short hairs and bristles. The greatly atrophied, scalelike first pair of wings are very inconspicuous and nonfunctioning. The peculiar disagreeable odour of bedbugs is due to the secretion of the scent, or stink, glands so characteristic of heteropterous insects.

"LIFE" PHOTO BY FRITZ GORO

BEDBUG (CIMEX LECTULARIUS), A PARASITE OF MAN, FEEDING

The male has a more pointed abdomen terminated by a large curved penis lying in a deep groove of the left side of the eighth segment. The female has on the right side of the fourth (or fifth) abdominal segment a copulatory pouch that is indicated ventrally by a notch in the hind margin of the segment. This pouch is the organ of Ribaga, beyond which is a mass of cellular tissue called the organ of Berlese. In mating, the male injects the spermatozoa into the organ of Ribaga, from which they pass through the organ of Berlese and reach the genital tract by wandering through the general body cavity (hemocoele). This method of mating is unique, since in other insects the spermatozoa are inserted into the female by way of the vagina.

The female lays an average of 200 or more eggs at the rate of 3 or 4 a day under favourable conditions, with temperatures about 70° F. and ample opportunities to feed. No eggs are laid at temperatures below 50° F., and starved females soon stop laying eggs. The eggs hatch in six days or longer, depending upon the temperature. There are five nymphal stages, and the nymph must feed before it will molt to the next stage. In favourable temperatures, the nymph requires from four to six weeks to reach maturity. There may be three or more generations a year.

Bedbugs are among the most cosmopolitan of human parasites. They are shy creatures that seek concealment during the day in tufts or folds of mattresses, in cracks and joints of bedsteads, even in the hollow frames of metal beds, beneath loosened wallpaper, behind baseboards, window casings, cracks in the wall or wherever they can find shelter. From these hiding places the bugs come forth at night to suck the blood of man. After feeding, they retreat to their hiding places to digest the meal, which may require several days. Adult specimens have lived a year without food. Bedbugs will feed on poultry and other animals as well as on man. Close relatives are *Cimex hemipterus* of tropical Africa and Asia, which have the same habits, and various species that feed on bats, swallows and martins.

Control involves vigilant cleanliness and thorough application of repressive measures. Infested quarters may be fumigated or heated to temperatures of 120° to 125° F. for several hours. Hiding places may be treated with a good fly spray; various DDT preparations give control. (H. B. HD.; X.)

BEDDGELERT, a village and civil parish of Caernarvonshire, north Wales. Pop. (1961) 808. The village lies in the heart of Snowdonia in a picturesque hollow where the Colwyn river joins the Glaslyn before the latter enters the pass of Aberglaslyn.

Bronze Age remains were found in the parish, within which lies Dinas Emrys, the site of an ancient Celtic fort famous in tradition. A Celtic monastic cell was founded there in the 6th century, said to be the oldest in Wales, excepting Bardsey. It was later superseded by a priory of Augustinian canons. The priory buildings have disappeared, but remains of the 13th-century monastic church are incorporated in the present parish church.

Beddgelert ("the grave of Gellert") may derive from the legend that Llewelyn's faithful hound Gellert (*q.v.*) was buried there. It is a noted tourist and fishing centre. (W. O. W.)

BEDDINGTON AND WALLINGTON, a municipal borough (1937) of Surrey, Eng., which under the London Government Act 1963 was joined on April 1, 1965, with Sutton and Cheam and Carshalton to form the new London borough of Sutton (*see* LONDON). Beddington and Wallington municipal borough, mainly residential, is 11 mi. S by W of St. Paul's Cathedral. Pop. (1961) 32,603. Area 4.8 sq.mi. Domesday Book mentions both Beddintone and Waletone (a royal manor later held by the Dymoke family). The manor of Beddington passed to the Carew family in 1349; rebuilt in the 16th century, the house was described by Daniel Defoe in *A Tour Thro' the Whole Island of Great Britain* . . . (1724–27). It is now used for educational purposes. Beddington church dates from the 14th century. The river Wandle flows through Beddington and Grange public parks, and part (344 ac.) of the former Croydon aerodrome is in the borough.

BEDDOES, THOMAS LOVELL (1803–1849), English poet, author of the strange tragedy *Death's Jest Book,* who never fulfilled his early promise, was born in Clifton, Somerset, on June 30, 1803. Beddoes' father was a celebrated scientist of considerable literary gifts. His mother was a sister of Maria Edgeworth. Sent to Bath grammar school (1814) and to Charterhouse (1817), where his marked abilities, his overbearing character and his passion for the drama soon became evident, he nourished his imagination (like Shelley, whom he greatly admired) on Gothic romances, writing one while still at school. In 1820 he went to Pembroke college, Oxford, and in his first year there published a group of three verse tales entitled *The Improvisatore* (1821) which reflect the nature of his early reading. Later he destroyed most of the copies. He first appears as a considerable writer in *The Bride's Tragedy* (1822), which is based on the story of a murder committed by an undergraduate and made the subject of a popular ballad. Beddoes' obsession with death is already evident: throughout much of the play, as throughout much of his later work, death is the only subject of conversation, but the verse is of a respectable quality and George Darley hailed Beddoes as a coming dramatist. In 1824 he took his B.A. and in 1825 he went to Göttingen to study anatomy and medicine. In Göttingen he continued his extraordinary poem, *Death's Jest Book* (or *The Fool's Tragedy,* 1850), which was not published until after his death. It is the work of a man who had thought long and deeply about the nature of the drama. In the preface he follows the Schlegels and Willem Bilderdijk in arguing that most modern dramatic theorists are "prejudiced in favour of the literature of the South." He believed that the English drama differed essentially from the Greek. "It is not Shakespeare who is lawless, they are lawless who judge his British example by the precept of the Greek." He described *Death's Jest Book* as an example of "the florid Gothic" and had little hope that it would be appreciated by reviewers "who have learnt the Odes of Horace by heart at Eton." Although his friends were probably right to dissuade him from early publication, the fact that *Death's Jest Book* remained on his hands for a long period seems to have interfered with his further development. It contains passages of brilliant verse, but everywhere one notices his inability to create characters entirely different from himself. It is difficult to keep one's attention on the plot: what one listens for is the ground bass of his incomparable meditation on life and death, the poet's strivings toward "a wished-for change of being." Yet Beddoes was more successful with blank verse than in the lyric. He said himself that he could seldom capture "the right sort of idea in the right light for a song" and besides powerful lines and images one finds in his lyrics a concentration of unmusical consonants which often recall Browning. He turned away as if by instinct from the Mediterranean to the wilder imaginings of the north.

After trouble with the university authorities Beddoes left Göttingen and went to Würzburg, where he received his M.D., joined a revolutionary group, the Freie Reichstadt, and after further trouble moved to Zürich, where he seems to have enjoyed one of

the happier interludes in his troubled life. His interest in writing English verse was waning, though he returned to it sporadically. Sometimes he wrote in German and some of his German writings survive. In 1840 he had to flee from Switzerland, probably for political reasons, and he never settled long in one place again. In 1846–47 he paid his last visit to England and on Jan. 26, 1849, he committed suicide in Basel. Browning was interested in his work and intended to have made it the subject of his first lecture, had he been elected professor of poetry at Oxford.

BIBLIOGRAPHY.—His *Works* were edited by H. W. Donner (1935), who also edited a comprehensive selection, *Plays and Poems,* in the Muses' Library (1950). This edition printed the whole early version of *Death's Jest Book* for the first time. Donner also wrote the standard biography, *Thomas Lovell Beddoes: the Making of a Poet* (1935) and edited *The Browning Box* (1935), a collection of letters by Beddoes' friends and admirers. (I. J.)

BEDE (BAEDA OR BEDA) (672 or 673–735), English historian and theologian whose *Historia ecclesiastica gentis Anglorum* (*Ecclesiastical History of the English Nation*) has justly earned him the title of the father of English history. Of Bede, commonly called the Venerable Bede, almost all that is known is contained in the short autobiographical notice which he has appended to his *Ecclesiastical History:* "Thus much concerning the ecclesiastical history of Britain, and especially of the race of the English, I, Baeda, a servant of Christ and priest of the monastery of the blessed apostles St. Peter and St. Paul, which is at Wearmouth and at Jarrow, have with the Lord's help composed, so far as I could gather it, either from ancient documents, or from the tradition of the elders, or from my own knowledge. I was born in the territory of the said monastery, and at the age of seven I was, by the care of my relations, given to the reverend Abbot Benedict (Biscop), and afterwards to Ceolfrid, to be educated. From that time I have spent the whole of my life within that monastery devoting all my pains to the study of the scriptures; and amid the observance of monastic discipline, and the daily charge of singing in the church, it has ever been my delight to learn or teach or write. In my 19th year I was admitted to the diaconate, in my 30th to the priesthood, both by the hands of the most reverend Bishop John (of Hexham), and at the bidding of Abbot Ceolfrid. From the time of my admission to the priesthood to my (present) 59th year, I have endeavoured, for my own use and that of my brethren, to make brief notes upon the Holy Scripture, either out of the works of the venerable fathers, or in conformity with their meaning and interpretation." Then follows a list of his works, so far as, at that date, they had been composed. As the *Ecclesiastical History* was written in 731, the following dates for the principal events in Bede's uneventful life are obtained: birth, 672–673; entrance into the monastery, 679–680; ordained deacon, 691–692; priest, 702–703.

The monastery of Wearmouth was founded by Benedict Biscop in 674, and that of Jarrow in 681–682. Though five or six miles apart, they were intended to form a single monastery under a single abbot, and so Bede speaks of them in the passage given above. It is with Jarrow that Bede is chiefly associated, though no doubt from the close connection of the two localities he would often be at Wearmouth. The preface to the prose life of Cuthbert proves that he had stayed at Lindisfarne prior to 721, while the Epistle to Egbert shows that he had visited him at York in 733. It is in his works that we must chiefly seek to know him. They fall into three main classes: (1) scientific; (2) historical; (3) theological. The first class comprises works on grammar, one on natural phenomena, and two on chronology and the calendar. These last were inspired largely by the Paschal Question, which was the subject of such bitter controversy between the Roman and Celtic Churches in the 7th century. They form a natural transition to the second class. In this the chief place is held by the *Ecclesiastical History of the English Nation.* By this almost exclusively he is known to others than professed students. It is indeed one of the most valuable and one of the most beautiful of historical works. Bede had the artist's instinct for proportion, the artist's sense for the picturesque and the pathetic. His style, too, modeled largely on that of Gregory in the *Dialogues,* is limpid and unaffected. And though it would be wrong to call Bede a critical historian in the modern sense of the words, he showed a very unusual conscientiousness in collecting his information from the best available sources, and in distinguishing between what he believed to be fact, and what he regarded only as rumour or tradition.

Other historical works of Bede are the *History of the Abbots* (of Wearmouth and Jarrow), and the lives of Cuthbert in verse and prose. The *History of the Abbots* and the prose life of Cuthbert were based on earlier works which still survive. In the case of the latter it cannot honestly be said that Bede has improved on his original. In the *History of the Abbots* he was much nearer to the facts, and could make additions out of his own personal knowledge. The Epistle to Egbert, though not historical in form, may be mentioned here, because of the valuable information which it contains as to the state of the Northumbrian church, on which the disorders and revolutions of the Northumbrian kingdom had told with disastrous effect. It is probably the latest of Bede's extant works, written in Nov. 734, only six months before he died.

The third or theological class of writings consists mainly of commentaries, or of works which, if not commentaries in name, are so in fact. They are based largely on the works of the four great Latin fathers, SS. Augustine, Jerome, Ambrose and Gregory, though Bede's reading is very far from being limited to these. His method is largely allegorical. For the text of Scripture Bede used both the Latin versions, the Itala and the Vulgate, often comparing them. But he certainly knew Greek, and possibly some Hebrew. Indeed it may be said that his works, scientific, historical and theological, practically sum up all the learning of western Europe in his time, which he thus made available for his countrymen. And not for them only; for in the school of York, founded by his pupil Archbishop Egbert, was trained Alcuin (Ealhwine), the initiator, under Charles the Great, of the Frankish schools, which did so much for learning on the continent. And though Bede made no pretensions to originality, least of all in his theological works, freely taking what he needed, and (what is very rare in medieval writers) acknowledging what he took, "out of the works of the venerable Fathers," still everything he wrote is informed and impressed with his own special character and temper. His earnest yet sober piety, his humility, his gentleness, appear in almost every line. "In history and in science, as well as in theology, he is before all things the Christian thinker and student." (C. Plummer's *Bede,* i. 2). Yet it should not be forgotten that Bede could hardly have done what he did without the noble library of books collected by Benedict Biscop.

Several quaint and beautiful legends have been handed down as to the origin of the epithet of "venerable" generally attached to his name. Probably it is a mere survival of a title commonly given to priests in his day. It has given rise to a false idea that he lived to a great age, some medieval authorities making him 90 when he died. But he was not born before 672 (*see* above); and though the date of his death has been disputed, the traditional year, 735, is most probably correct. This would make him at most 63. Of his death a most touching and beautiful account has been preserved in a contemporary letter. His last hours were spent, like the rest of his life, in devotion and teaching, his latest work being to dictate, amid increasing bodily weakness, a translation into the vernacular of the Gospel of St. John, a work which has not survived. It was a fitting close to such a life as his.

Bede was canonized and named a doctor of the church in 1899. His feast day is May 27. (C. P.)

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apostolorum et retractatio (1939); trans. of Epistle to Egbert, D. Whitelock, *English Historical Documents 500–1042*, no. 170 (1955).

Many aspects of Bede's work are discussed by various scholars in *Bede: His Life, Times, and Writings*, ed. by A. Hamilton Thompson (1935). *See* also B. Capelle, "Le rôle théologique de Bede le Venerable," *Studia Anselmiana* (1936); M. L. W. Laistner and H. H. King, *A Handlist of Bede Manuscripts*, pp. 215–336 (1943); E. S. Duckett, *Anglo-Saxon Saints and Scholars*, (1947). On Bede's chronology, *see* R. L. Poole, *Studies in Chronology and History* (1934); W. Levison, *England and the Continent in the Eighth Century*, pp. 265–279 (1946); C. W. Jones, *Saints' Lives and Chronicles in Early England* (1947).

(D. Wk.)

BEDFORD, EARLS AND DUKES OF. The present English title of duke of Bedford comes from a line of earls and dukes in the Russell family. John, Baron Russell, was created earl of Bedford in Jan. 1550, and his descendant, William, the 5th earl, became duke of Bedford in May 1694. The title of duke of Bedford had been previously held, however, notably by the third son of King Henry IV, and the earlier creations will first be considered here.

John Plantaganet (1389–1435) was born on June 20, 1389, the third son of Henry IV of England, and was created duke of Bedford by his brother Henry V in 1414. He acted as lieutenant of the kingdom during Henry's expedition to France in 1415 and in Aug. 1416 commanded the ships which defeated the French fleet at the mouth of the Seine and was instrumental in relieving Harfleur. Again appointed lieutenant in July 1417, he marched against the Scots who abandoned the siege of Berwick at his approach; and on his return to London he brought Sir John Oldcastle, the Lollard leader, to trial and was present at his execution. He resigned as lieutenant in Dec. 1419 and joined the king in France. Returning to England he undertook the lieutenancy for the third time in June 1421 and in the following May conducted the queen to join Henry in Normandy. Replacing his brother, who was ill, as commander of the English troops, he went to the relief of Cosne, but on hearing of the king's danger he left the army and hurried to his side. Henry, who died in Aug. 1422, may have wanted Philip the Good, duke of Burgundy, to become regent in France, but when he declined the office it too was assumed by Bedford who, after the death of the French king Charles VI in Oct. 1422, presided at a session of the *parlement* of Paris and compelled all present to take an oath of fidelity to Henry VI, the new king of England. Meanwhile the English parliament had decided that Bedford should be "protector and defender" of the kingdom, and that in his absence the office should devolve upon his brother Humphrey, duke of Gloucester. Confining himself to the conduct of affairs in France, the protector took up Henry V's work of conquest, captured Meulan and other places, and sought to strengthen his position by an alliance with Philip of Burgundy. This task was rendered more difficult as Gloucester had just married Jacoba, countess of Holland and Hainaut, a union which gave the English duke a claim on lands which Philip hoped to secure for himself. Bedford, however, having allayed Philip's irritation, formed an alliance with him and with John VI, duke of Brittany, at Amiens in April 1423, and himself married (June 1423) Anne, a sister of the Burgundian duke. With powerful allies the war against Charles VII of Valois was prosecuted with vigour and success, and a real victory was won over the French and Scots at Verneuil on Aug. 17, 1424. But Bedford's efforts to foster Anglo-Burgundian friendship were jeopardized by the hostility between Philip and Gloucester, and his work was partially destroyed by Gloucester's invasion of Hainaut in Oct. 1424. Bedford's rule in France was deliberately mild. He lowered taxation, reformed the debased coinage, encouraged trade by granting privileges to merchants, and purified the administration. But since he had to finance his government and campaigns without English aid, his rule, however moderate, was bound to be burdensome to the French.

Bedford was forced to return to England in 1426 when the struggle for power between Gloucester and the chancellor, Henry Beaufort, bishop of Winchester, resulted in an open quarrel. After he had effected a public reconciliation and knighted the young king Henry VI, Bedford promised to act in accordance with the will of the council and, in harmony with the decision of this body, raised some troops and returned to France in March 1427. Having ordered Gloucester to desist from a further attack on Hainaut, he threatened Brittany and compelled Duke John to return to the English alliance; and the success of his troops continued until the siege of Orléans, to which he consented with reluctance, was undertaken in Oct. 1428. The siege lost England both allies and prestige for it involved attacking a lord who was a prisoner, and breaking a treaty. Having assured himself that Philip was prepared to desert him, Bedford sent orders to his army to raise the siege in April 1429. He then acted with great energy and judgment in attempting to stem the tide of disasters which followed this failure, strengthened his hold upon Paris and sent to England for reinforcements; but before any engagement took place he visited Rouen, where he sought to bind the Normans closer to England, and after his return to Paris resigned the French regency to Philip of Burgundy in accordance with the wish of the Parisians. Retaining the government of Normandy, Bedford established himself at Rouen and directed the movements of the English forces with some success. He did not interfere to save the life of Joan of Arc. He was joined by Henry VI in April 1430, when the regency was temporarily suspended, and he secured Henry's coronation in Paris in Dec. 1431. His wife Anne died in Nov. 1432 and he was married at Thérouanne to Jacqueline, daughter of Pierre I, comte de St. Pol, in April 1433.

But notwithstanding Bedford's vigour the English lost ground steadily. The death of Anne and Bedford's second marriage destroyed the friendly relations between England and Burgundy. Negotiations for peace had no result, and the duke had to return to England in June 1433 to compose the dissensions which increased his difficulties at a critical stage of the war. In England Bedford did his utmost to restore the finances of the government, appointing a new treasurer and ordering a detailed investigation into the crown's resources and commitments. Discouraged by the result, which showed the resources of the government to be inadequate for peace, let alone war, and by the failure of the commons to grant new supplies, he remained in England as chief councilor when his demands with regard to a continual council were conceded (Dec. 1433). He left England again in 1434, but early in 1435 was obliged to consent to the attendance of English representatives at a congress held to arrange terms of peace at Arras. Unable to consent to the French terms, the English envoys left Arras in September, and Philip of Burgundy made a separate treaty with France. Bedford only lived to see the ruin of the cause for which he struggled so loyally. He died at Rouen on Sept. 14, 1435, and was buried in the cathedral of that city. He left a natural son, Richard, but no legitimate issue. Bedford was a man of considerable administrative ability, brave and humane in war, wise and unselfish in peace. Universally respected, he had been a moderating influence in English politics at a time when the talents of most statesmen were marred by personal ambition, and his death was a great loss for England at a critical period.

George Nevill (*c.* 1457–83), son of John, earl of Northumberland, was created duke of Bedford in 1470, but after his father's attainder and death at the battle of Barnet in 1471 he was degraded from the peerage (1477).

The next duke of Bedford was Jasper Tudor (*c.* 1430–95), half-brother of Henry VI and uncle of Henry VII. He was made earl of Pembroke in 1453. Having survived the vicissitudes of the Wars of the Roses he was created duke of Bedford in 1485 after Henry VII's accession. The duke, who was lord lieutenant of Ireland from 1486 to 1494, died without legitimate issue on Dec. 21, 1495.

John Russell (*c.* 1485–1555), 1st earl of Bedford, was a son of James Russell (d. 1505 or 1506). In 1513 he took part in the war with France. He was with Henry VIII at the Field of Cloth of Gold in 1520 and, returning to military service when the French war was renewed, lost his right eye at the siege of Morlaix in 1522. In 1523 he went secretly to France, where he negotiated a treaty between Henry and Charles, duc de Bourbon, who wished to betray the French king, Francis I. After a visit to England,

Russell was sent with money to Bourbon, joining him at the siege of Marseilles. He visited Pope Clement VII in Rome in 1524 and, having eluded the French, who endeavoured to capture him, was present at the battle of Pavia in Feb. 1525, returning to England about the close of the year. In Jan. 1527 he was sent as ambassador to Clement, who employed him to treat on his behalf with Charles de Lannoy, the general of the emperor Charles V. The next few years of Russell's life were mainly spent in England. He entered the Reformation parliament for Buckingham in 1529 and, although an opponent of the party of Anne Boleyn, retained the favour of Henry VIII. He took an active part in suppressing the Pilgrimage of Grace in 1536, and was one of the commissioners appointed to try the Lincolnshire prisoners. He received many high honours and offices, and became Baron Russell in 1539. When Charles V and Francis I were threatening to invade England in 1539, he was sent into the west, and crossed to France when Henry attacked Francis in 1544. He was in command of an army in the west of England in 1545, and when Henry died in Jan. 1547 was one of the executors of his will. Under Edward VI Russell was lord high steward and keeper of the privy seal, and the defeat which he inflicted on the rebels at Clyst St. Mary, near Exeter, in Aug. 1549, was largely instrumental in suppressing the rising in Devonshire. He was created earl of Bedford in Jan. 1550, and was one of the commissioners appointed to make peace with France in this year. He opposed the proposal to seat Lady Jane Grey on the throne; supported Mary I, who reappointed him lord privy seal (Nov. 1553); and helped to prevent Sir Thomas Wyat's rising from spreading to Devonshire. He went to Spain to conclude the marriage treaty between Mary I and Philip II in 1554. He died in London, soon after his return, on March 14, 1555. By extensive acquisitions of land, Bedford was the founder of the wealth and greatness of the house of Russell. Among the many properties which fell into his hands was Covent Garden, and seven acres of land in London formerly the property of the protector Somerset.

Francis Russell (*c.* 1527–85), 2nd earl, was the only son of the 1st earl. He took his seat in the house of lords as Lord Russell in 1552. Russell was in sympathy with the Protestant reformers, whose opinions he shared, and was imprisoned during the earlier part of Mary's reign. He inherited the earldom in 1555, and left for the continent where he met foreign reformers and fought at the battle of St. Quentin (1557). When Elizabeth I ascended the throne (Nov. 1558) Bedford became an active figure in public life. He was made a privy councilor, had some influence in the religious settlement, and was sent on diplomatic errands to Charles IX of France and Mary Stuart. He was governor of Berwick and warden of the east marches of Scotland (Feb. 1564–Oct. 1567) in which capacity he conducted various negotiations between Elizabeth and Mary. When the northern insurrection broke out in 1569, Bedford was sent into Wales, and he sat in judgment upon the duke of Norfolk in 1572. He was president of the council of Wales in 1576, and in 1581 was deputed to arrange a marriage between Elizabeth and the duc d'Anjou. Bedford died in London on July 28, 1585. He was succeeded by his grandson Edward Russell (1572–1627).

Francis Russell (1593–1641), 4th earl, was the only son of William, Lord Russell of Thornhaugh, to which barony he succeeded in Aug. 1613. He became earl of Bedford by the death of his cousin Edward, the 3rd earl, in May 1627. When the quarrel broke out between Charles I and parliament in 1628, Bedford supported the demands of the house of commons as embodied in the Petition of Right, and in 1629 was arrested for his share in an opposition pamphlet, but was quickly released. The Short parliament meeting in April 1640 found the earl as one of the king's leading opponents. He was in the confidence of John Pym and Oliver St. John. In July 1640 he was among the peers who wrote to the Scottish leaders refusing to invite a Scottish army into England but promising to stand by the Scots in all legal and honourable ways; and his signature was afterward forged by Thomas, Viscount Savile, in order to encourage the Scots to invade England. In the following September he was among those peers who urged Charles to call a parliament, to make peace with the Scots and to dismiss his obnoxious ministers; and was one of the English commissioners appointed to conclude the treaty of Ripon. When the Long parliament met in Nov. 1640, Bedford was generally regarded as the leader of the parliamentarians. In 1641 he became a privy councilor and was appointed treasurer. Bedford was essentially a moderate man. He did not wish to alter the government of the church, was on good terms with Archbishop Laud and, although convinced of Strafford's guilt, was anxious to save his life. The earl of Clarendon considered that he supported the opposition more from ambition than from principle, like many peers excluded from the royal service. Bedford died in the middle of the parliamentary struggle on May 9, 1641. Apart from politics, Bedford was important as head of an association for draining a great area of the fens called after him the "Bedford level." However, the scheme ran into financial difficulties and the king took it into his own hands in 1638, giving land to the earl in compensation.

William Russell (1616–1700), 5th earl and 1st duke of Bedford, played a minor part in politics. His son Lord William Russell (1639–83) was involved in the opposition to Charles II, led by Lord Shaftesbury, and was executed for treason in 1683. It was partly because of his son's fame as a patriot martyr that the 5th earl was granted a dukedom in 1694. He died on Sept. 7, 1700, and was succeeded by his grandson Wriothesley Russell (1680–1711), 2nd duke, who was succeeded by his son Wriothesley Russell (1708–32).

John Russell (1710–71), 4th duke, brother of the 3rd duke, was born on Sept. 30, 1710. The new duke joined the opposition to Sir Robert Walpole and in Nov. 1744 became 1st lord of the admiralty in the administration of Henry Pelham. He was subsequently lord privy seal in Lord Bute's cabinet of 1761. He wanted peace at any cost, was sent to France to negotiate in 1762, and signed the peace of Paris in 1763. He was lord president of the council in George Grenville's cabinet in the same year. Bedford was the leader of a political group which bore his name. The Bedford Whigs were a group built up on family connections and electoral influence. Lord Sandwich, Lord Gower, Lord Weymouth and Richard Rigby were notable Bedfordites. Because of his failing eyesight, Bedford himself did not hold office after 1765, when the Grenville administration fell, but his party continued to hold office in successive ministries, and it remained a cohesive political group for more than a decade after Bedford's death at Woburn on Jan. 15, 1771.

Francis Russell (1765–1802), 5th duke, eldest son of Francis Russell (d. 1767), marquess of Tavistock, the eldest son of the 4th duke, was born on July 23, 1765, and succeeded his grandfather as duke of Bedford (1771). Regarding Charles James Fox as his political leader, he joined the Whigs in the house of lords and became a member of the circle of the prince of Wales, afterward George IV. Bedford was greatly interested in agriculture. He established a model farm at Woburn and made experiments in sheep breeding which were recorded by Arthur Young in the *Annals of Agriculture* (1795). He was a member of the original board of agriculture, and was the first president of the Smithfield club. He died at Woburn on March 2, 1802.

Francis was succeeded by his brother John Russell (1766–1839), 6th duke, who continued his work for agriculture, and became a governor of the newly founded Agricultural society in 1838. He also rebuilt Covent Garden market. The 19th-century dukes of Bedford, who were noted for their eccentricity, mainly devoted themselves to the management of their estates. The 6th duke was succeeded by his eldest son Francis Russell (1788–1861), upon whose death his only son William Russell (1809–72) became 8th duke. William was succeeded by his cousin, the grandson of the 6th duke, Francis Charles Hastings Russell (1819–91), 9th duke, a horticulturalist and agriculturalist who made experiments in fertilizers and cattle breeding. He became president of the Royal Agricultural society in 1879. His sons, George William Francis Sackville Russell (1852–93) and Herbrand Arthur Russell (1858–1940) succeeded in turn to the title. Herbrand, who was a noted naturalist, built up the live collection of rare animals still kept in Woburn park and was president of the Zoological Society of London (1899–1936). His wife

MARY DU CAURROY (née Tribe) (1865–1937), attained notoriety in the 1920s as the "Flying Duchess" and took part in record-breaking return flights to India (1929) and South Africa (1930). Their son HASTINGS WILLIAM SACKVILLE RUSSELL (1888–1953), 12th duke, was a keen ornithologist and a supporter of the Social Credit movement. He was well known and the object of much public animosity, because of his pacifism in World War II.

JOHN ROBERT RUSSELL (1917–), 13th duke, was born on May 24, 1917, the elder son of the 12th duke. Faced, after succeeding to the title in 1953, with paying heavy death duties on his father's estate, the 13th duke developed to the full the commercial possibilities inherent in opening a "stately home" to the public. He showed himself to be a resourceful publicist and by the end of the 1950s both he and Woburn abbey were well known to the British public. In 1959 he published a volume of memoirs, *A Silver-Plated Spoon.*

See J. H. Wiffen, *Historical Memoirs of the House of Russell* (1833); G. S. Thomson, *Two Centuries of Family History* (1930).

BEDFORD, a municipal borough and the county town of Bedfordshire, Eng., lies 50 mi. N.N.W. of London by road. Pop. (1961) 63,317. The town lies in the fertile valley of the Great Ouse, on both sides of the river. Near the site was a small Roman station controlling the ford; the rich cemetery of Kempston indicates Saxon occupation. Bedford (Bedcanforda, Bedanforda, Bedeford) is first mentioned in 571 when Cuthwulf defeated the Britons there. It was captured from the Danes by Edward the Elder in 914. Because of its central position and fordable river site it became the capital of the nascent shire to which it gave its name (*see* BEDFORDSHIRE). In the Domesday Book, as the county town, it was entered apart from the rest of the shire and was assessed for ship service. The prescriptive borough received from Henry II its first charter which was confirmed by successive sovereigns down to Charles II. The castle, first mentioned in 1136, was destroyed in 1224. St. Paul's, the principal church and one of the four old ones, is mainly Decorated and Perpendicular; it contains the pulpit where John Wesley preached his assize sermon in 1758 and a brass to Sir William Harpur, a Bedfordian and lord mayor of London in 1561, to whom four schools owe their foundation. These schools, controlled by the Bedford Charity (Harpur trust), are Bedford High school and Dame Alice Harpur school for girls, Bedford Modern school and Bedford school for boys. The latter, administered by the canons of Newnham priory since the 12th century, seemed likely to disappear after the dissolution of the monasteries, but Bedford corporation obtained letters patent from Edward VI in 1552 to maintain the school, and Harpur endowed it with land in Bedford and London. The "Bunyan Meeting" (1850) stands on the site of the barn in which John Bunyan preached from 1656 onward and in the panels of a pair of bronze doors (1876) are scenes from his *Pilgrim's Progress;* the parlour is now the Bunyan museum. Bedford's public library contains the Mott-Harrison collection of his works as well as a collection of old books and pamphlets. In the town Bunyan, who was born at Elstow about 1½ mi. S., underwent a long but in part nominal imprisonment. Howard house, which belonged to John Howard, the prison reformer, is near the Howard Congregational church which he helped to found in 1772. The Cecil Higgins Museum of Art contains works of art, and the Prichard collection of natural history and antiquities is housed in the Embankment museum nearby. Close by is a mound on which stood the Norman castle and where there was a bowling green for more than four centuries. There are four public parks. Bedford gave its name to several towns in the U.S., including one in Massachusetts and one in Indiana.

Bedford is traversed by two trunk roads and a main line railway from London to Scotland. The county town of a large agricultural area, it is a centre for commerce (especially law, banking, insurance) and for local government, including branches of government departments and nationalized industries. The largest factories make pumps, diesel engines, gas and steam turbines, agricultural implements, milling machinery, switchgear, malleable tube fittings, castings of all kinds, electric lamps, transistors and confectionery. Complementary to the Royal Aircraft Establishment at Thurleigh, outside the town, are the wind tunnels in the town operated by a consortium of leading aircraft firms. There is a College of Aeronautics at Cranfield (10 mi. S.W.) and an Institute of Agricultural Engineering near Silsoe (10 mi. S.). Bedford College of Physical Education for girls was founded in 1903. At Cardington (2½ mi. S.E.), once the home of John Howard, is the Royal Air Force centre where the airship R-101 (destroyed over France in 1930) was built. (G. F. SI.)

BEDFORD, a city of Indiana, U.S., 70 mi. S.S.W. of Indianapolis; in the heart of the Indiana limestone district; the seat of Lawrence county. (For comparative population figures *see* table in INDIANA: *Population.*)

Bedford was settled in 1825 and incorporated as a city in 1889. Deposits of oölitic limestone were discovered in the 1830s, and limestone soon became the region's primary industry. Bedford limestone is a highly prized building material. Immense quarries and mills produce, fabricate and ship an average of 6,000,000 cu.ft. of stone annually.

Other industries include foundries, machine shops, clothing manufacturing and wood products. A local cattle and hog auction is one of the most active in the midwest. The city owns 477 ac. of well-developed public parks and has the state's first municipally owned forest. (J. M. GU.)

BEDFORD, a borough and county seat of Bedford county, Pa., U.S., on the Raystown branch of the Juniata river, 38 mi. S.W. of Altoona. Its permanent population is less than 5,000. In the heart of the Alleghenies, it is the centre of a recreational area; Bedford Springs, a fashionable resort nearby, was the summer White House of Pres. James Buchanan. Bedford is the centre of a region producing limited amounts of metal, mine, lumber and textile products.

A settlement was made there about 1750 by an Indian trader, Robert Ray, and the place was originally known as Raystown. Ft. Bedford (named for the duke of Bedford), an important frontier post for many years, was built in 1751 and served as a supply base for the campaign against Ft. Duquesne in 1758. The town was laid out in 1766 and incorporated in 1795. Washington went there in 1794 to review the army sent to quell the Whisky insurrection. His headquarters, as well as other interesting 18th-century houses, are still standing. (C. C. G.)

BEDFORDSHIRE, a south midland county of England, is bounded northeast by Huntingdonshire, east by Cambridge, southeast by Hertfordshire, west by Buckinghamshire and northwest by Northamptonshire. Its area is 473.5 sq.mi.

Physical Features.—Bedfordshire lies principally in the middle part of the catchment basin in the Great Ouse, which enters from the west and traverses the vale of Bedford in a very winding course before leaving the county near St. Neots, Huntingdonshire, and draining northeastward toward the Wash. In the south are the headwaters of the Lea, which joins the Thames, and in the north a few tributaries of the Nen.

Three upland ridges cross Bedfordshire from southwest to northeast, dipping gradually to the southeast, and between them two lowland areas cover most of the county. The northern uplands are little more than a rising cap of boulder clay, marking the northern limit of the Ouse valley. Apart from the older rocks exposed in the upper Ouse valley, the whole of the northern half of the county rests on Oxford Clay. Between Turvey and Stevington the Great Oölite is exposed by the Ouse mainly as limestone bands, formerly quarried for building stone and used in the riverside villages. Above, also occurring as a thin strip, are cornbrash limestones, and overlying them the Kellaways beds, revealed in boreholes and shallow diggings as a sandy clay containing irregular "doggers" (masses) of concreted sands. South of the clay vale the Lower Greensand forms an elevated ridge running from Leighton Buzzard through Woburn and Ampthill and broken in the east by the valley of the Ivel. A narrow plain of gault lies between this ridge and the chalk of the Chiltern hills, which there rise abruptly to a range of hills and ridges reaching nearly 800 ft. in the Dunstable downs. Below the Lower Chalk of the northern escarpment the Chalk Marl has washed down to form a sloping shelf passing by gradual transition into the upper gault. Dividing the Lower Chalk

and the Chalk Marl is a band of Totternhoe stone, a clunch much used in the early churches of the region. All over the county considerable patches of drift deposits obscure the solid formations below. Clay-with-flints occurs as a capping to the chalk hills, while boulder clay, the most extensive, forms a large spread in the north and centre. Gravels, alluvium and peat occur in most of the principal valleys.

The soil surface is greatly varied. Clays cover almost two-thirds of the county, the Oxford Clay region having a heavy, dark-brown soil with the highest clay content which is difficult to drain. The boulder clay soils are lighter and chalky, with an admixture of stones and fine gravel. In association with alluvial deposits, as in the Ivel valley, the boulder clay forms good market gardening soil, and where it occurs as a capping over greensand it gives a light loam. The gault gives rise to stiff, tenacious soil, badly drained, but lighter and suited to arable farming where it approaches the chalk. The greensand provides a light sandy soil. On the chalk the lime content is high and the soil light, but where it is covered with gravel or clay-with-flints the variety is greatly increased.

The county shares the relatively continental climate of East Anglia. Average temperatures show a wide range from 40° F. in January–February to 61°–62° F. in July. Humidity and average annual rainfall are low, the latter varying from about 20 in. in the Ouse valley to 28 in. in the Chilterns.

About 58% of Bedfordshire is devoted to mixed farming, the most intensive concentration being in the east and centre. About 22% is permanent grass and rough grazing, mainly in the gault clay vale, in the southern part of the vale of Bedford and on the chalk hills, where stretches of open downland still remain, with isolated patches of heath on the clay-with-flints. Water meadows lie in well-marked strips on the alluvium of the river valleys and an isolated survival of undrained alluvial bog occurs at Flitwick moor. Woodland, once the natural vegetation of Bedfordshire, now accounts for only about 4% of the total, with scattered woods, predominantly oak, on the northern boulder clay, and a series correlated with the greensand, mainly coniferous plantations (especially around Woburn), on the site of earlier natural woods.

Woburn park contains a large private collection of deer, including the famous Père David's herd, and other imported animals, but apart from possible escapes there are no wild ungulates. Resident wild mammals and birds are typical of the south midlands. The broad movement of summer visitors and passage migrants from the south brings them across the county, and wild fowl pass over on their migration routes from the Wash, many geese, ducks and swans pausing to rest by flooded pits, artificial lakes and riversides, where in spring waders may also be seen. The larks of Dunstable downs were once supplied to the London market in considerable quantity. A small downland National Nature reserve at Knocking Hoe, Shillington, preserves an unusual assemblage of chalk-loving plants, while other parts of the chalk downs at Dunstable and Sharpenhoe are under the care of the National Trust. At Whipsnade is the country zoo of the Zoological Society of London.

History.—Fossil remains of rhinoceros, mammoth, etc., have been found with Paleolithic implements in the preglacial valley gravels at Biddenham and Kempston, and at Cardington an Acheulean working floor was discovered buried in the deposits of a small ancient lake.

Where it is free from clay-with-flints, the chalk provided the prehistoric inhabitants with hunting grounds and pasture, while across its northern edge runs an ancient trade route, the Icknield way. The light soils of the greensand were also readily cleared and cultivated, but the gault and Oxford Clay regions were impenetrable. Maiden Bower, near Dunstable, probably represents a causewayed camp (now with Iron Age ramparts) of the earliest Neolithic inhabitants. There is evidence of secondary Neolithic habitation at Waulud's bank (Leagrave), Eaton Socon and Barton Hill farm (Streatley), and a crouched woman, buried with a polished flint knife, was excavated from a bowl barrow among the Five Knolls group of tumuli on Dunstable downs. The Beaker folk, arriving about 1800 B.C., lived mainly on the alluvial deposits of the Ouse basin. Burial mounds at the Five Knolls and Galley Hill (north of Luton) represent barrow cemeteries of the early Bronze Age, and collared urns and bronze weapons from a number of sites evidence the arrival of farmer–herdsmen from northwest Europe about 800 B.C.

The Chiltern escarpment, on which earthworks remain, offered defensible sites to the Iron Age arrivals spreading from East Anglia by way of the Ouse and Icknield way. Remains indicate that their settlements were restricted to the chalk and greensand, to river valleys and to the gault where overlain with gravel. Fine bronzes have been found at Felmersham and Stanfordbury, Shefford. Roman settlement followed the same pattern, with some opening up of the north of the county. Watling street crosses the Romanized Icknield way at Dunstable where there was a posting station (Durocobrivae), and Bedford and Sandy were stations at fords across the Ouse and Ivel respectively. A Roman road ran north through Biggleswade and Sandy to Godmanchester, and others crossed from southwest to northeast.

Cemeteries at Kempston, Luton and Sandy provide evidence of Anglian and Saxon penetration via the Fenland river routes by early in the 6th century, and the *Anglo-Saxon Chronicle* records, in 571, the capture of Limbury (Lygeanburg) by West Saxons advancing along the Icknield way from the Thames valley. Alfred's treaty of about 886 placed the Danelaw boundary "along the Lea as far as its source; then straight to Bedford, then up the Ouse as far as Watling street." (C. E. Fr.)

The Saxon king Edward the Elder recovered the Danish part of the area, of which Bedford had become a military centre, and soon afterward the whole area became known as Bedfordshire. From this time it had both stability and unity, though from the Norman conquest until 1574 it had the same sheriff as Buckinghamshire. Bedford received its first charter in 1166. The royal manors of Leighton Buzzard and Luton were sizeable and that of Dunstable sometimes exercised burghal privileges, but Bedford is really the only ancient borough.

Bedfordshire has been a county of prosperous farming on moderate-sized estates; of small market towns; of cottage industries; of river navigation; in the middle ages, of modest religious houses; after the Reformation, of Puritan tendencies; and from the mid-19th century, of industrial development.

The estates of the Norman lords, of whom Hugh de Beauchamp of Bedford was the chief in 1086, gradually disintegrated. Bedford castle was besieged and demolished in 1224. The only medieval baronial family continuing until the 20th century was that of Grey of Silsoe. The Tudor period saw a new gentry, such as the Burgoynes, Crawleys and Gerys. The yeomen and village craftsmen flourished (Thomas Tompion, the clockmaker, was the son of a Northill [or Ickwell] smith) and market gardening was known at Sandy by at least 1618.

The monastic houses included: the Benedictine nunnery of Elstow, founded by Judith, niece of William the Conqueror (the church partly survives); the Cistercian abbeys of Woburn and Warden; the Gilbertine priory of Chicksands, of which there are remains, and the Augustinian priories of Newnham and Dunstable. This last, founded by Henry I and still partly standing, kept a chronicle, and its best-known prior, Richard de Morins (1202–42), was entrusted with special missions by king and pope.

The area was served by several small market towns. The making of pillow lace, of which the first local evidence is at Eaton Socon in 1596, took strong hold in Bedfordshire; lacemen of Bedford and a dozen other centres distributed thread and patterns to village lacemakers and marketed the finished work. By 1689 plaiting straw for hats was extensively carried on as a home industry in and around Dunstable, though in the 19th century the hat factories eventually concentrated at Luton.

Puritanism came slowly, yet took deep root, especially during the Civil War and Commonwealth when, though there were such royalists as the Wentworths, the county as a whole under Lord St. John and Sir Samuel Luke took the parliamentary side. In 1650 was founded in Bedford the congregation now known as "Bunyan Meeting" from its later minister, John Bunyan. After the Restoration Bunyan was imprisoned, during part of which time he wrote *Pilgrim's Progress*. John Howard of Cardington, the

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WOBURN ABBEY, BEDFORDSHIRE

prison reformer, was also a Nonconformist.

In the main the landed estates remained small, but in the 18th century land began to be concentrated in fewer hands and by the end of the 19th century half the county was owned by fewer than 50 persons. The largest estate belonged to the duke of Bedford; his family, the Russells, had increased their holding in the county to 33,000 ac. by 1873, their residence, Woburn abbey, having been extended and rebuilt by Henry Flitcroft and Henry Holland and their park enlarged to 2,500 ac.

Communication was by roads mainly radiating from Bedford, until in the 17th century the Ouse was made navigable up to Bedford for lighters from King's Lynn. This was followed in the 18th century by further navigation to Shefford along the Ivel. The years after 1840 saw the coming of railways; the collapse of river navigation; the incorporation (1864) of Dunstable (*q.v.*); the great growth of Luton (*q.v.*, 1876); the development of industry in all three boroughs; the rise to importance of the brick, cement and sand industries; and the disappearance of almost all the large estates.

Among secular buildings of historic interest are: Luton Hoo (former seat of the marquis of Bute), designed by Robert Adam (1767), but later gutted by fire; Hinwick house (Queen Anne period); Elstow Moot hall, a 17th-century museum associated with Bunyan; and a 16th-century dovecot and stable at Willington, owned by the National trust.

Population and Administration.—The population of the town of Bedford was only about 4,000 as late as 1801, while Leighton Buzzard (*q.v.*) and Luton were half that size and other towns smaller still. The population of Bedfordshire was 380,704 in 1961, that of the three boroughs being Bedford, the county town (63,317), Luton (131,505) and Dunstable (25,618). There are three parliamentary divisions and one parliamentary borough (Luton), each returning one member to parliament. The county has one court of quarter sessions and seven petty sessional divisions; Bedford and Luton have separate commissions of the peace and Bedford a separate court of quarter sessions. Assizes are held at Bedford. The archdeaconry of Bedford is in the diocese of St. Albans.

Industries and Communications.—Bedfordshire is a prominent agricultural county where interests are almost equally divided between cereals (chiefly wheat), livestock (including milk) and root crops, except for practically the whole of the eastern side, where the light soils of Potton, Biggleswade, Sandy and Maulden are wholly suited to intensive market gardening. Some of the best vegetables (sprouts, potatoes, peas) in the country are grown there for London and provincial markets.

Bedford, Luton and Dunstable have all become industrial centres manufacturing both capital and consumer goods, this development being attributed to their proximity to London and their good rail and road communication with midland sources of raw materials. Luton's products include ball bearings, hats, electrical equipment, precision instruments and automobiles (the last being also made at Dunstable), and Bedford produces machinery, generating plant and precision and electronic instruments.

The various geological formations are considerably exploited, notably by a great range of brickworks in the Oxford Clay south of Bedford. Chalk is quarried for cement near Dunstable and Houghton Regis, while around Leighton Buzzard quantities of sand are taken for glassmaking and brick and molding purposes.

Near Bedford are the College of Aeronautics and a royal aircraft establishment. The National Institute of Agricultural Engineering is at Wrest Park, near Silsoe, and a large food research centre at Colworth house, near Sharnbrook. At Old Warden is the Shuttleworth (agricultural) college and there are colleges of further education at Bedford and Luton.

The London-Birmingham motorway (expressway) crosses the southern part of the county, entering near Luton, and there are three important trunk roads: Watling street passing through Dunstable, the Great North road by Biggleswade and the London-Leicester-Carlisle road through Bedford. The county is crossed by three main railway routes from London to Scotland; that from King's Cross passes through Biggleswade; the Euston route serves Leighton Buzzard; and the St. Pancras route runs through Luton and Bedford. There are also rail services from Bedford to Northampton, Bletchley and Cambridge. There is a civil airport at Luton. (A. J. Go.)

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BÉDIER, (CHARLES MARIE) JOSEPH (1864–1938), French scholar, who made an invaluable contribution to the study of medieval French literature, was born in Paris on Jan. 28, 1864. He was appointed professor of medieval French language and literature at the Collège de France in 1903. He won recognition as early as 1893 with *Les Fabliaux*, a work on 13th-century French narrative poetry. The publication of his *Roman de Tristan et Iseult* in 1900 set a European seal on his reputation as a writer, while his profound scholarship found its fullest expression in his epoch-making critical edition of the *Roman de Tristan* by Thomas (1902–05). He was the first to show that the earliest Tristan poem was the product of an individual genius, not of popular tradition. In his next great work, *Les Légendes épiques* (4 vol., 1908–21), he developed with a wealth of detail his theory that the great epic poems of medieval France were equally remote from popular tradition and that they were closely connected with certain sanctuaries situated along the routes used by pilgrims in the 11th and 12th centuries. As a sequel to this study he published in 1922 a critical edition of the *Chanson de Roland* in which he applied the strictly conservative method of editing which became closely associated with his name. He was elected to the Académie Française in 1921. He died at Grand-Serre, Drôme, on Aug. 29, 1938. (E. VR.)

BEDLAM, the popular name of Bethlehem Royal hospital, the first lunatic asylum in England and, with the exception of one in Granada, Spain, the first in Europe. It was originally founded by Simon FitzMary, sheriff of London, in 1247, as a priory in Bishopsgate street for the sisters and brethren of the order of the Star of Bethlehem. Bedlam was mentioned as a hospital in 1330 and some lunatics were accommodated there by 1403. In 1547 it was handed over by Henry VIII with all its revenues to the City of London as a hospital for lunatics. It became famous and afterward infamous for the brutal ill-treatment meted out to the insane. In 1675 it was moved to Moorfields; and in 1815 to St. George's road in southeast London; and in 1930 to Shirley on the borders of Beckenham and Croydon. Now a part of the national health service, it is known as Bethlem Royal hospital and the Maudsley hospital. The word Bedlam was used generically for all insane

asylums and is used colloquially for an uproar.

BEDLINGTON, an urban district (officially called Bedlingtonshire) in the Wansbeck parliamentary division of Northumberland, Eng., 12 mi. N. of Newcastle upon Tyne by road. Pop. (1961) 29,403. It lies on high ground about 2½ mi. above the mouth of the Blyth river. The port of Blyth is partly in Bedlingtonshire. The main industries are mining and exporting coal, brickmaking and agriculture; there are also factories making shirts, gloves, electrical components and light engineering equipment. The iron works flourished until the 1860s. Bedlington is known for a famous breed of terriers.

Bronze Age remains were found in the area. Bedlington and the hamlets belonging to it were bought by Cutheard, bishop of Durham, between 900 and 915 and (although in Northumberland) became part of the county palatine of Durham over which Bishop Walcher was granted royal rights by William the Conqueror. Bedlington lost these privileges in 1536, though remaining in the hands of the bishops of Durham until taken over by the ecclesiastical commissioners in 1866. Bedlingtonshire was made part of Northumberland for civil purposes in 1832 and 1844.

BEDLOE, WILLIAM (1650–1680), English informer, who in Oct. 1678 came forward to claim the £500 reward for information concerning the murder of the magistrate Sir Edmund Berry Godfrey and who for a while played a role second only to that of Titus Oates in sustaining the panic of the alleged "popish plot." Bedloe was born at Chepstow on April 20, 1650. Emboldened by his success he denounced various Roman Catholics and, having become very popular, married an heiress and lived luxuriously. Afterward his fortunes waned and he died of a riding injury at Bristol on Aug. 20, 1680. He appears to have been well-educated; he was certainly clever, and after coming to London in 1670 he became acquainted with some Jesuits and was occasionally employed by them. Calling himself at different times Captain Williams, Lord Gerard, Lord Newport or Lord Cornwallis, he traveled from one part of Europe to another, underwent imprisonment and became an expert in all kinds of duplicity. But the details of his career, provided by partisans, must be treated with caution.

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BEDMAR, ALFONSO DE LA CUEVA, Marqués de (1572?–1655), Spanish diplomatist, was allegedly responsible for the so-called "conspiracy of Venice" in 1618. Philip III of Spain nominated him ambassador to the Venetian republic in 1607—a time when the viceroys of Naples and Milan, the duque de Osuna and the marqués de Villafranca, were endeavouring to increase Spanish power in Italy. To this policy Venice was resolutely opposed. The ambassador, who was made marqués de Bedmar in 1614, had little hesitation about using his diplomatic privileges to promote the designs of Osuna and Villafranca. Consequently the Venetian government invented the alleged conspiracy to seize the republic in order to provide a pretext for Bedmar's expulsion.

Philip III then sent him to the Spanish Netherlands where, for a time, he exercised the functions of first minister. In 1622 he was made a cardinal, resigning the marquisate to his brother Juan. He spent much of his later life in Rome, assisting in Spanish diplomatic representation to the Vatican. In the 1620s he was made bishop of Málaga and of Oviedo, where he died.

He either wrote, or caused to be written, *Squittinio della libertà veneta* (1612), an anonymous work attacking the Venetian government.

BEDOUIN (Arabic *badawi* "desert dweller"), the nomadic tribesmen of the middle eastern deserts, who live in black goats' hair tents and subsist on the products of animal husbandry. The Bedouins constitute about one-tenth of the total population of the middle east, but inhabit or utilize almost nine-tenths of its land area. The annual wandering cycle of the Bedouins, determined by the grazing needs of their herds or flocks, takes them into the desert during the rainy winter season, and closer to the cultivated land with its rivers, springs and wells, in the dry summer months. The Bedouins can be classified according to the animal species which form the basis of their livelihood. First in prestige and historical importance are the camel nomads, occupying huge wandering territories and organized into large tribes in the Syrian and Arabian deserts, as well as in the Sahara, where the most typical representatives are the Tuareg. Beneath them rank the sheep and/or goat nomads, whose much smaller wandering areas keep closer to the cultivated regions, in the fertile crescent countries of Jordan, Syria and Iraq. A special subvariety of the latter are the west-Iranian and Moroccan tribes practising transhumance; *i.e.*, a vertical kind of nomadism, up into the mountains and highlands in the summer, and down into the valleys and lowlands in the winter. The cattle nomads are found mainly in south Arabia and in the Sudan where they are called Baggara (*q.v.*).

Following World War I the Bedouin tribes had to submit to the control of the governments of the countries in which their wandering areas lay. This also meant that internal feuding and the raiding of outlying villages had to be given up, to be replaced by more peaceful commercial relations. The tribal character of Bedouin society continued, however, as did the patriarchal order in their extended, patrilineal, endogamous and polygynous families. Among the Arabic-speaking tribes, the head of the family, as well as of each successively larger social unit making up the tribal structure, is called *shaykh* ("sheikh"); the *shaykh* is assisted by an informal tribal council of male elders. Religious traditions, frequently older than the official religion of Islam, play an important role in Bedouin life, as do the values of hospitality, bravery, generosity, dignity and honour, vengefulness and forgiveness, independence and leisure.

In addition to the "noble" tribes who trace their ancestry to either Qaysi (north Arabian) or Yamani (south Arabian) origin, Bedouin society comprises scattered, "ancesterless," vassal tribal splinter groups who shelter under the protection of the large noble tribes and make a living by serving them as blacksmiths, tinkers, artisans, entertainers and other trades. This class structure has assumed a most elaborate form among the Tuareg (*q.v.*) who, alone among the middle eastern Bedouins, are matrilineal. Slavery still persists among both the Arabian and Saharan Bedouins.

Although the Bedouins traditionally despise agricultural work, artisanship and other manual labour, many of them have become sedentary throughout the millennia of middle eastern history because of political or economic pressures. After the 1920s, and even more so after World War II, this trend became greatly accelerated, as a result of the settlement policies of middle eastern states.

See also Arab; Nomads.

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BEDSORE: *see* Skin, Diseases of.

BEDSTRAW, a common name for small lacy-flowered herbs of the genus *Galium* of the madder family (Rubiaceae). The name refers to the old practice of using the dried plants in the making of beds. About 300 species are known, found chiefly in temperate parts of the northern hemisphere, many of them being common weeds.

The tiny white or yellow flowers often aggregate into large airy clusters. In the United States and Canada there are about 60 species of *Galium*, several of which are introduced weeds. Among the more conspicuous are the sweet-scented bedstraw (*G. triflorum*); the northern bedstraw (*G. boreale*), with profuse clusters of white flowers; the white or great hedge bedstraw (*G. mollugo*), called also wild madder and false baby's-breath; and the California bedstraw (*G. californicum*), a yellow-flowered species. Common British species are the yellow or Our-Lady's-bedstraw (*G. verum*) and the goose grass, or cleavers (*q.v.; G. aparine*); both are found in Europe and North America. Some species, including *G. verum*, *G. trifidum* and *G. boreale*, yield dyes.

BEDWELLTY, an urban district in the Bedwellty parliamentary division of Monmouthshire (*q.v.*). Pop. (1961) 27,308.

The district is about 6 mi. long and is largely a high ridge between the Sirhowy and Rhymney valleys, though the northeastern portion almost adjoins the Ebbw vale. The district includes many villages or townships such as Bedwellty, New Tredegar, Aberbargoed (where are the municipal offices), Pengam, Charlestown and Blackwood, the last, at the southern end of the district, about 13 mi. N.W. of Newport by road. St. Sannan's church in Bedwellty village dates back to the 12th century and its register to 1624.

The chief industries of the area are farming and coal mining and there are clothing factories and an iron foundry.

BEDWORTH, a manufacturing and residential town and urban district of Warwickshire, Eng., lies 3 mi. S. of Nuneaton and 5½ mi. N. of Coventry. Pop. (1961) 32,509. Coal is mined from two pits. There is a growing light engineering industry centred in a modern trading estate, and tapes, ribbons and trimmings are made; similar industries are carried on in the area of Coventry, extending southward from Bedworth. Corley hall, 4 mi. W., is a Jacobean farmhouse, reputed to be the original Hall farm in George Eliot's *Adam Bede*.

BEDZIN, a town in the Katowice *wojewodztwo* (province) of Poland, lies on the Czarna Przemsza river, a tributary of the Vistula, 290 km. (180 mi.) S.W. of Warsaw. Pop. (1960) 39,000. One of the oldest towns in the Upper Silesian industrial region, Bedzin arose on the trade route between Wroclaw (Breslau) and Cracow (*qq.v.*). A castle and settlement were in existence there in the 13th century. After the third partition of Poland, in 1795, the town was seized by Prussia. Between 1807 and 1918, when it was returned to Poland, it belonged successively to the duchy of Warsaw and the Polish kingdom (a Russian dependency). The first coal mine in the Upper Silesian basin was started there in 1785. The town is now a mining and industrial centre (metallurgy, machinery and electrotechnical products). (K. M. Wi.)

BEE, the common name for any of about 20,000 species of insects of the superfamily Apoidea of the order Hymenoptera (*q.v.*). In addition to the few common sorts that readily come to mind—honeybees, bumblebees and perhaps carpenter bees—thousands of more wasplike or superficially flylike bees are included in the Apoidea. The smallest are only 2 mm. (about $\frac{1}{13}$ in.) in length, the largest over 30 mm. (over 1 in.). Bees are universally abundant, wherever there are flowers (*see* below).

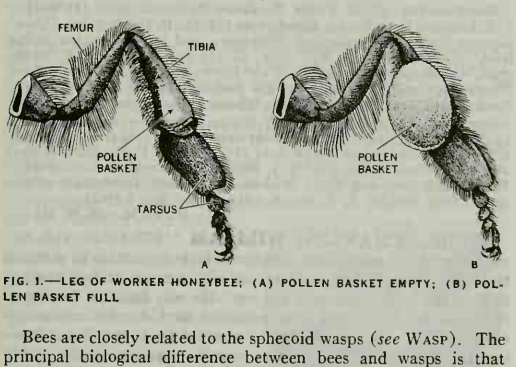


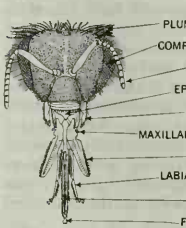
FIG. 1.—LEG OF WORKER HONEYBEE; (A) POLLEN BASKET EMPTY; (B) POLLEN BASKET FULL

Bees are closely related to the sphecoid wasps (*see* Wasp). The principal biological difference between bees and wasps is that most bees (except for parasitic kinds, *see* below) directly provide their young with a mixture of pollen and honey, storing such supplies in their nests, whereas wasps feed their young prepared animal food or provision their nests with insects or spiders. Associated with this difference in food preference are certain structural differences. Whereas wasps are covered with unbranched hairs, bees have at least a few branched or feathered hairs to which pollen often clings. Such hairs are part of the mechanism by which bees gather pollen.

Relationships to Flowers.—Bees are entirely dependent on flowers for food, which consists of pollen and nectar, the latter sometimes modified and stored as honey. There is no doubt that the bees and the flowers that they pollinate evolved simultaneously during the earth's history.

As bees go from flower to flower gathering pollen, they lose small quantities. These small amounts of inadvertently lost pollen are significant, for they often result in cross-pollination of plants. (Self-pollination, the closest possible inbreeding, is often genetically undesirable or, in some plants, produces no seeds.) The practical value of bees as pollinators is enormously greater than the value of their honey and wax production. Especially in areas of intensified agriculture, where natural habitats of bees have been destroyed, efforts are being made to encourage the increase of both wild bees and the honeybee.

General Description.—Male bees are usually short lived and never collect pollen, nor have they other responsibilities in connection with providing for the young. Female bees do all the work of nest making and provisioning and usually have special anatomical structures that assist them in carrying pollen. In most females, hairs on the end segments (tarsi) of the forelegs are used to brush pollen from the anthers of the flowers. The tarsi of the fore and middle legs gather the pollen from the hairs of the body of the bee. Collected pollen is then passed to the pollen-carrying organs, which vary among different kinds of bees.



BY PERMISSION OF BAZAAR EXCHANGE & MART, FROM CHESHIRE, "BEES AND BEE-KEEPING"

FIG. 2.—HEAD AND MOUTH PARTS OF HONEYBEE

Some primitive bees (*e.g.*, in the families Colletidae and Halictidae) have masses of long hairs on the basal segments (coxae, trochanters and femora) of the hind legs and on the undersurface of the abdomen. These hairs constitute the scopa, the pollen-carrying structure. In many bees of the families mentioned above the scopa has been lost from the abdomen, being limited to the hind legs; in two subfamilies (Panurginae and Anthophorinae) the scopa is enlarged on the more distal parts (tibiae) of the hind legs and reduced or absent on both the abdomen and basal leg segments; finally, in the social bees (honeybee, bumblebee, etc.) the scopa is limited to the outer sides of the hind tibiae where it consists of long hairs surrounding a smooth area, the whole being called a pollen basket, or corbicula. In the family of leaf-cutting bees (Megachilidae), the scopa has been lost from the legs and is limited to the underside of the abdomen. In one subfamily of colletid bees (Hylaeinae) the scopa is absent, and pollen, mixed with nectar, is carried to the nest in the expanded portion of the fore-gut, the crop.

Most bees are polylectic; that is, they gather pollen from a wide variety of flowers; however, some bees collect pollen only from flowers of certain families, others from flowers of certain colours. Finally, there are the oligolectic bees, which gather pollen from only a few related kinds of flowers. Some oligolectic bees show no structural adaptations to their favoured flowers, but others have obvious adaptations of this sort. For example, several unrelated bees have scopae consisting of sparse bristles; this enables them to carry the pollen of Onagraceae (evening primrose and relatives), which is webbed together as though by cobwebs. Some tiny tubular flowers have anthers inside the tube, from which ordinary bees cannot easily extract the pollen. Unrelated oligolectic bees have evolved means of getting such pollen; for example, *Proteriades* and some species of *Andrena* pull pollen out of *Cryptantha* flowers by means of hooked hairs on the proboscis; some *Calliopsis* species hook pollen within *Verbena* flow-

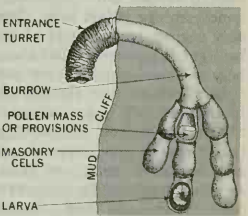


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FIG. 3.—NEST OF BURROWING BEE (ANTHOPHORA OCCIDENTALIS): EXTERIOR VIEW WITH TWO CELLS CUT OPEN

ers with groups of curved hairs on the front tarsi.

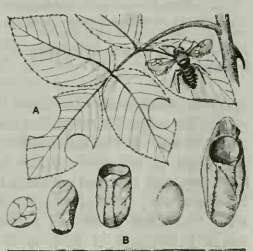
The mouth parts of bees, like the pollen-collecting and -carrying devices, seem to be adapted to different flowers. In colletid bees the lobelike glossa is short and broad, like that of most wasps; other bees (families Halictidae, Andrenidae, Melittidae) have short but pointed glossae. The remaining families of bees have long mouth parts which serve for sucking nectar from deep tubular flowers; some species of *Euglossa* from the American tropics have mouth parts so long that they reach beyond the tip of the abdomen even when folded. The jaws are not involved in these adaptations; they are used mainly for making the nest.

Solitary Bees.—The majority of the Apoidea are solitary bees; that is, each female makes her own nest (usually a burrow in the ground) and provisions it. Among such bees there are no castes (worker, queen, drone). The mother bee constructs cells, each of which is an enclosed space supplied with pollen and honey, and lays a single egg in each. Some cells of burrowing bees are lined with wax, others with cellophanelike material, whereas a few are unlined. Sometimes the cells branch from the main burrow; occasionally they are sections of the burrow separated by partitions. When a cell is completed and an egg laid, the mother closes the cell and goes on to build and provision another. All families of bees contain species that live in this way.

On flat ground nests are indicated by the little hillocks (tumuli) of dirt excavated and left around the entrance. Some species make chimneys or turrets at the nest entrance; *Anthophora* species, for example, construct their nests in clay banks, fashioning turrets that project outward and downward (fig. 3). Nests of these bees often are made in aggregations, so that the term solitary is hardly appropriate, although each female makes her own nest.

Some of the solitary bees nest in wood or in the pith of twigs or canes; carpenter bees (*Xylocopa* species), which sometimes damage timbers by their burrowing, are good examples.

The family Megachilidae, which includes the leaf-cutting bees, contains species which find and use pre-existing burrows or hollows or make exposed nests. The cells are made of materials such as pieces of leaves or petals, pebbles, mud, resin and down plucked from plants. The leaf-cutting bees, *Megachile* species, are among the commonest members of this family. They make nests consisting of rows of cells laid end to end in burrows in wood, in the ground, in corn or weed stalks, etc. (fig. 4). Neatly cut oval pieces of leaves, often from roses, are used to make a thimble-shaped cell. After a cell is provisioned with pollen and honey, an egg is laid in it, then the cell is capped with remarkably perfect round pieces of leaves. Some European megachilid bees (of the genus *Osmia*) are noteworthy for making their nests only in abandoned shells of land snails.



FROM GRANDI, "INTRODUZIONE ALLO STUDIO DELLA ENTOMOLOGIA," VOL. II

FIG. 4.—LEAF-CUTTING BEE (MEGACHILE CENTUNCULARIS): (A) ADULT ON LEAVES OF OWN CUTTING; (B) DIFFERENTLY SHAPED PIECES OF LEAVES (LEFT) FASHIONED INTO A CELL (RIGHT) AROUND A POLLEN MASS; (C) SERIES OF LARVAL CELLS CONSTRUCTED IN STEM

Most solitary bees are short lived as adults. Some species may be in flight only a few weeks of the year, having spent the rest of the year in their cells as eggs, larvae, pupae and young adults. Other species have several generations yearly, so that adults may be found during two or three different periods, or more or less continually. In temperate climates solitary bees usually pass the winter in their cells, either as mature larvae (prepupae) or as young adults.

Social Bees.—Occasionally, nests of normally solitary bees are inhabited by two females, each of which makes her own group of cells. In a few species as many as 40 females normally live together in one burrow, but each makes and provisions her own cells. In some halictid bees (sweat bees) weakly differentiated queens and workers exist. The queens establish their nests in the spring, making and provisioning the cells and laying eggs; during the summer the eggs hatch as workers. In the fall young queens and males are produced; the males and workers die, but the queens hibernate and start the cycle again the next spring. This is very much the same life cycle as that of the bumblebees, except that the halictid colonies are very small, consisting of a queen and two or three workers, rarely up to hundreds of individuals. As in the solitary bees, the halictids put all necessary food for one larva in a cell and do not add to it after the egg is laid and the cell closed.

The better-known social types, *e.g.*, bumblebees and especially honeybees, feed the young progressively; the queens lay their eggs in empty or nearly empty cells and food is not provided until the eggs hatch. There is, however, an interesting little group of bees (species of *Allodape*, *Exoneura*, etc.) found in Africa, southern Asia and Australia, in which progressive feeding occurs among scarcely social forms. These bees live in hollow twigs; the nest is a mere burrow. The eggs are laid on the walls of the burrow and when they hatch the larvae are fed progressively.

The bees that exist in large, well-organized colonies represent a minority of the Apoidea, the subfamily Apinae (family Apidae). Included in the social bees are the well-known honeybees (*Apis* species), bumblebees (*Bombus* species) and the less known meliponines, or stingless bees (*Melipona* and *Trigona* species). For details on the life cycle of social bees *see* SOCIAL INSECTS. An account of the honeybee is given in BEEKEEPING.

Parasitic Bees.—In several families of bees there have evolved species that are called parasitic because they lay their eggs in cells of various working bees. The young larva, which usually has a large head and large jaws, destroys the egg or young larva of the host, then eats the provisions. These bees lack the scopa and other structures associated with collecting and carrying pollen. They also lack various structures of the jaws and legs that are used for making nests. Robbers and parasites of the social bees are also known.

See ENTOMOLOGY; INSECT; *see* also references under "Bee" in the Index volume.

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(C. D. M.; M. H. MI.)

BEEBE, (CHARLES) WILLIAM (1877–1962), U.S. biologist, explorer and author, combined high distinction in detailed biological research and exploration with an unmatched literary skill in the field of natural history. He was born in Brooklyn, N.Y., on July 29, 1877, and educated at Columbia university (B.S., 1898). He was curator of ornithology at the Bronx Zoological park from 1899 and director of the department of tropical research of the New York Zoological society from 1919. He led numerous scientific expeditions to Mexico, Venezuela, the orient, British Guiana, Sargasso sea, Bermuda, Galápagos Islands and the West Indies. He descended in a bathysphere to a depth of 3,028 ft. in 1934, a record at that time. Noted as a lecturer, he received numerous prizes and honours for scientific research and writing. Among many important technical and popular books and articles are *Monograph of the Pheasants* (1918), *Jungle Days* (1925), *Beneath Tropic Seas* (1928), *Book of Naturalists* (1944), *High Jungle* (1949) and *Unseen Life of New York* (1953). His versatile interests ranged from mountain pheasants through the mammals of lowland tropical forests to the fishes of the deep sea, and

he was equally enthusiastic about living animals in their native habitats whether insect, tadpole, snake, anteater or hummingbird. He died in Trinidad on June 4, 1962. (A. E. E.)

CY COLEMAN

FLOWERS OF THE AMERICAN BEECH (FAGUS GRANDIFOLIA)

BEECH, the name for well-known trees of the genus *Fagus,* members of the family Fagaceae to which belong also the oaks, chinquapins, chestnuts and tanbarks. The name beech is from the Anglo-Saxon meaning "a book." The connection of the beech with books is supposed to have originated in the fact that the ancient runic tablets were made from thin slabs of beechwood. Ten species, several with well-known horticultural varieties, have been described; all are indigenous to the northern hemisphere. They are all large (80–100 ft. or more), round-headed and spreading, with smooth light-coloured bark. The two principal species are the American (*Fagus grandifolia*) and the European beech (*F. sylvatica*).

The American beech ranges from New Brunswick to Minnesota and south to Florida and Texas. It attains its best development on dry sandy loams, but is found on a variety of sites throughout its range and is one of the principal trees of the northeastern climax forest. Root suckering is prevalent, and a considerable portion of the natural reproduction has its origin under the parent trees in this manner. Several varieties of the American beech are also recognized: these include *pubescens, caroliniana* and *ferruginea.* The wood of this tree is used for veneer, flooring, novelties, turnery and furniture and is destructively distilled for charcoal, wood alcohol and acetate of lime.

The European beech is a common and important forest tree spreading from southern Norway and Sweden to the Mediterranean. It is a native of England and a commonly planted tree in Scotland and Ireland. It occurs in the Swiss Alps up to elevations of 5,000 ft.; it abounds in the U.S.S.R. and is widely distributed in Asia Minor and the provinces of Iran. Beechmast, the fruit of this tree, was at one time known in England as buck; the county Buckingham was so named because of its famous beech forests. Beechmast has been used as a food in times of distress and famines, and produces an abundant supply of food for game animals and swine, which are turned into beech forests to forage on the fallen fruits. In France the fruits are used for feeding pheasants and fattening domestic poultry. The well-ripened nuts yield from 17% to 20% of a nondrying oil suitable for illumination, and are used in certain parts of France in cooking and as a substitute for butter.

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AMERICAN BEECH (FAGUS GRANDIFOLIA) LEAVES AND FRUIT

European beech features broadly oval, lustrous, dentate leaves, which often persist on the branchlets through the winter, although dead. Conspicuously elongated, shiny, chestnut-brown winter buds, unisexual flowers which are monoecious, and smooth olive-gray bark which remains unbroken even on the oldest and largest trunks are other identifying features. Several well-known varieties are important decorative plants. These include the graceful weeping beech (var. *pendula*); the bronze or copper beech (var. *atropunicea*), a form with purple or copper-coloured leaves; and the cutleaf beech (var. *laciniata*), featuring sharp, deeply lobed leaves. The Japanese species, *F. japonica* and *F. Sieboldii,* also are occasionally used as ornamentals in the western hemisphere.

The antarctic beeches, 17 species widely distributed in Australia, New Zealand and South America, belong to the genus *Nothofagus.* *See* also NUT; WOOD. (E. S. HR.)

BEECHAM, SIR THOMAS (1879–1961), the leading English conductor of his time and the main figure in the revival of opera in England. He was also a master of language who endeared himself to the public by his witty speeches and tirades against the insufficiencies of British musical standards.

Born at St. Helens, Lancashire, April 29, 1879, he was educated at Rossall school and Wadham college, Oxford. He studied music with S. Walsing (piano), J. Varley Roberts and Charles Wood (composition), and M. Moszkowski (orchestration). In 1902 he gained experience as conductor of K. Truman's traveling opera company and in 1905 he gave his first London concert at the Bechstein (later Wigmore) hall with players from the Queen's hall orchestra. In 1910 he began to promote the production of opera in England, and during the following years conducted the first performances in England of works by Delius, Richard Strauss, Stravinsky and others. He was knighted in 1916 and later that year succeeded to the baronetcy of his father, Sir Joseph Beecham. Selfless in the pursuit of his ideal, he made great financial sacrifices to establish opera in England, founding the British National Opera company after World War I, and the Imperial League of Opera in 1927. In 1928 he visited the United States and in the following year organized in London a festival of the works of Delius. In 1932 he founded the London Philharmonic orchestra and in 1933 was appointed artistic director at Covent Garden. During World War II he toured Australia, Canada and the U.S. and in 1947 founded the Royal Philharmonic orchestra.

Beecham greatly improved the standards of British orchestras and ensured an international status for British opera production. His repertory ranged from Handel to the mid-20th century and his interpretations were admired for their verve and elegance of style. His personal preference went, however, to the 18th century and he was especially associated with the works of Mozart. He wrote his autobiography, *A Mingled Chime* (1943) and the standard biography of Delius (1958). He died in London on March 8, 1961.

BEECHDROPS, a North American annual plant, *Epifagus virginiana,* belonging to the broomrape family (Orobanchaceae). It is parasitic on the roots of the American beech, *Fagus grandifolia,* and ranges from Nova Scotia and Wisconsin south to Florida and Louisiana. The slender, branching stems, up to one and one-half feet high, and purplish-, yellowish- or pale brown, bear scalelike leaves and numerous axillary flowers. The usually sterile upper flowers, about one-third inch long, are whitish with two brown-purple bands; the lower, which may develop even underground, are smaller, unopening and fertile. Each capsule contains about 850 minute seeds. The underground portions of the plant are a tuberous stem from which arise the flowering shoots, and the roots that maintain contact with the host. Beechdrops seeds germinate only when they are in contact with beech roots. Beechdrops is sometimes called cancerroot because of its supposed efficacy in the treatment of cancerous sores. (J. W. TR.)

BEECHER, HENRY WARD (1813–1887), U.S. clergyman, holds a leading place in the history of American oratory, and was one of the most conspicuous and controversial public figures of his day. Born on June 24, 1813, in Litchfield, Conn., he was the eighth child of the Rev. Lyman Beecher (*q.v.*) and his first wife, Roxana Foote. The boy who was to become (in John Hay's estimate) "the greatest preacher the world has seen since St. Paul preached on Mars Hill" grew up a boisterous but apparently backward child. Sent to various schools, he showed little promise until taken in hand by instructors at the Mount Pleasant Collegiate institute in Amherst and then at Amherst college, where he enrolled in 1830. Though never distinguished as a scholar, he managed to curb a congenital distaste for hard study, at the same time gaining sufficient poise to become a superior speaker and popular leader. After three postgraduate years in Cincinnati, O., at Lane

Theological seminary, of which his father had been made president in 1832, Beecher in 1837 was settled over his first parish, a Presbyterian congregation of 20 souls at Lawrenceburg, Ind. His marriage to Eunice White Bullard took place the same year.

During this pastorate and a later one at Indianapolis, Ind. (1839–47), Beecher gradually discovered and cultivated the techniques that were the vital elements of his power as a preacher. He came to believe that a sermon succeeds through adherence to the single objective of effecting a moral change in the hearer. His extraordinary dramatic sense and his ability in the use of figurative language were well adapted to such an objective, as was his highly emotional conception of God as one who "loves a man in his sins for the sake of helping him out of them." Beecher's success mounted in both preaching and lecturing, and in 1844 he gained a wide reputation through publication of *Seven Lectures to Young Men*, a set of vivid exhortations on the vices and dangers in a frontier community.

In 1847 Beecher accepted a call to the newly established Plymouth Church (Congregational) in Brooklyn, N.Y. By the early 1850s his oratory was drawing weekly crowds of 2,500, and the church claimed the largest membership of any congregation in the United States. The minister and his admirers sometimes exaggerated his influence in public affairs, but Beecher clearly did become a spokesman and symbol of the Protestantism of his time; both his pronouncements and his personal life were regularly matters of national or even international interest. Dramatic antislavery gestures atoned in the public mind for the preacher's earlier reticence on this subject, and his lectures of 1863 in England worked the Beecher magic upon audiences initially hostile both to him and to the northern point of view. After the American Civil War he was outspoken and frequently courageous in support of a moderate Reconstruction policy, in favour of Cleveland's 1884 candidacy, and in advocacy of woman suffrage, evolutionary theory and scientific biblical criticism. His outlets for these appeals, in addition to Plymouth Church, were the *Independent*, a Congregational journal which he edited in the early 1860s, and later the undenominational *Christian Union*.

The public had more than its share of exposure to Beecher's personal life in the 1870s, after his former friend and protégé Theodore Tilton brought suit against him for alleged adultery with Tilton's wife. Two ecclesiastical tribunals exonerated Beecher, but the jury in the civil suit failed to reach agreement, as have later students of the evidence. That the minister was at least indiscreet to a degree that did little credit to his intelligence has been generally accepted, and was in fact acknowledged by Beecher himself.

Despite the shadow cast by this scandal, Beecher remained active and influential for another decade. He died of apoplexy on March 8, 1887. Mrs. Beecher and four of their ten children survived him.

Besides his sermons, the works that best indicate the nature of his contributions to American Protestantism and to the art of preaching are *Evolution and Religion* (1885), *Life of Jesus the Christ* (1871–91) and *Yale Lectures on Preaching* (1872–74). Other notable works are *Star Papers* (1855), *New Star Papers* (1859), *American Rebellion: Report of Speeches Delivered in England . . .* (1864) and *Norwood: a Tale of Village Life in New England* (1867).

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BEECHER, LYMAN (1775–1863), U.S. clergyman, was an outstanding exponent of the revivalistic tradition in American Protestantism and founder of one of the most remarkable families of the 19th century. He was born in New Haven, Conn., on Oct. 12, 1775, and was graduated from Yale college in 1797. During pastorates at Litchfield and Boston he became widely known as the sturdy and eloquent champion of the established religious order, fostering a "continuous revival" and battling rationalism, Roman Catholicism and the liquor traffic as well as disestablishment of the churches.

In 1832 Beecher turned his attention to the evangelization of the west, becoming president of the newly founded Lane Theological seminary in Cincinnati, O. This venture did not live up to expectations. Beecher's Calvinism, hard doctrine for Bostonians, proved too mild for western Presbyterians, who had the revivalist tried for heresy; and a bitter dispute over the slavery issue dealt the seminary a blow from which it never fully recovered. Retiring in 1850, Beecher died on Jan. 10, 1863.

Lyman Beecher was, by one contemporary estimate, "the father of more brains than any other man in America." Among the 13 children of his three marriages, Henry and Harriet achieved lasting fame (*see* BEECHER, HENRY WARD; STOWE, HARRIET ELIZABETH BEECHER), and five others were well known in their day: CATHARINE (1800–78) was a leader in the women's education movement; EDWARD (1803–95) attained prominence as minister, college president and antislavery writer; CHARLES (1815–1900) became superintendent of public instruction in Florida; ISABELLA (1822–1907) was an able campaigner for women's legal rights; and THOMAS (1824–1900) was a pioneer in adapting church life to modern urban conditions.

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BEEF is the flesh of mature cattle, as distinguished from veal (the flesh of calves), and comprises the red muscle or lean meat, fat and connective tissues; in carcasses the term also includes the bones.

Beef as a Food.—Beef is a staple food in most meat-eating countries and in some the demand for it is closely associated with prosperity. It is easily digestible and is an excellent source of high-quality protein as well as of considerable food energy, minerals and vitamins. One hundred grams of medium-fat beefsteak, edible portion, cooked, contains 59% water and provides 233 calories, 27 g. protein, 13 g. fat, 224 mg. phosphorus, 3.4 mg. iron and 5.5 mg. niacin, as well as small amounts of other minerals and vitamins.

National and regional preferences for special types and weights of beef persist. In New England the preference is for mature "heavy steer beef" from animals two and one-half to three years old, refrigerator-cured for 10 to 20 days, while in general the trend in the United States and Great Britain has been toward younger, leaner and more tender beef, at the expense of flavour. Yearling or baby beef, slaughtered at 10 to 16 months and at live weights of 700 to 1,200 lb., after intensive grain feeding, provides tender, high-quality roasts and steaks of a size suited to the needs of the modern small urban family. Beef from dairy cows is used mainly for meat products in the United States but is prepared for the table in some countries.

Methods of preparation and cooking vary widely with national tastes and the quality of the meat. The finer cuts from the ribs, loin and round (the upper part of the hind leg) are usually used for roasts and steaks. Cuts containing coarser muscle and more connective tissue may need longer, slower cooking as in stews and pot roasts, or may be chopped or ground for hamburger, sausage and other meat products. Beef is canned in many forms, such as roast beef, corned beef, beef stew, beef hash and chili con carne. It can also be cured as salt (corned) beef or dried (jerked) beef. Boneless ground beef, when cooked, dehydrated and compressed, forms an important food in emergency army rations. (*See* FOOD PREPARATION.)

As might be expected, beef consumption is highest in the major exporting countries. In Argentina the annual per capita consumption is well over 200 lb. In Australia and New Zealand it is 110 to 130 lb. and in the United States and Canada 80 to 90 lb. United Kingdom consumption, about 50 lb., is higher than in most western European countries.

Factors Affecting Beef Quality.—Tenderness, juiciness and

flavour in beef are largely determined by the amount and distribution of fat, the composition of the muscle bundles making up the red meat and the presence and consistency of connective tissue (tendons and ligaments). Apart from the differences in cuts from different parts of the animal, these factors may be affected by its age, breed, sex, feeding, health and treatment before and after slaughter. As a beast matures, it lays down fat externally and later between the muscle bundles, giving an effect of marbling; this improves the flavour and texture of the meat. With age, the colour of the red meat deepens, the flavour strengthens and the muscle fibres may become coarser and the connective tissue tougher. The highest-quality beef comes from specialized beef breeds that mature quickly. Beef from stock that have been used for breeding is generally coarser and tougher than that from young females (heifers) and castrated males (steer, ox or bullock beef). Toughness may be found also in meat from animals that have been undernourished, diseased or exhausted before slaughter. Whether in the public municipal abattoir common in Europe or the private meat-packing plants, more usually found in the western and southern hemispheres, stunning, mechanical or electrical, usually precedes bleeding, except in ritualistic slaughter. Inadequate bleeding can affect adversely the keeping quality of the meat. Great attention is paid to hygienic aspects of the slaughter processes, and ante-mortem and (especially) post-mortem inspection may be obligatory.

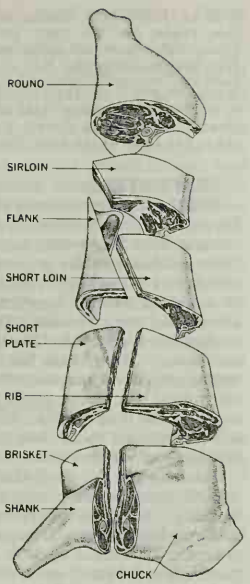

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FIG. 1.—U.S. METHOD OF CUTTING BEEF

Beef is generally improved in tenderness and flavour by aging or ripening; *i.e.*, hanging for 10–14 days at approximately 36° F. Changes that enhance the meat are brought about by the formation of lactic acid in the muscles and the action of enzymes which hydrolize the connective tissue. Modern developments in controlled ripening involve forcing fat into the lean meat, using ultraviolet lamps and treating with enzymes. When beef is frozen for storage or shipment, large ice crystals can form, damaging the muscle fibres and breaking up the texture. This may produce "drip," with loss of flavour and keeping quality when the meat is thawed. Chilled beef, which is carried at temperatures of 28° to 30° F., does not suffer in this manner.

Classes and Grades.—From the butcher's point of view the beef animal should have a high proportion of carcass to live weight. The percentage varies from 40% to 65%, with an average of 54%. Beef carcasses are classified, largely on the basis of sex, into steers, heifers, cows, bulls, stags and rigs. Steers are castrated males; heifers are females that have not calved. Heifers mature earlier than steers and tend to fatten more readily. The two are, however, classified together under most grading systems. Cows are females that have calved. They may be marketed after a number of years in the breeding or dairy herd, or quite young because of inefficient production. Their carcasses may therefore range from little worse than heifer beef to something suitable only for hamburger. Bulls are adult males, and stags are males that have been castrated after reaching maturity. Their flesh is coarser and darker than that of steers, increasingly so with age; like cows, they produce a wide range of carcass types. Rigs are males that have been imperfectly castrated or in which one or both of the testicles have failed to descend.

The classes are subdivided into grades that are determined by conformation, finish or fatness and quality, including marbling, texture and firmness. The ideal beef carcass should be compact and well-fleshed and should yield a low percentage of bone and a high percentage of the more valuable cuts (rib, loin, rump and round). The external fat or covering should be firm, smooth and evenly distributed. Marbling and fine texture are usually taken as indications of tenderness. A bright cherry-red lean meat and creamy white fat are desired by the trade. Meat that shows youth and has soft, porous bones with pronounced cartilages is generally preferred.

In the United States federal grading and stamping of beef was started by the department of agriculture on May 1, 1927. The official grades of steers and heifers in descending scale of fatness and natural tenderness are prime, choice, good, standard, commercial, utility, cutter and canner, the four higher grades being applied to younger animals. Cows are graded commercial or lower; vealers and calves: prime, choice, good, standard, utility and cull; and bulls and stags: choice, good, commercial, utility, cutter and canner. Similar grading standards are employed in other countries, especially in the export trade.

Cutting practice varies from country to country, as do the names given to the cuts from different parts of the carcass. In the second half of the 20th century, self-service at retail brought increased emphasis on smaller cuts and prepackaging.

Beef By-Products.—The most valuable by-product is the hide, which represents about 7% of the live weight. This is used for leather. The body hair is used for felt, the ear hair for brushes and the tail hair for upholstery. Edible beef suet is used in some countries for oleo oil and oleostearin, both of which are used for oleomargarine, salad oils and lard compounds. Inedible fats are used for soap, glycerin, lubricants and leather dressing.

Bones, hoofs and horns may be used for novelties or, ground into bone meal, for casehardening steel, for animal feed or for fertilizer. Edible bones and connective tissue are cooked to make gelatin. Glue is made from inedible bones. Most of the blood is dried and used for animal feed or fertilizer, but some is used in textile sizing, waterproof glue and pharmaceutics and some in the manufacture of sausages for human consumption.

Casings and bladders are used for sausage, lard and cheese containers and goldbeater's skins. Many offal parts are valuable food, such as liver, heart, tongue, brain, sweetbread (thymus gland), kidney, tail and tripe (stomachs of adult cattle). Miscellaneous parts not suitable for human food are cooked, dried and ground for poultry and animal feed.

Important pharmaceutical products are made from many glands and organs. Best-known of these are insulin and adrenaline, made from the pancreas and adrenal glands respectively. Extracts are also made from the pituitary, pineal, thyroid, parathyroid and sex

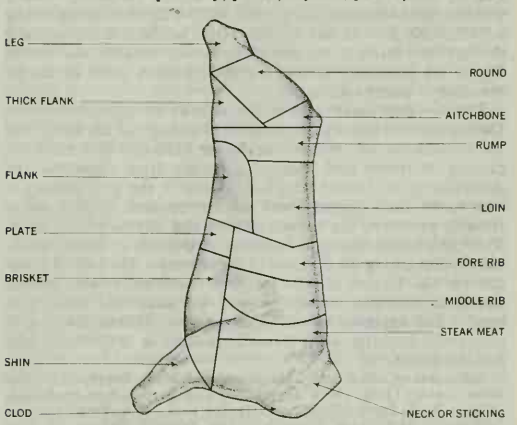

FIG. 2.—ENGLISH METHOD OF CUTTING BEEF

glands and from the liver and spleen. Bone marrow and rennet are other by-products.

Beef Production.—Because of their extensive digestive tract (complex "stomach") cattle are able to subsist entirely upon grass and roughage such as hay, fodder crops, silage and crop residues. Many of the world's cattle, estimated at nearly 1,000,000,000 in the second half of the 20th century, are produced extensively in regions where topography, deficient rainfall or distance to market makes more intensive agriculture impracticable. To the extent that cattle are produced upon pasture, beef is a seasonal product, being most plentiful at the close of the normal grazing season. This can be avoided if cultivated pastures are used, as in Argentina, where beef cattle reared on remote, poor natural grasslands are fattened for the European market all the year round on alfalfa pastures near the ports. In other areas, too, range cattle not sufficiently fat for slaughter as high-grade beef are sold for further feeding to farmers in surplus feed-producing areas, such as the corn belt of the United States. In Australia cattle reared in the Northern Territory uplands may walk hundreds of miles to be fattened in the eastern coastal areas of Queensland. Similarly nearly 500,000 cattle go from Ireland to Great Britain every year for further fattening. Only in Britain, Canada and the United States are grain feeds, with hay, silage and by-product feeds such as sugar beet pulp, distiller's grain and molasses, used extensively in cattle fattening. This makes possible the production of good beef in the winter months. Mixed supplement formula feeds and added doses of hormones, such as stilbestrol, are used to increase the rate and efficiency of fattening gain.

In the past, the best-quality beef has been produced in temperate climates. The principal regions of commercial production have been North America, the southeastern part of South America, the north and east of the Australian continent and Europe. In the 20th century, however, there were developed several breeds of cattle that thrive in hot, humid climates (*see* CATTLE: *Breeds*). Experiments have also been made in synthetic tenderization of beef carcasses. Such developments have enabled, for example, the southeastern United States to become an increasingly important producing area.

In addition to the production from specialized beef breeds, there has always been some by-production from dairy herds, the quality being improved by using a beef bull on cows of suitable breeds to produce steers and heifers that mature quickly and produce good beef carcasses. This contributed to the rapid growth of production in the United Kingdom, for instance. World production of beef and veal was estimated to exceed 50,000,000,000 lb. annually in the early 1960s. The United States was by far the largest producer, with a total of about 16,000,000,000 lb.; Argentina and the U.S.S.R. each produced nearly 6,000,000,000 lb.; Brazil and France, nearly 3,000,000,000 lb.; the United Kingdom, western Germany and Australia nearly 2,000,000,000 lb. and Canada nearly 1,500,000,000 lb. All had increased their production substantially during the century. In several countries, notably the United States, the increases followed a cyclical pattern based on the interaction of prices and supply.

Trade.—Beef enters into world trade on an appreciable scale. During the 19th century it was exported mainly "on the hoof," but the introduction of refrigeration in the 1880s led to a rapid expansion of frozen beef shipments, mainly from Argentina and Australia to the United Kingdom. Early in the 20th century it was found that shipping beef at temperatures slightly above freezing preserved the natural quality and flavour of the meat. This chilled beef became a dominant proportion of South American exports during the first half of the century. The United Kingdom is the largest market for beef imports. Other western European countries, mainly western Germany and Italy, take smaller but appreciable quantities, and the United States is a substantial importer when domestic production is cyclically low. *See* also MEAT.

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(R. W. HD.; I. O. H. L.)

BEEFEATERS: *see* YEOMEN OF THE GUARD.

BEE FLY, any member of the family Bombyliidae of the order Diptera (*q.v.*), many of which resemble bees in appearance; most of them have long proboscises and obtain nectar from flowers. Their coloration, which is sometimes metallic, results from the presence of dense hair; in many species the body bears patches of scales and these are sometimes present on the wings; they are delicate and easily abraded. The larvae are thought to be either predaceous or parasitic. The largest number of species occur in the tropics. Many of the bee flies are quite small, and their immature stages are unknown. The largest and most showy species are tropical, but species with a length of ½ in. occur in temperate regions. Too little is known about the biology of bee flies to permit a conclusion about their value to man; those known to be beneficial are very common.

The large bee fly, *Bombylius major,* of holarctic distribution, is parasitic on solitary bees; it is one of the earliest to appear in spring. Larvae of several species of *Villa* are of importance in destroying eggs of grasshoppers, while others are parasites of caterpillars. *Anthrax anale* is a parasite of tiger beetle larvae; the habits of the European *A. trifasciata,* parasitic on the wall bee, are described by Jean Henri Fabre. In Africa several species of *Villa* and *Thyridanthrax* are parasitic on the puparia of tsetse flies. *Villa* (*Hemipenthes*) *morio* is directly injurious, being parasitic on the beneficial ichneumonid, *Banchus femoralis.*

(C. H. CN.)

BEEKEEPING. Beekeeping is one of the oldest forms of animal husbandry; its beginnings are lost in antiquity. It is the art of caring for and manipulating colonies of honeybees (*Apis* species) so that they will produce and store a quantity of honey above their own requirements. In recent years bees have been frequently utilized to pollinate crop plants in order to increase the production of seed, fruit or fibre.

Some areas are especially well suited for beekeeping and honey production; others, because of the lack of sufficient nectar-producing flowers or because of severe climatic conditions, are entirely unsuited. It is not economically feasible to overcome unfavourable climatic conditions or to grow nectar plants exclusively for honey production.

HISTORY

In spite of the long history of beekeeping little progress in increasing the productivity of bees was made until after 1850. Colonies of bees were kept in bark, reed, straw or even earthenware hives, and any honey present was taken whenever desired, colonies often being killed in the process. Lack of any method of controlled breeding hindered the development of characteristics useful to the beekeeper.

Man first domesticated honeybees by establishing colonies in cylinders of bark, straw, mud or other materials. Hives essentially of this type are still in use in some areas of the old world. In Europe the dome-shaped, woven straw "skep" became the standard hive. In early America a section of hollow log, known as a bee gum, was widely used; however, it began to be replaced even in colonial times by the box-type hive. The common practice was to remove all the honeycombs through the bottom of the skep or box hive and from the end (back) of the bee gum hive; but in Europe, at least from the 17th century on, additional chambers of straw or wood that communicated with the main chamber through holes in the top or sides of the latter chamber were often added during the honey season to be filled with honey. This led to the method of multiple-story beekeeping perfected later (*see* below).

Although improvements in hive structure were steadily intro-

duced from early times, none gained enough acceptance to change the nature of beekeeping.

Modern beekeeping stems from about the mid-19th century. About 1840 Moses Quinby of New York placed boxes capable of holding about five pounds of honey over holes in the top of box hives. By replacing these boxes as they became filled with honey he developed a method of multiple-story beekeeping in which the actual nest of the colony remained undisturbed. About the same time he invented the bellows smoker, which is used to quiet bees during handling. In 1851 the Rev. L. L. Langstroth discovered the "bee space" and invented the truly movable frame hive. The bee space, a space of approximately $\frac{5}{16}$ in. between surfaces, is an area that bees will not fill with comb or propolis (a cementing substance) as they do smaller or larger areas. Quinby and Langstroth entirely independently published books in 1853 setting forth their discoveries and beekeeping methods. The invention of comb foundation (a thin sheet of wax molded into the form of the midrib of a comb used to guide the bees in building their combs in the frames), the honey extractor and the queen excluder, within the following 30 years, completed a revolution in beekeeping methods.

KINDS OF HONEYBEES

There are four species of honeybee: one of these is the well-known and almost universally domesticated common, or western, honeybee, *Apis mellifera,* found wild in Europe, Asia Minor and Africa; the other three are the giant, or rock, honeybee (*A. dorsata*), little honeybee (*A. florea*) and eastern honeybee (*A. indica*), all native to India and southeastern Asia and found abundant throughout jungle and cultivated areas.

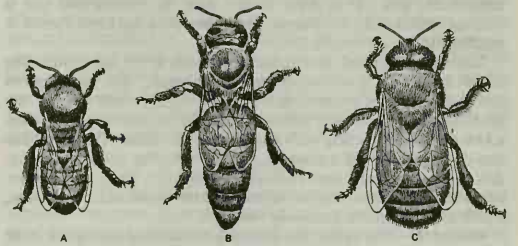
Common Honeybee.—Many so-called races of *A. mellifera* are known and several of them have been carried to many countries. The European, or black, bee is found throughout northern Europe from Great Britain to the U.S.S.R. The British form appears to differ somewhat from that of the continent. The most widely distributed and used race is the Italian—a yellow bee, originally from the mountainous areas of northern Italy. Two races of grayish bees, the Carniolan, from the areas east of the Adriatic sea, and the Caucasian, from the Caucasus mountains, have been widely distributed but are not as extensively used as the Italian. Each of these four races has certain merits for beekeeping. The northern European bees are reported to be more hardy than the southern races in severe climates, but they have a shorter tongue, tend to swarm excessively and are more susceptible to certain diseases and parasites. Caucasians are reported to be the most gentle, but they carry excessive amounts of propolis into the hive so that the frames and parts of the hive are sealed together.

Other races of the eastern Mediterranean—Egyptian, Cyprian and Syrian—have been exported to other countries for trial, but appear to have less desirable characteristics than the commoner races. They are nervous, frequently vicious, and do not seem to be very productive. They are now seldom, if ever, used outside their native habitats.

Other Species.—The rock and the little honeybees build a single comb in the open, suspended from a limb of a tree, cornice of a house or similar surface. Neither of these species is readily adaptable to beekeeping as a colony builds only a single comb, and colonies leave the comb in mass and migrate to a new locality if bothered or if nectar supply becomes scarce. Attempts, however, have been repeatedly made to keep *A. dorsata* in hives, and a hive of a suitable shape for the large single comb is in use on a limited scale in parts of India. The eastern honeybee is used rather extensively in India and other areas of southeast Asia in the same type of beekeeping which is employed for *A. mellifera.*

ROSS E. HUTCHINS

FIG. 1.—EUROPEAN SKEP, A HIVE MADE OF WOVEN STRAW



(TOP) BY COURTESY OF UNIVERSITY OF ILLINOIS, COLLEGE OF AGRICULTURE; (BOTTOM) BY COURTESY OF THE U.S. DEPT. OF AGRICULTURE

FIG. 2.—THREE CASTES OF BEES: (A) WORKER; (B) QUEEN; (C) DRONE; (TOP) PHOTOGRAPH OF LIVING BEES; (BOTTOM) DRAWINGS OF THE THREE CASTES

THE COLONY

A colony of honeybees consists of several to many thousands of individuals (up to about 50,000) living in a nest. Most of the colonies of domesticated honeybees are nested in man-made hives; occasionally, when a hive is crowded, the bees will swarm and nest in a hollow tree, under house eaves and in other sheltered places. In any case the nest is almost always within a cavity that the bees fill, at least partially, with vertical combs of wax. This wax is secreted by the worker bees. The combs consist of two layers of hexagonal cells, each extending outward from the midrib for slightly more than one-half inch with a slight upward slope. The combs are approximately an inch thick and are spaced approximately $1\frac{3}{8}$ to $1\frac{1}{2}$ in. from centre to centre, leaving a bee space slightly less than $\frac{1}{4}$ in. wide between combs.

Castes

The bees of a colony include three castes—one queen, several hundred drones and the remainder workers. The queen and workers are females, the drones males. The colonial or social life of the honeybee has a family basis since the queen is normally the mother of all other members. The basis of this family-society is a division of labour in which the function of reproduction is performed by the queen and drones and all other duties are performed by the workers.

Colonies of honeybees are perennial and the development of new colonies is accomplished by swarming, when a queen and some of the workers move to a new location.

Queen.—The queen honeybee is considerably larger than a worker bee and longer than a drone, although not so thick or broad.

Queens are produced in a colony under only three conditions: (1) queenlessness (when the queen is killed or is removed from the colony); (2) a failing queen (when a queen because of age or other reason is unable to produce the number of eggs required); and (3) the swarm impulse.

Both unfertilized and fertilized eggs are produced by every normal queen. In the peculiar type of reproduction found in the bee, the males (drones) develop from unfertilized eggs. Fertilized eggs develop into females. Whether the female larvae develop into workers or queen is determined by the type and quantity of food given to them. At first all larvae receive mass feedings of a special food known as royal jelly secreted by a pair of modified salivary glands of the worker.

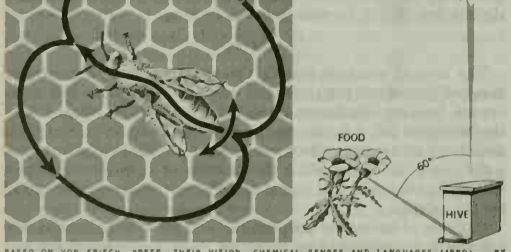
During the third day after an egg hatches, in the case of worker and drone larvae, the nurse bees change the manner of feeding by giving the food directly to the larvae at intervals. This apparently results in a reduction in the amount supplied. It is generally thought that the composition is also changed by the addition of pollen and honey (or nectar) and that the proportion of these materials is gradually increased until they make up the entire food supply. In the case of larvae destined to be queens the mass feeding of royal jelly continues throughout larval life. Caste-determining substances are also thought to be present in the larvae of the queen and workers. The queen larva is reared in a specially constructed cell. It is much longer than the worker cell and is vertical rather than horizontal since the space between combs is insufficient for its length.

The developmental period for the queen is 16 days, including 3 days as an egg, 5½ as a larva and 7½ as a pupa. The young queen leaves the hive on orientation flights during the early days of her adult life and on mating flights during the second week. Within a few days after mating with one or several drones, the queen begins to lay. Although a queen is capable of laying 3,500 eggs a day, this number is hardly ever reached. Probably a third of this number is the usual rate even in the most active brood-rearing seasons, which are late spring and early summer.

Workers.—The entire life span of a worker bee during the most active seasons (late spring and summer) is made up of three periods of approximately three weeks each. These are the developmental period and the periods of inside and outside duties. Bees developing in late summer have less arduous duties and live several months over the inactive winter season. The developmental period of 21 days consists of 3 days for the egg, 6 for the larva, and 12 for the pupa.

Although bees may perform any duty at almost any age, they are physiologically more suited to certain tasks at certain ages. Therefore in a balanced colony the workers engage in a succession of duties in a rather regular sequence, though with considerable overlap.

The time schedule, from which individual bees deviate greatly, is as follows. During the first three days after emergence as adults, bees groom themselves, loiter on the combs of brood and receive food from other bees, but do not take it from cells themselves. The 3rd to the 6th day is devoted to caring for older brood, and from the 6th to the 13th to caring for larvae less than three days old. During the period from the 12th to the 18th days the wax glands are producing at their maximum potential, and whenever wax is required it is furnished by bees of this age. The final two or three days of the period of indoor activities are spent in guard duty at the entrance to the hive. Depending upon the season and the requirements of the colony several other functions are performed by member bees during the second and third weeks of adult life. These include ventilating the hive; packing pollen into the cells; cleaning out and polishing cells; removing debris from the hive; and receiving (from field bees), manipulating and depositing nectar. During the second week bees usually begin orientation flights—short flights in front of the hive and into the surrounding area; thus they learn the appearance of their home and can return directly from the field when outside duties are undertaken. In a balanced colony with a population of bees of various ages, outside duties, which consist of gathering water, nectar and pollen, are begun about the 21st day and continued as long as the bee lives. No definite sequence in gathering food and water has ever been noted, but the field force is divided among the different activities according to the needs of the colony. Once started, an outside duty is usually continued as long as conditions remain unchanged, even to gathering of nectar or pollen from the same plant species and in the same exact locality.



BASED ON VON FRISCH, "BEES, THEIR VISION, CHEMICAL SENSES AND LANGUAGE" (1950). BY PERMISSION OF CORNELL UNIVERSITY PRESS

FIG. 3.—WORKER BEE DANCING ON VERTICAL SURFACE OF HIVE; BY THE ANGLE OF ITS BODY AND THE RAPIDITY OF ITS MOVEMENT, THE BEE CAN INDICATE WITHIN 15° THE LOCATION OF NECTAR

Drones.—The only function of the drone is to serve as a potential mate for the queen. Drones develop in a manner similar to that of the workers, but 24 days (3 for the egg, 6½ for the larva and 14½ for the pupa) are required. Their adult life may continue for several months, or until no nectar is available in the field. When the honey flow stops, the drones are prohibited by the workers from eating. When they then become weakened, they are carried from the hive by the workers and left to die.

Life Cycle and Work

Yearly Cycle.—The honeybee is greatly influenced by temperature. When the temperature approaches 100° F. (about 38° C.) bees do not go into the field but remain in the hive, or cluster around the entrance on the outside. Bees lose the power to fly at 50° F. and to move at all at 45° or slightly below.

Despite their sensitivity to cold temperatures honeybees are the only insects that do not hibernate but remain active during the winter. When the temperature within the hive falls to 57° F. a cluster is formed. This consists of a more or less spherical shell of three outer layers of bees, with other bees inside. All of the bees, however, do not join the cluster until the temperature falls below 50°. As the temperature continues to fall the cluster becomes more and more compact. It can never become a solid mass of bees as it is intersected by the combs, which must contain some stores of honey and pollen to sustain the bees through the winter.

Contraction of the cluster conserves heat (supplied by the metabolic processes of the bees) by reducing the radiating surface in proportion to the mass. This allows the colony to maintain a temperature of at least 57° F. except on the surface of the cluster.

As the cluster contracts, higher temperatures are produced in the centre; whenever this temperature reaches 91° or 92° F., the queen begins egg laying. Once brood rearing is started, higher temperatures must be maintained. Brood rearing is usually begun in mid-winter and continues with gradual increase until spring. When the weather becomes warm enough for bees to gather pollen and nectar from early blooming plants, brood rearing increases much more rapidly.

In late spring the population of the colony reaches a high level and the hive becomes crowded. This acts as a stimulus to the swarming instinct. A portion of the bees and the old queen leave the hive, migrate to a new location and establish a new colony. A newly emerged queen then takes over the old colony.

With an abundance of nectar-producing flowers in the summer the colony is able to manufacture more honey than it requires. The instinct of the bee is to store this excess for food in the future.

Brood rearing is somewhat reduced during this honey flow but continues at a low rate and finally stops in the autumn.

In climates without a cold or dormant season the spring and summer activities described above continue at all times.

Manufacture of Honey.—Nectar, the raw material of honey, is produced by the flowers of many plants. It is essentially a watery solution of three sugars—fructose, glucose and sucrose—with traces of proteins, salts, acids and essential oils. Although other sugars and other compounds are sometimes found, 99% of the solids in nectars are the three sugars mentioned. The sugar content of nectars varies from 3%–4% to 80%, depending on the species of flower, on soil and air conditions—especially moisture—and probably on other factors. The honey produced by a colony at any given time is usually derived from the nectar of only one or of a few plant species.

Bees prefer nectars of high sugar content and usually do not gather those of less than 15% sugar. To change nectar to honey the bees convert a complex sugar, sucrose, to simple sugars, fructose and glucose, using enzymes produced by special salivary glands. Water is removed from nectar by evaporation until the sugar content reaches about 80%.

Whenever the weather is suitable, a few scout bees of a colony are always in the field. These bees find sources of nectar and pollen and direct other bees to these sources. A scout returning with a supply of newly found nectar attracts the attention of other bees by performing a "dance." This consists of a series of loops and straight runs performed on the comb accompanied by "tail wagging." The direction and distance of the source of nectar are indicated by the intensity and rapidity of the maneuvers of the scout. Samples of the nectar that has been gathered are distributed by the scout to possible recruits. The recruited workers then proceed to the indicated position and search for the same type of nectar. Such recruits, after finding an abundant supply of nectar, return to the hive and try to attract other bees. This process continues until the available field force of the colony is at work gathering the same type of nectar.

When a nectar gatherer returns to the hive with a load of nectar it is given to one or more of the hive bees. These bees manipulate the nectar with their mouth parts, then deposit it in cells. The manipulation of nectar by the bees and the moving of air over its surface after it has been placed in a cell evaporate the excess water.

Pollination.—Many plants require insect pollination for the production of seed and fruit. These include most of the clovers and related small legumes, vegetable crops and fruits. Of course, these plants have always required insect pollination, and this occurred naturally until the practices of modern agriculture produced extensive areas of pure stands of crops that produce pollen and nectar for only a relatively short portion of the year. Since insect pollinators, especially the honeybees, require a steady supply of food throughout their active period, they were forced to disperse to more promising wild fields and many of them have been greatly reduced in number. The extensive use of herbicidal chemicals since World War II, in an effort to eliminate weeds in fence rows, roadsides and cultivated fields, and the application of insecticides to control insect pests (at the same time killing pollinators) has intensified these problems. Although the honeybee is not the most efficient pollinator for some plants it is the only insect that can be controlled so that desired numbers can be obtained where and when needed. The number of bees required for efficient pollination varies with the crop. For apple and other fruit trees one colony per acre is the usual recommendation; for others with abundant bloom, such as clover and alfalfa (lucerne), two to four colonies may be necessary; while such crops as melons may be properly pollinated with one colony to several acres.

The presence of colonies of bees does not assure the pollination of a particular crop, and the placing of bees for pollination frequently presents special problems to the beekeeper. Another plant blooming within the flight area may attract the bees from the crop for which pollination is desired.

Some areas, because of the lack of food plants at certain seasons—no available major honey plant—or other factors, require that bees be introduced when bloom begins and removed as soon as pollination is accomplished. Although few crops require the application of an insecticide at the exact time pollination is in progress, application of a poison even at other times and on other plants may adversely affect the bee by contamination of other blooms, as of cover crops in an orchard. If the crop is not a major honey plant but requires pollination at the time the honey crop is usually produced the beekeeper must receive sufficient return for the services of the bees to pay the expense of moving and the equivalent of the value of the honey crop.

In spite of these limitations and problems farmers and beekeepers, with the aid of research entomologists, have developed rather successful methods for the use of honeybees in the pollination of most major crops.

BEEKEEPING PRACTICES

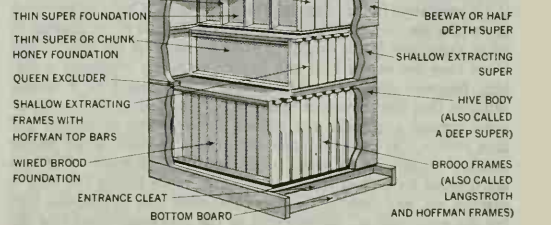
Although the theory of beekeeping management is rather simple, in practice keen observation and attention to detail are necessary. One of the most important principles is to have a vigorously producing queen at all times. Although queen bees may live several years, modern beekeeping practices require such a rate of egg laying that queens should be replaced after one or two years. Ideally, whenever the brood pattern appropriate to the season is not maintained the colony should be requeened.

Old queens, and perhaps also defective ones, tend to increase the frequency of swarming of even uncrowded colonies. Since natural supersedure or even rearing the new queen within the colony causes too much interruption in the brood-rearing cycle to be economical, separate colonies and equipment are used for rearing queens. Queens may also be bought from specialist rearers who operate largely in Italy and the southern United States, where the climate is favourable for rearing queens early in the season.

Materials

Hives.—The so-called Langstroth hive or those of similar construction are now generally used in all areas where beekeeping is of importance, except in German-speaking countries. The size of the hive is determined by the size and number of frames. The standard hive contains ten frames, 9⅛ by 17⅜ in. spaced 1⅜ in. from centre to centre. The hive body is a box without top or bottom, with the ends grooved at the upper edge to support the top bars of the frames. This rests on a bottom board, so constructed that an opening is left at the front for the hive entrance. Two hive bodies are usually used in order to furnish room for the development of strong colonies and to contain enough stores for wintering. Surplus honey is stored in supers placed above the hive bodies. Full depth supers are identical with hive bodies except in position and function. Shallow extracting supers are similar except the frames are only 5⅜ in. deep. Comb honey supers used for the production of comb honey are usually 4¾ in. deep. They are filled with sections 4¼ in. square, resting in section holders with separators or fences between each. The top of the hive usually has two covers—a flush fitting inner cover and an outer, or telescopic, cover.

Beekeeping Tools and Equipment.—A veil, smoker and hive



BY COURTESY OF WALTER T. KELLEY CO.

FIG. 4.—CUTAWAY VIEW OF A LANGSTROTH HIVE; THIS TYPE AND COMPARABLE MODELS ARE MOST COMMONLY USED IN U.S. BEEKEEPING

tool are essential for working with bees. The veil is usually a protective cylinder of cloth or wire netting with appropriate fittings at the top and bottom to fit around the crown of a hat and the neck or shoulders of the wearer. The smoker, used to tranquilize the bees, is a metal cylinder, a portion of which serves as a firebox, with one end drawn out into a spout; smoke can be directed as desired by use of a bellows attachment opposite the spout. The hive tool—a thin piece of steel eight to ten inches long, with one end bent at a right angle—is sharpened at both ends; it is used to pry apart the different parts of the hive and to scrape wax, propolis and debris from frames, bottom boards and the interior surfaces of the hive.

Gloves of leather or wax-impregnated cloth are frequently used, although the experienced beekeeper works without them except under unfavourable conditions. A bee brush is sometimes used to brush the bees from combs.

Many other devices are frequently used in the apiary. A queen excluder is an insert of wire (or wire and wood) or a zinc sheet, with passageways .163 in. wide permitting worker bees but not the queen to pass through. It is sometimes placed between the brood nest and super, or elsewhere in the hive to prevent the queen from moving into a certain area. A bee escape is a small metal device made to fit into an oval opening usually present in the inner cover; it allows the bees to move in one direction but not to return. It is frequently placed below supers of honey before they are to be removed to free them of bees.

Extractors are essential pieces of equipment for separating honey from the comb. An extractor is a metal cylinder in which some type of basket or carrier for frames of honey may be whirled, by hand or motor. The wax plugs, or caps, are removed from the combs by means of a hot uncapping knife, or in large establishments by a power-vibrated blade. The combs are then placed in the extractor and the honey removed by centrifugal force. Extractors are of two general types: the small basket or reversible rack-type in which 2, 4 or perhaps 8 small frames are placed at right angles to the radius of the extractor; and the radial type that may hold as many as 30 or 50 frames placed in the position of radii. The latter must be power-operated.

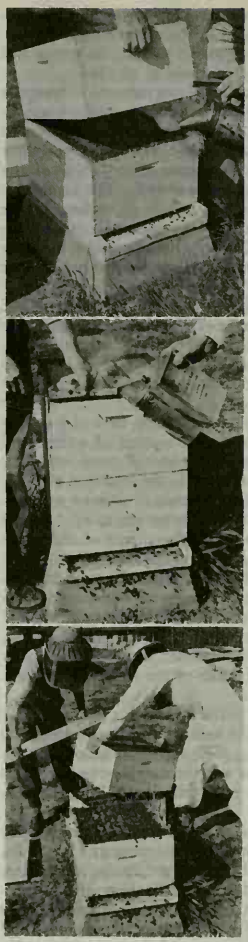
A wax press is necessary to separate wax from the cocoons in old brood combs; new combs can simply be melted and filtered to obtain the wax.

Procedure

The beekeeper's year is said to begin in the autumn. At this season proper wintering conditions must be provided. These include a large colony of young bees, a vigorous queen, sufficient stores of honey and pollen in the combs and adequate protection. Dependent upon the size of the colony, the strain of bee and the climate, especially the length and severity of the winter, the amount of honey required will be 20 to 80 lb. In areas with extremely cold winters additional insulation should be provided around the hive, elsewhere protection from the full force of the wind is sufficient. In mild, damp climates ventilation should be as free as possible. Hive entrances should be protected in some way to keep out predators.

In the spring, hive bodies and frames should be manipulated so that those containing brood are below, since the bees are inclined to extend the area of brood upward but not downward. Swarming is prevented by not allowing the brood nest to become crowded. A certain amount of unfilled combs should always be present to allow expansion of the brood, to provide room for the bees to rest when they are in the hive and to receive nectar whenever a surplus becomes available. The proper management of a colony requires that the beekeeper open the hive to determine the conditions present and make the proper manipulation of frames and hive bodies. As far as possible this should be done under proper weather conditions, on warm sunny days without wind. The bees are quieted by puffing smoke into the entrance before the hive is opened, and into parts of the hive containing bees at intervals during the examination. Movements of the beekeeper should be deliberate as quick motions tend to excite the bees.

As a honey flow develops, supers of combs should be added, a new one before the one previously added has been completely filled. Dependent upon the character of the available nectar, the climate and the organization of the beekeeper's work, honey is removed as each unit (super or comb) is filled with ripened honey, at the end of the flow from each major source or at the end of the producing season. Average annual yields of honey (above what the bees need for wintering) range from 10 to 20 lb. in southern England and 30 to 40 lb. in the southern United States to several hundred pounds in Australia where eucalyptus trees supply abundant nectar.



BY COURTESY OF KANSAS STATE UNIVERSITY OF AGRICULTURE AND APPLIED SCIENCE

FIG. 5.—(TOP) SMOKING HIVE ENTRANCE; (CENTRE) SMOKING UNDER INNER COVER; (BOTTOM) REMOVING UPPER BROOD CHAMBER. AN EXTRA COVER IS USED TO PREVENT ROBBING

Proper management requires that some honey be left for the use of the colony at all times. In temperate climates it is a generally accepted practice that a food chamber, a super containing honey, be left or returned to the colony at the approach of winter. This is the second or upper story of the brood nest which usually becomes restricted to one story by the end of the honey flow. In Europe beekeepers remove nearly all the reserve honey, replacing it with a sugar sirup.

Control of Honeybee Diseases and Enemies.—Bees are subject to several diseases and parasites. The most serious of these are two bacterial diseases of the larva—American and European foul brood—and the acarine and nosema diseases of the adults.

An infestation of American foul brood is usually fatal to a colony unless prompt treatment is given. Formerly American foul brood was extremely serious, as control or prevention was almost impossible in the bee yard. Now, however, disease-resistant strains of bees are available and medication, by the use of sulfadrugs, etc., is effective in preventing the development of the disease, or in some cases in curing colonies in which it has appeared.

European foul brood is less damaging to the colonies, visible symptoms usually being restricted to a short period of the year, followed by spontaneous disappearance, though the infestation persists. Proper management, usually requeening, may enable the bees to recover from an attack; but complete eradication is difficult.

Acarine disease is caused by a mite infestation of the adult honeybees' breathing system (the trachea). It has been equated, on doubtful evidence, with "Isle of Wight disease," reputed to have arisen in that island in 1904 and to have killed very large numbers of colonies in Great Britain. It later spread throughout much of northern Europe and appeared in India, Africa and South America, but is not found in Scandinavian countries and has not spread to North America, Australia or New Zealand. Chemical controls have been somewhat effective, and it appears that races other than the European, or black, bee are somewhat resistant to the mite.

Nosema disease is caused by a protozoan parasite infecting the adults' digestive tract. Proper beekeeping practices, especially proper wintering and the provision of fresh water, appear to lessen the effects of the disease and eventually eliminate it from an apiary.

Other diseases, such as parafoul brood, sacbrood, purple brood and fungus infections, affect larvae; and septicemia and fungus infections, adults. All of these are of minor importance and proper beekeeping practices usually prevent their development or eliminate them when they appear.

The wax moth will completely destroy unprotected combs, whether empty or filled with honey. Such an infestation cannot develop in a strong, healthy colony because the bees literally carry the moths out of the hive. Stored combs may be protected by the use of fumigants.

Minor enemies of bees include mice, rats, skunks, raccoons, bears and woodpeckers. Mice enter the hives during the winter, when the bees are clustered, and destroy the combs. Skunks and raccoons sometimes disturb the hives at night and eat the bees as they crawl from the entrance. Woodpeckers make large holes in hives, and bears smash hives to obtain honey. Certain birds and toads as well as dragonflies, robber flies and a few other insects destroy numbers of honeybees.

Sources of Information on Beekeeping.—Because of the long and intimate association of man and the honey bee, the literature on bees and beekeeping is voluminous. Much of it, however, is philosophical or even anthropomorphic rather than factual and practical.

In most countries there are governmental agencies engaged in research, educational and regulatory activities in beekeeping. In the United States these activities are usually within the scope of entomology, but in other countries they are more likely to be associated with agricultural production divisions such as horticulture, agronomy or animal husbandry. In Canada and the United States governmental agencies conduct research, issue bulletins or other publications and otherwise disseminate information. Almost all agricultural colleges have a course in beekeeping in the curriculum and furnish basic information to beginning beekeepers and report new discoveries or improved practices to experienced ones by means of meetings, field demonstrations, bulletins, press releases and radio and television presentations. Many associations of beekeepers and auxiliary groups such as apiary inspectors, research workers and industrial concerns (bee supply manufacturers, honey packers, etc.) hold regular conventions and many of them issue periodical letters or news sheets.

Laboratories for research on bees and beekeeping exist in most countries, and are usually run or supported by governmental agencies or by universities. These laboratories are not necessarily permanently located, but extensive research has been carried on over long periods at Beltsville, Md.; Madison, Wis.; Baton Rouge, La.; Davis, Calif.; Phoenix, Ariz.; and Logan, Utah.

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BEELZEBUL (Beelzebub or Baalzebub), in the Gospels, is the prince of devils (*e.g.*, Matt. xii, 24). In the Old Testament, in the form Baalzebub, it is the name given to the god of the Philistine city of Ekron (II Kings i, 1–18). Neither name is found elsewhere in the Old Testament, and there is only one reference to it in other Jewish literature.

The meaning of the word is obscure. Baal (*q.v.*) is a common title for Semitic gods, and *zebub* derives from a root meaning "flies"; hence, "lord of flies." The form Beelzebub is due to the influence of the Vulgate, while the form used in the Greek text is Beelzebul. *Zebul* is probably a distortion of *zebub*, introducing the stigma of "dung."

See G. Kittel (ed.), *Theologishes Wörterbuch zum Neuen Testament*, vol. i, pp. 605 ff. (1933); F. L. Cross (ed.), *The Oxford Dictionary of the Christian Church*, p. 149 (1957).

BEER, the beverage obtained by the alcoholic fermentation of a malted cereal, usually barley malt with or without other starchy material, and to which hops have been added. For information on the history and process of brewing, *see* the article Brewing.

Lagers and Ales.—Although the term beer is frequently employed to designate fermented malt beverages in general, a distinction exists between the so-called lager beers of the type most popular with the U.S. consumer and the ales brewed mostly in Great Britain, both with respect to their method of production and their final taste characteristics.

In the brewing of lager beer, bottom fermentation is employed, so termed because the type of yeast selected settles to the bottom of the fermenting tank after completion of fermentation. After fermentation has terminated, the "green" beer is aged in huge storage tanks from one to two months or longer at temperatures near the freezing point of water (32°–34° F.). During storage, the beer becomes "mature"; *i.e.*, it clears up, acquires mellowness and becomes charged with carbon dioxide gas, all important factors in the final taste appeal of the finished product. It is from the storage phase of the brewing process that the beer derives its name, the German word for storage being *Lager*.

In ale brewing, on the other hand, the yeast selected is of the top-fermenting type; *i.e.*, it rises to the top of the fermenting ale, forming a relatively thick foam. Also, somewhat higher fermentation and storage temperatures are employed.

United States.—Of U.S. lager beers, nearly all of which were originally introduced by German brewers about the middle of the 19th century and which since then have largely displaced the top-fermented beers then in vogue, the Pilsener and Dortmund types enjoy by far the greatest popularity. These beers are characterized by a pale colour, a medium hop flavour, a relatively strong carbonation and an alcohol content of 3%–3.8% by weight. These two types, which differ only slightly, comprise the major volume of U.S. beer production.

The Vienna type, with its amber colour and very mild hop taste, and the various Munich type beers with their dark-brown colour, full-bodied and somewhat sweet malt flavour, slight hop taste and alcohol contents ranging from 3%–5% by weight have never attained more than local importance in regions having concentrated foreign populations.

Bock beer, thought to have originated in the German city of Einbeck, whose name was confused with *ein Bock* ("a goat"), is brewed in winter for consumption in the spring. It is a heavier beer, similar in colour to the Munich type, with a slightly sweet malt flavour and a more pronounced hop taste than regular pale beer.

California steam beer, available in the San Francisco region, is characterized by a very high carbon dioxide gas content that renders the beverage highly effervescent. All but the last of these beers first gained prominence in the German cities and localities after which they are named.

Ale, stout and porter now form a relatively small percentage of the total U.S. beer production.

Great Britain.—In England today ale is synonymous in meaning with beer. Until about the end of the 17th century, however, ale meant a brew made with malt, yeast and water alone, whereas beer was a malt brew in which hops also had been used. Since that time, the distinction has no longer applied, except insofar as the term ale is not applied to black beers (stout and porter) or to lager beer. The Old English ale, a very potent liquor, had no rival un-

til the 15th century when beer was introduced by continental brewers. The popularity of the new liquor grew gradually, although in rural districts generally the old-style ale prevailed until early in the 18th century. By the end of the 16th century brewers in London and other centres had combined the techniques of ale and beer brewing and were producing very strong, well-bittered beers, for which a substantial demand arose at home and in Europe.

Pale ale, a light-coloured beer with an incisive hop flavour, was evolved at Burton upon Trent in the 18th century and widely exported. It is still one of the most popular brews in the United Kingdom. Its alcohol content ranges from 3% to 5% by weight Strong ales, which are usually darker in colour, have up to 6.5% alcohol by weight.

Stout, first brewed about the end of the 17th century, has a dark, often black, colour, a rich malty taste and, in some brands, a strong hop flavour. The strongest brands have an alcohol content of over 5% by weight.

Another of the main types of British beer is draught mild or bottled brown ale, generally nut-brown in colour, lightly hopped, often sweetish and, on the average, the least alcoholic.

Altogether about 3,000 "beers" of local or wider use and reputation are produced in the United Kingdom and many do not fall in any of the main categories—strong ale, pale ale, mild or brown ale, stout and lager. Porter, popular in the 18th and 19th centuries, was a dark, full-bodied beer with a mild hop flavour, resembling weak stout.

Miscellaneous.—Weiss bier, a special type of ale peculiar to the Berlin region of Germany, and at one time brewed on a small scale in the U.S., is made of wheat and barley malt and has a very pale colour, a somewhat tart taste and a rich foam.

There are several other special types of beer or beerlike cereal beverages that enjoy only local favour or are consumed for dietetic reasons. Among the former may be mentioned the Faro and Lambic beers found in Belgium that are fermented with wild yeasts and are rather acidic in character. To the second category belong the various malt tonics of high nutritive value and low alcohol content and often enriched with minerals and vitamins, and the so-called near beers that are similar to the Pilsener type beers but have an alcohol content of less than .4% by weight. Beerlike drinks brewed from other starchy materials are widely known and used, among them the sake of Japan and suk of Korea, both made from rice.

Beer of 4% alcohol content is slightly more than nine-tenths water. A total of 100 g. includes 4.4 g. of carbohydrates (about 170 cal. per 12 ounce bottle), .6 g. of protein, 4 mg. of calcium, 26 mg. of phosphorus, .03 mg. of riboflavin, .2 mg. of niacin, a trace of thiamine and .2 g. of ash. Flavour, taste and aroma are usually considered best by Americans at a temperature of 42° to 45° F. For consumption figures *see* BREWING: *Consumption*.

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BEERBOHM, SIR MAX (1872–1956), British caricaturist and writer whose economical and often caustic drawings stand alone as a sophisticated commentary on the social and literary life of his time. Henry Maximilian Beerbohm was born in London, Aug. 24, 1872, and educated at Charterhouse and Merton college, Oxford. Before he had left Oxford, Beerbohm had made a reputation as an essayist of wit and polish, *The Yellow Book* offering him a congenial hospitality. This reputation was maintained, when he succeeded G. B. Shaw as dramatic critic to the *Saturday Review*, by the judiciously small amount of work which he published and its uniformly high accomplishment in essays, fiction and parody alike. This includes *The Works of Max Beerbohm* (1896); *The Happy Hypocrite* (1897); *More* (1899); *Zuleika Dobson* (1911); *Seven Men* (1920); *And Even Now* (1921); *Around Theatres*, 2 vol. (1924); and *Mainly on the Air* (1946). He showed the same skill and charm as a broadcaster after 1935.

As a caricaturist, Beerbohm's fame followed a parallel line, and his skill as a draftsman increased with the years. Among his published drawings are *Caricatures of Twenty-five Gentlemen* (1896); *The Poet's Corner* (1904); *Fifty Caricatures* (1913); *A Survey* (1921); *Rossetti and His Circle* (1922); and *Observations* (1925). His residence in Italy, at Rapallo, gave him many advantages for the detached observation of personalities and tendencies, although once or twice it may have endangered his perspective; and he was free from a fear of acid comment which had dimmed the art of caricature in England since the early Victorian age.

Beerbohm was knighted in 1939. He died in Rapallo, Italy, on May 20, 1956.

See A. E. Gallatin and L. M. Oliver, *Max Beerbohm: a Bibliography* (1952; U.S. title, *Bibliography of the Works of Max Beerbohm*); J. G. Riewald, *Sir Max Beerbohm, Man and Writer* (1953); S. N. Behrman, *Portrait of Max* (1960; British title, *Conversation with Max*). (J. H. M.; X.)

BEERNAERT, AUGUSTE MARIE FRANÇOIS (1829–1912), Belgian statesman and Nobel prize winner, was born in Ostend on July 26, 1829, of Flemish stock. A lawyer by profession, he was elected to the Belgian chamber of deputies in 1873 and later served as minister of public works. He was prime minister and minister of finance from 1884 to 1894. In 1895 he was elected president of the chamber of deputies.

He held the post of president of the International Law association from 1903 to 1905. He was Belgium's first representative at the Hague peace conferences in 1899 and 1907. In 1909, when he was 80 years old, Beernaert and Baron d'Estournelles de Constant were awarded the Nobel peace prize. Beernaert died in Lucerne, Switz., on Oct. 6, 1912.

BEERSHEBA, the chief town of the Negev, the arid southern part of Israel, lies on the border between cultivation and the wilderness. Pop. (1961) 43,158; municipal area 11 sq.mi. A Turkish-Arab town was laid out there by German army engineers about 1900, in rectangular form. After it became a part of Israel its main streets were renamed Herzl, Independence and Liberation. The principal buildings were a mosque (now municipal museum) and the government offices. Since 1949 there has been a large growth of residential quarters with shopping centre, cultural hall, youth hostels, a resident hostel for scientists (Hias house) and an institute for research in the arid areas. Building is the main industry. The industrial zone contains ceramic, glass and chemical factories, a motor vehicle repair workshop and a flour mill. A railway links the town with Lydda (Lod) and Dimona. Main roads fan out to Elath (Eilat) by the Gulf of Aqaba, the potash works by the Dead sea and the phosphate mines in the hills. An agricultural belt surrounds the town which is the chief market for about 100 settlements in the northern Negev, for the mining enterprises, and for the 15,000 nomad Bedouin in the region.

In the Bible Beersheba is mentioned as the home of the patriarchs Abraham and Isaac and is referred to in the book of Samuel as the southern limit of the Holy Land, in the phrase "from Dan to Beersheba." In Roman times, when it was known as Birosaba, it was the capital of a flourishing district, and in the Byzantine empire an episcopal see. The name may mean "seven wells", or "well of the oath" (of Abraham and Abimelech; Gen. xxi, 31). In World War I the capture of Beersheba on Oct. 31, 1917, by British troops opened the way for the penetration of the Turkish front in Palestine, and ultimately to the capture of Jerusalem. (No. B.)

BEESTON, CHRISTOPHER (alias HUTCHINSON) (1570?–1638), actor and theatrical manager, was one of the most influential figures in the English theatre in the early 17th century. Nothing is known of his early life. In 1598 he appeared in *Every Man in His Humour* with Shakespeare, Augustine Phillips and Richard Burbage and in 1602 he was with Worcester's Men. He remained with them after they became the Queen's Men in 1603 and succeeded Thomas Greene as their business manager in 1612. In 1616 he established them at his theatre, the Cockpit (later the Phoenix) in Drury Lane, where he remained for the rest of his life as manager to the succeeding companies. Beeston held two-thirds

of the shares, owned the costumes and retained control of the plays he had bought—practices that brought him the reputation of being shrewd rather than honest—but he had great influence with the training he gave young actors. In 1637 he collected together the King's and Queen's Boys, more popularly known as Beeston's Boys, a company that was established by royal warrant and afterward managed for a short time by his son William. Beeston was a life-long friend of Thomas Heywood and produced many of his plays and also contributed verses to the *Apology for Actors* (1612). He died in London and was buried at St. Giles in the Fields on Oct. 15, 1638.

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BEESTON AND STAPLEFORD, an urban district in the Rushcliffe parliamentary division of Nottinghamshire, Eng., 4 mi. S.W. of Nottingham. Pop. (1961) 56,720. The Trent and Erewash rivers, the construction of the Beeston canal at the end of the 18th century and of the railway in 1838–40 and, most of all, the proximity of the coal field, have contributed to the industrial development of the district. It has also expanded as a residential area for workers in Nottingham and other towns nearby. A large group of drug factories are at Beeston which also has engineering works making boilers, etc., and factories for telecommunications equipment, fluorescent lighting, textiles, and other goods. Beeston and Stapleford parish churches are both of the 13th century, and there is a manor house dating from the 17th century. The Bramcote manor house is Elizabethan and at Stapleford is the Hemlock stone, a 40-ft. pillar of Triassic sand. The railway marshaling yard at Toton is one of the largest in the country. Other industries in the district include the production of pencils, cardboard boxes, clothing and furniture. There are gravel and sand works and some mining and quarrying. The district is well known for rose growing.

BEESWAX, the most widely distributed and commercially important animal wax, is a product of digestion secreted by the worker bee for constructing the cell walls of the honeycomb; it is estimated that about ten pounds of honey are consumed for one pound of wax secreted.

Beeswax is a yellowish solid of agreeable, somewhat honeylike odour and of a faint balsamic taste. It is insoluble in water but soluble in carbon tetrachloride (warm ether dissolves beeswax, but it is not soluble in this solvent in the cold) and chloroform. The commercial value of beeswax for polishes results from its texture. In early times it was preferred to tallow for candles on account of its higher melting point (62°–65° C.) and freedom from odour. The modern use of beeswax for church candles is in accordance with religious ordinance. U.S., European and some Japanese waxes are derived from the common honeybee, *Apis mellifera,* whereas the bulk of the African and Indian waxes are from other varieties, especially *Apis dorsata.* Large quantities are exported from east Africa, South America and the West Indies, and considerable quantities are produced in the United States.

Beeswax, besides being used for church ceremonial candles, is also employed in the manufacture of furniture and floor waxes, ointments, encaustic paints, wax paper, lithographic inks, artificial fruits and flowers, modeling wax, etc.

Beeswax is separated from the honeycomb by the following method: after removal of the honey by draining or by means of a centrifuge, the combs are melted in hot water and the wax strained from gross impurities (dead bees, cocoons, etc.); the residue is pressed to obtain more wax. In large-scale operations the melted honycombs are expressed in a hydraulic press. The press residues are boiled up with water and pressed again. The cake still contains about 10% of wax, which is recovered by extraction with a volatile solvent; such extracted wax is darker and of lower quality that that obtained by expression.

Beeswax varies in colour from golden-yellow to almost black, depending on the care used in its preparation and also on the age and food of the bees. To preserve the quality and colour, beeswax must always be melted in water and never by direct heat. For some purposes the wax must be bleached; the most satisfactory method is to expose the wax in the form of thin films to the action of moist air and sunlight. The addition of a little oil of turpentine accelerates the process. Ozone may be used, but bleaching by chemical oxidizers, such as chlorine, etc., is less satisfactory, since the produce is unsuitable for many purposes (*e.g.,* candles). Bleached beeswax is used in cosmetics and ointments.

Beeswax consists chiefly of free cerotic acid and myricin (myricyl palmitate), with small quantities of other fatty acids and alcohols, and about 10% of hydrocarbons. East Indian (Ghedda) wax, like most waxes from the far east, exhibits marked chemical differences from that of European origin.

(P. R. E. L.; G. H. W.)

See C. S. Bisson, *Investigations on the Physical and Chemical Properties of Beeswax* (1940).

BEET, a biennial plant grown for the thick, fleshy taproot and adjoined hypocotyl that forms during the first season. In the second season a tall, branched, leafy stem arises to bear numerous clusters of minute green flowers which develop into brown corky fruits commonly called seeds or seed balls. Most of these fruits contain several seeds. The flowers are normally cross-pollinated by wind-borne pollen; cross-pollination may occur over distances of a mile or more.

Types.—Beet is the cultivated form of the plant *Beta vulgaris* (family Chenopodiaceae), a native of Mediterranean lands. Four distinct types of beet are cultivated: (1) sugar beet, as a source of sucrose or "cane" sugar; (2) garden beet (also called table beet and red beet), as a garden vegetable; (3) mangel-wurzel or mangold, as a succulent feed for livestock; and (4) leaf beet or Swiss chard, for its leaves which are used as a potherb.

Cultivation.—Cultivation of the leaf beet, in common with most crop plants, goes back to prehistoric times. The garden beet was developed about the beginning of the Christian era but its origin is obscure. The sugar beet is unique among important crop plants because it is a modern development with a well-documented history. It originated in Germany early in the 19th century.

Beets grow best on deep friable soils that are high in organic matter and they respond well to chemical fertilizers and manures. Beets are grown extensively under irrigation. They tolerate relatively high salt content of the soil but are sensitive to high acidity and to low content of boron. Boron deficiency retards growth and causes black lesions in the flesh of the root.

Beets are most extensively grown in temperate to cool regions or during the cooler seasons of regions having hot summers. In garden beet, high temperature reduces the intensity of colour and increases the prominence of light-coloured zones in the root.

As commonly grown in the United States, garden beet varieties are harvested 8 to 10 weeks after planting; in Europe they are grown a few weeks longer. Sugar beets and mangel-wurzels are harvested after 20 to 30 weeks, and leaf beets after 8 weeks. Average yields in the United States are: (1) garden beets for market, 175 to 200 bu. per acre; for canning, 9 tons per acre; (2) sugar beets and mangel-wurzels, 14 to 16 tons per acre. Yields two to three times as high as the averages are sometimes obtained.

Garden Beet.—Garden beet (called beetroot in Great Britain) ranges in shape from flattened oblate through globular and somewhat conical to long tapered. Skin and flesh colours are usually dark to dark purplish red, some nearly white. The flesh is marked by concentric zones of lighter red, purple or white. On cooking, the colour diffuses uniformly through the flesh. Garden beet is grown commercially and in kitchen gardens in Europe, the U.S. and Canada.

The seeds are sown about 1 in. apart in drills 15 to 24 in. apart. In Great Britain and Europe the plants are thinned to stand about 8 in. apart in the row and are allowed to grow large. In the United States beets for fresh market are thinned to 3 to 4 in. apart and are harvested when 2 to 2½ in. in diameter. In growing "baby beets" for canning the stand is not thinned. This practice saves hand labour and through crowding of the plants produces heavy yields of the desired small size of roots. In the U.S. beets for canning are usually harvested by machines that lift the plants from the soil, remove the tops and deliver the roots into a truck

driven alongside the harvester. Beets for fresh market are pulled by hand, tied in bunches and hauled to a central point for washing and packaging.

The leaves that form atop the enlarged root are sometimes used as a potherb, but the leaf beet (*Beta vulgaris* var. *cicla*) is more often so used. In leaf beet the leaves are highly developed but no fleshy enlarged root is formed. (*See* CHARD.)

Sugar Beet.—The sugar beet is far more important commercially than other types. It has been bred to produce a high content of sugar in its roots and a high yield. The average sugar content is about 15% but that of beets in some fields may approach 20%. The sugar beet has white flesh and nearly white skin; it is typically of a half-long, sharply tapered shape. It is the dominant source of sugar in regions too cool for growing sugar cane.

About one-third of the world's sugar production is from beets and two-thirds from cane. The principal beet-sugar growing areas are the U.S.S.R. (European and Asiatic), the United States, France, Poland, the Federal Republic of Germany, the German Democratic Republic, Czechoslovakia and the United Kingdom. In the United States the principal beet-sugar producing states are California, Colorado, Idaho, Montana, Nebraska, Minnesota, Michigan, Washington, Utah and Wyoming.

BY COURTESY OF THE GREAT WESTERN SUGAR CO.

SUGAR BEET. A CULTIVATED FORM OF THE PLANT BETA VULGARIS: ROOTS OF THE SUGAR BEET MAY EXTEND SEVERAL FEET INTO THE GROUND

Powered implements had been long used in preparing the soils and planting and cultivating sugar beets, but until the 1950s no machines were generally available that could reduce the expensive hand labour of thinning the beets and of harvesting. *See* also SUGAR.

(V. R. B.)

BEETHOVEN, LUDWIG VAN (1770–1827), German composer, was born in Bonn on Dec. 16 or 17, 1770, and baptized on Dec. 17.

LIFE

Origins and Family.—Beethoven's family came from the Flemish Brabant. His earliest-known ancestor was Jan van Beethoven, who lived in Campenhout at the end of the 15th century. Most of his forebears on his father's side were farmers and labourers and the "van" was only an indication of family descent, not a title of nobility. Records of Beethoven's grandfather, Louis van Beethoven (baptized 1712 at Mechelen [Malines]; died at Bonn 1773) state that he was the principal singer at St. Peter's at Louvain, bass singer at St. Lambert's at Liège and, from 1733, singer and later *Kapellmeister* of the electoral chapel at Bonn. Of his three children only one survived, Johann (born in 1740, died in Bonn in 1792); he was a tenor at the electoral court and married Maria Magdalena Keverich (born 1746 in Ehrenbreitstein, died 1787 in Bonn), who had previously been the wife of a valet of the elector of Trier, and who came from a respected family of the Rhine and Moselle district. She bore Johann van Beethoven seven children, of whom four died young. Ludwig was the second child; his two brothers, Karl and Johann, followed him later to Vienna, where they were to play a considerable part in his life.

Bonn and Vienna.—Beethoven's father, aware of the child's talents, wanted to turn him into an infant prodigy. His method of teaching was not practical, however, being at once too strict and too unsystematic. In later years drunkenness brought the father so low that, after the death of his mother, young Ludwig was appointed by the court to act as his brothers' guardian, a fact that certainly influenced his entire life. Beethoven had a few lessons from the court organist, Gilles van der Eeden, and the musicians Tobias Friedrich Pfeiffer and Franz Georg Rovantini, but he did not receive any regular musical instruction until after the arrival in Bonn of Christian Gottlob Neefe in 1779. As early as 1782 Ludwig was his deputy as court organist, and later he also played the harpsichord and viola in the court orchestra. In 1783 the *Neun Variationen über einem Marsch von E. C. Dressler* appeared as his first work in print, on the title page of which he appears as two years younger than his actual age. In fact, as late as 1810 Beethoven was under the impression that he was born in 1772.

His attendance at a private school left him with gaps in his education, which he was at pains to fill during the rest of his life. However, the spelling of his letters does not indicate a lack of culture; his correspondence reveals a wide knowledge of technical, philosophical and literary writings and an ability to think loftily and to express himself with style and ease. He had no use for show of any kind. His cultural development was encouraged by his knowledge of the family of the deceased court councilor Christoph von Breuning, who considered him as one of the household. A lifelong friendship bound him to the councilor's daughter Eleonore, her husband-to-be, Franz Wegeler, a physician, and her brother Stephan.

Beethoven's gifts were such that at the beginning of 1787 he set out, possibly at the suggestion of Neefe, to meet Mozart in Vienna. However, his mother's illness brought him back to Bonn after a fortnight, and her death in 1787 affected him deeply. In 1790 Haydn visited Bonn on his way to England. There is no proof that Beethoven met either Mozart or Haydn on these occasions. In 1791 he accompanied the court orchestra to Mergentheim, and in the same year, at Aschaffenburg, he took part in a competition with the abbé F. X. Sterkel, one of the greatest pianists in Germany. In 1792 his patron in Bonn, Count Ferdinand Waldstein, himself a gifted composer, sent Beethoven again to Vienna, this time to study with Haydn.

Beethoven arrived in Vienna on about Nov. 10, 1792, and, except for some brief journeys, he was never to leave the city again. He was now a fine pianist, proficient also on the violin and viola, and the numerous works he had written during his later years at Bonn, including piano and chamber works and particularly the two cantatas (1790) on the death of Joseph II and the accession of Leopold II, gave proof of his talents. As a member of the court orchestra he was familiar with the German, French and Italian music of the time. In spite of this, however, he sought to acquire further knowledge in Vienna from a number of experts. He first went to Haydn, but in spite of mutual respect master and pupil failed to satisfy each other. Greatly preoccupied with activities of his own, among them his second journey to London in 1794, Haydn was judged by the young Beethoven not to be strict enough. Somewhat behind Haydn's back, Beethoven went to other teachers: the theorist Johann Schenk, to J. G. Albrechtsberger for counterpoint, and the court composer, Antonio Salieri, for vocal composition.

During 1794 and 1795 Ludwig's brothers came to Vienna. In the meantime the court at Bonn had been dissolved and so there was no practical reason for his returning there. Because of his introductions and obvious gifts he soon made his entrance into the cultured middle class, and, through Count Waldstein, into the nobility. He was in demand everywhere as a performer and as a teacher. In 1795 his Piano Trios, op. 1, were published, surpassing all his earlier compositions.

Life in Vienna.—Beethoven maintained close links with Vienna throughout his life; he played his works in its *salons* and academies; he had pupils from all walks of life, including the archduke Rudolph. He spent the summer months, and sometimes part

of the autumn, out of town, where in long walks he could indulge his love of nature. In 1796 he undertook a journey to Nürnberg, Prague, Dresden and Berlin, where he played at the Prussian court and at the Singakademie, and composed Cello Sonatas, op. 5, for the king, Frederick William II. He paid several visits to Hungary, in particular to Budapest. The years 1811 and 1812 he spent at Bohemian spas with visits to Prague and Linz in 1812. Later his correspondence frequently contains plans for traveling to Italy, Paris and, particularly, London. But because of illness or lack of money or work in hand they were never realized.

An invitation in 1808 to leave Vienna for Kassel as music director led to important social and aesthetic developments. As a result of this offer three of Beethoven's most powerful patrons, Archduke Rudolph, Prince Josef Max Lobkowitz and Prince Ferdinand Kinsky, combined to guarantee him an annual salary of 4,000 florins, in order that he could devote his entire time to composition, on the condition that he should remain a resident in Vienna. Beethoven was thus placed in the unprecedented position (for a composer) of complete independence from any employment or commission. Mozart had achieved freedom from his princely patron, not indeed to the detriment of his musical genius but at the cost of greatly reduced circumstances; the aging Haydn won equality through the esteem in which he was held by Prince Esterházy. Beethoven, however, secured independence not only for himself but subsequently, by his example, for all musicians. The musician was no longer a servant of the court; he was the equal of the nobleman, a belief to which Beethoven firmly adhered and which was to have a far-reaching influence. In the meantime Beethoven's troubles were by no means over. Mainly because of the devaluation of the Austrian currency in 1811 the contract with the princes was continually being reduced, and payment often did not arrive for months. The archduke Rudolph attempted to meet his obligations, but Beethoven had to go to law to receive part of the sums due him from the princes.

Beethoven was similarly unfortunate with regard to payments due him from his publishers. His correspondence with them shows that he was often financially harassed; fees were sent grudgingly or arrived late. Moreover, Beethoven sometimes asked his brothers to help him in business affairs, causing further vexation and disagreement. After the death of his brother Karl in 1815, Beethoven was appointed guardian of his nephew, also named Karl, born in 1806. This led to long and bitter quarrels with Karl's mother, Johanna, whom Beethoven not unjustly considered unfit to be a mother, and also with the nephew himself, who was of a difficult nature. Beethoven undertook his obligation seriously but his treatment of the boy was severe, leading to the latter's attempted suicide. Beethoven's intentions, however, were of the best: though he could ill afford it he was determined to provide an inheritance for his nephew.

Ill-health is a recurring subject in Beethoven's correspondence. During his youth he survived an attack of typhoid fever, and later he frequently wrote of abdominal complaints and colic. As early as 1794 and 1796 there were signs of an ear infection, which in 1801 he mentioned to his friend Wegeler. The realization that he was threatened with deafness nearly drove him to suicide. His "Heiligenstadt Will," written for his brothers in 1802, is an impressive and moving document of inner self-conquest. The affliction progressed swiftly and after 1818 it was only possible to converse with him by writing. In the numerous "conversation books" left by Beethoven (many of them deliberately destroyed by the composer's biographer, Anton Schindler) the speech of Beethoven's interlocutor and sometimes that of Beethoven himself was written down. Beethoven's deafness thus indirectly provided a unique biographical source. But mistrust resulted from his deafness, making social intercourse increasingly difficult with friends and even more with constantly changing servants.

Beethoven and Women.—Beethoven remained unmarried, although he had a considerable number of woman admirers, corresponded with ladies of the aristocracy and is said to have seriously considered marriage in 1810 with Therese Malfatti, the daughter of a landowner. An important document is Beethoven's passionate love letter, *An die unsterbliche Geliebte* ("To the immortal beloved"), found on his desk after his death. The date of this letter is not known, nor is it known whether it was ever sent and if so whether the recipient returned it. Attempts were made to show that it was destined for Countess Giulietta Guicciardi, for Countess Therese von Brunswick or for the singers Magdalena Willmann and Amalie Sebald. Later research discounted these claims and postulated Countess Josephine Deym, younger sister of Therese von Brunswick. A number of love letters from Beethoven to her were published. Subsequently Countess Anna Marie Erdődy, to whom Beethoven also wrote, at whose house he stayed and to whom he dedicated chamber works, was suggested. From all Beethoven's correspondence with these women, however, and even from his caustic criticisms of the mother of his nephew there emerges a lofty conception of womanhood. He frequently regrets not having been blessed with a happy marriage, that it was not his lot to marry the woman of his choice. Indeed, his conception of the ideal woman is evident enough without recourse to his correspondence: it is expressed in the sublime and sensitive music of *Leonore* in his only completed opera.

Last Years.—The history of Beethoven's later years is almost entirely that of his music. By 1810, when his deafness had isolated him, he had completed the "Emperor" Concerto and was engaged on the Seventh Symphony, performed in Vienna in 1813. The following year the new version of *Fidelio* was given successfully in Vienna. Beethoven was greatly preoccupied later with legal matters concerning the custody of his nephew, and relatively few works were written between 1815 and 1820. The *Missa Solemnis* was completed in 1823 and the Ninth Symphony in the following year. The latter was performed in May 1824 in Vienna, though the Philharmonic society in London, to whom Beethoven had sent a score, had earlier paid for the sole right to perform it over a period of 18 months. In 1826, disturbed by his nephew Karl's attempt at suicide, Beethoven took the boy to Gneixendorf, the home of his brother Johann. On his way home Beethoven caught a cold that developed eventually into cirrhosis of the liver, from which he died in Vienna on March 26, 1827.

Character.—Beethoven's character is partly revealed in the vast number of his letters to friends, publishers, artists and various official institutions, and in the annotations of his sketchbooks. First references are to the supplementing of his early education. He was born and bred in the Rhineland, where the many political changes developed a democratic outlook and a desire for independence. Having dedicated his Third Symphony to Napoleon the liberator, he tore up the dedicatory page on hearing that Napoleon had proclaimed himself emperor. His belief in democracy and independence never left him, despite his friendly relations with the nobility and acquaintance with court circles. His responsibility for his brothers and his activities in the court orchestra in Bonn early accustomed him to rely on himself, and his concern for his nephew proves that he retained this sense of responsibility in later life. His love of nature may well have been inspired by the beauty of the countryside around Bonn and the nearby hills of the Siebengebirge. The same trait is seen in his frequent visits to villages near Vienna, in the choice of his many abodes in Vienna, where he usually tried to procure an open view, and above all, of course, in the "Pastoral" Symphony.

Hélène von Breuning, who was something of a second mother to him, states that in boyhood Beethoven would be overcome by fits of rage. He was in no mood, during these seizures, to listen to reason; she had to wait until they subsided. This inner tension was not reduced with the years nor was his violent temper; they were inclined to be exacerbated by his deafness. He would fly into a rage if he felt slighted, or if he felt aspersions had been cast on his honour or responsibility, though in matters of social standing there was never any question of snobbery. He was aware of these outbursts, of course; indeed, he was sometimes ashamed of them and would try to make amends.

In 1812 Beethoven was in the company of Goethe at Teplice, Carlsbad and Bilina. Beethoven's much-quoted remark showing that, unlike Goethe, he had little respect for the imperial court ("They must make room for us, not we for them") has been exaggerated, but two remarks of Goethe epitomize Beethoven's

character. "Never have I met such a concentrated, forceful and fervent artist. I can well understand that he must have a strange relationship to the world," Goethe wrote to his wife. And to C. F. Zelter: "I am astonished by his talent but he is unfortunately an altogether untamed personality . . . One must forgive him and pity him for his loss of hearing which, however, is perhaps less harmful to him from a musical than from a social viewpoint." It was of course precisely this "untamed" element in his character, which by endless effort and labour he was able to bring under control in his work, that raised his gifts to the level of genius. True enough, there are aspects of Beethoven's character and his behaviour that are baffling and that will remain so whatever explanation may be sought in the outer or inner circumstances of his life—the unsettled political conditions, his unceasing struggle for independence, his deafness, which often put him at the mercy of unreliable people, and his celibacy. He was, on the other hand, fundamentally honest and above all honest in his knowledge of himself. Worshiping nature and believing in the hereafter, he took Kant's motto: "Within us morality, above us the starry heavens."

MUSIC

Life and Work.—Beethoven's life was wholly absorbed by music. He was never without his sketchbook to store up themes and ideas that passed through his mind. Musical ideas, developed in the form of a canon, also occur in some of the notes with amusing rhymes and puns that he sent to his friends. Asking his doctor to call on him, he sends him a canon on the words *Doktor sperrt das Tor dem Tod* ("the doctor bars the gate against death"); to the tutor Brauchle and the cellist Joseph Linke, both in the service of Countess Erdődy, he writes in the form of a canon, the text of which is their two surnames. Several improvised canons on the text *Ars longa, vita brevis* ("art is long, life short") appear in friends' albums. To Anna Milder, the soprano who triumphed as Leonore, he sent a musical pun on her husband's name. To Friedrich Kuhlau he sent a canon on the words *Kühl, nicht lau* ("cool, not lukewarm")—the theme, originally by Kuhlau, was on the letters of the name Bach (which in German means "a brook"). Beethoven was clearly fond of improvising canons in this way, prompted by some personal situation. Many of his major works were similarly inspired by some event or state of mind connected with his personal life. In this Beethoven differs from his predecessors, who, though not necessarily less subjective, adhered more strictly to orthodox forms. Though it is not an indication of their greatness, it is right to say that each of Beethoven's major works still defines a world of its own more sharply than do the cantatas of Bach, the operas of Handel or the symphonies of Haydn or Mozart. The fact that earlier sketches may have been incorporated in a particular work does not detract from its individual character since it was Beethoven's habit to select from his store of sketches those that anticipated the work in hand. It is therefore not surprising that he was less successful than other composers with "occasional" works, *e.g.*, the incidental music for August Kotzebue's *Die Ruinen von Athen*, the overture *König Stephan*, also for a play of Kotzebue, and the cantata *Der glorreiche Augenblick*, hurriedly written for the congress of Vienna in 1814. Works written to commission without a time limit were of course another matter. Four years were spent on the three "Rasumovsky" String Quartets, op. 59 (written for Count Andreas Rasumovsky), the same time on the three quartets, op. 127, op. 130 and op. 132, written for Prince Nicolas Galitzin, while the great *Missa Solemnis* intended for the enthronement of his pupil the archduke Rudolph as archbishop of Olomouc in 1820 was not completed until three years later.

Though each of Beethoven's creations has a character of its own, significant features reappear throughout his work. The theme of the song "Gegenliebe" (1794–95) serves as the theme of the variations in the Fantasia for Piano, Chorus and Orchestra, op. 80 (1808), and it has a distinct resemblance, both with regard to the text to which it is set and in its musical shape, to the theme of the "Ode to Joy" in the Ninth Symphony. Thematic resemblances of this kind can serve musicologists on another plane. Comparing motives in the various works dedicated to Countess Erdődy, Dana Steichen has attempted to establish her as "the eternal beloved."

Dedications.—Beethoven's dedications, like his canons, have a personal significance. Early in his career they were expressions of gratitude to his patrons or of admiration and friendship, such as the dedication of the Piano Sonata, op. 2, to Joseph Haydn and the third Piano Concerto to Prince Louis Ferdinand of Prussia in recognition of his fine piano playing and his admiration of the composer. His pupil Baroness Dorothea von Ertmann showed a particular understanding of Beethoven's style and was accordingly the dedicatee of the delicate yet powerful Sonata, op. 101. The *Sonata quasi una fantasia*, op. 27, no. 2 (later to become famous under the title of the "Moonlight" Sonata), was understandably dedicated to Countess Giulietta Guicciardi, whom Beethoven much admired at the time. The mighty Sonata, op. 53, was written for his former patron, Count Ferdinand Waldstein, and the delicate Sonata, op. 78, for his friend Therese von Brunswick. The fervent but extremely varied Piano Trios, op. 70, were dedicated to Countess Erdődy.

Opus Numbers.—Since Beethoven never had difficulty in having his works published soon after their composition, a high opus number usually indicates a late composition. There are, however, some important exceptions: the Wind Octet, op. 103, published posthumously, was composed in 1792 for the court banquets of the elector at Bonn and appeared in 1796 in a version for string quintet as op. 4; a *Rondo a Capriccio* for piano, op. 129, was published posthumously, though the autograph copy that the publisher edited had been written between 1795 and 1798 and entitled by Beethoven *Alla ingherese, quasi un capriccio*, not, as it is better known, *Die Wut über dem verlorenen Groschen* ("Rage over a lost penny"); a number of songs, later given opus numbers, particularly the eight songs forming op. 52, in fact belong to the Bonn period.

Beethoven usually gave no opus numbers to his variations until he wrote the Piano Variations, op. 34 and op. 35, which he mentions in a letter to the publishers, Breitkopf and Härtel, as "among the real number of my greater musical compositions." The numbers allocated by Beethoven himself reach as high as op. 137, which is a short fugue for string quintet, composed in 1817 and published in 1827.

Stylistic Origins.—In spite of the many studies that have been written of Beethoven's relation to his predecessors, and his independence of them, he was not a revolutionary. Rather, he enormously developed music as he found it. His methods of thematic development have been compared with those of Haydn, and his use of the first movement sonata form, which he inherited from Haydn and Mozart, has been shown. The String Quartets, op. 18, are compared to works of Carl Philipp Emanuel Bach, A. E. Forster, the Mannheim composers, Haydn and Mozart. Such comparisons, however, apply to external characteristics only; namely, thematic development and peculiarities of form.

His well-known admiration for the French school of opera composers of his time, Grétry, Méhul, Gossec and Cherubini (*q.v.*), leads to a consideration of the heroic element in his work. The "heroic" style was deliberately cultivated by these composers and certain aspects of their work clearly suggest Beethoven. The French violinist and opera composer Rodolphe Kreutzer, to whom the Violin Sonata, op. 47, is dedicated, should also be mentioned here. From the French Beethoven borrowed the idea of fanfare motives that reverberate throughout his work from the first movement of the First Symphony in C (1799) to the Third "Eroica" Symphony in E flat (1803); the overture *Leonore*, no. 3; *Wellingtons Sieg*, op. 91; the "Emperor" Concerto, no. 5 in E flat, op. 73 (1809); the recitative from the Ninth Symphony in D minor (1817–24), and the Agnus from the *Missa Solemnis* (1818–23). From an ethical viewpoint Beethoven was naturally drawn to subjects of epic or heroic grandeur and attempted to illustrate them in music by numerous means. He cultivated the march form in his early piano variations, the Piano Sonatas, op. 26 and op. 101, and military marches occur in his work up to the Ninth Symphony. Significantly the third "Rasumovsky" Quartet is also known as the *Heldenquartett* ("Heroes' Quartet"). He himself entitled the quartet, op. 95, *Quartetto serioso*, and the evocation of the figure of fate at the beginning of the Fifth Symphony (1805–07) belongs to the same order of ideas. Mention must also be made here of

the frequent use of the key of C minor, which he seems to have favoured from 1790 to 1807, using it in *Kantate auf dem Tod Josephs II;* Piano Trio, op. 1, no. 3; String Quartet, op. 18, no. 4; the Third Piano Concerto; the Fifth Symphony; and the overture *Coriolan.* In his later works he seems deliberately to have avoided this key. The choice of C minor for the Piano Sonata, op. 111, was dictated by the use of an earlier sketch.

The derivative elements of Beethoven's style do not detract from the originality of his work. Indeed, features of style, form or technical procedure immediately acquire his personal stamp. His profile is outlined in the early Piano Trios, op. 1 (1793–95), and even more clearly in the Piano Sonatas, op. 2 (1795), all works displaying even at this early stage strongly contrasted but interdependent themes, a masterly sense of design and a highly condensed conception of form. While in his symphonies and chamber works Beethoven adhered to the four-movement plan of Haydn and Mozart, he used the piano sonata for a great variety of experiments in musical form, possibly because he was himself a pianist and therefore able to give immediate expression to his ideas at the keyboard. Breaking away from the conventional plan, the opening movement of the Sonata, op. 26, is a suitelike series of variations followed by a scherzo, a funeral march and finally an allegro of almost virtuoso brilliance. The first movement of the "Moonlight" Sonata, recalling the mood of a romantic novel, suggests a nocturne. In the same unconventional category is the great op. 57 (the "Appassionata") and the two movements forming op. 78, with its strange introductory bars. The first movement of the "Hammerclavier" Sonata, op. 106 has basically the same form as the first movement of the earliest sonata (op. 2, no. 1) but is greatly enriched by contrapuntal devices. A master of fugue and canon, Beethoven attempts, in the finale of the Sonata, op. 10, no. 2, a fusion of fugue and sonata form. The same combination is impressively used in the Sonata, op. 109, and again, in a completely novel manner, in the finale of op. 106. Through Neefe Beethoven early had become acquainted with Bach and knew much of the *Well-tempered Clavier* by heart. "He should not be called Bach (in German, 'brook')," he declared, "but *Meer* ('sea')." Long-cherished projects were for a quintet and an overture based on the notes bearing the four letters of Bach's name (in German B is B flat and H is B natural). Beethoven's polyphonic style, first illustrated in the Cello Sonata, op. 102, was wonderfully developed in the Piano Sonatas, op. 100, 109, 110 and 111, and again in the late string quartets, works that break completely new ground.

Following the theory of Wilhelm von Lenz, set out in his book *Beethoven et ses trois styles* (1852–55), much Beethoven criticism was devoted to his "three styles," as if his work fell into three distinct stylistic categories. This conception is no longer valid, in the sense that each of these styles coincides with a specific period in Beethoven's life. It is true that Beethoven's growth was a continuous process, but his early works are as perfect of their kind as those he wrote at the end of his life. The division of his work into stylistic periods is not erroneous so long as each style is not pinned down to a specific period and provided it is recognized that one style may find itself juxtaposed with another within a given work. On this basis an examination of the quartets is illuminating. The six quartets forming op. 18 (1798–1800), though traditional in structure, are perfect works of art covering a vast range of experience. Particularly memorable are the grave mood of the adagio affetuoso (no. 1), "La Malinconia" (no. 6), the gay and graceful andante scherzoso (no. 4) and the cross rhythms of the scherzo (no. 2). The fourth quartet of op. 18 also conveys a mood of solemnity and sadness; in the first movement of the first quartet a motive is developed on all four instruments.

The middle group consists of the three "Rasumovsky" Quartets, op. 59 (1806), introducing Russian melodies as a tribute to the Russian ambassador in Vienna to whom they are dedicated, the "Harp" Quartet, op. 74 (1809), so-called because of a harplike accompaniment figure in the first movement, and the *Quartetto serioso,* op, 95 (1810). Here a richer sonorous texture almost suggests an orchestral conception. These middle-period quartets are laid out on a bigger scale and make greater technical and emotional demands.

The third group, op. 127, op. 130 to 135 and op. 137 (1824–26), explores further problems. These quartets are remarkable for their wonderful transparent texture, the independence and also the interplay of the four string parts, and the profusion of thematic ideas. Additional movements are introduced. Not surprisingly the full significance of these late quartets was not immediately apparent and it was not until they were performed by the Joachim quartet toward the end of the 19th century that they gradually became established in the repertory.

It is less easy to establish a dividing line between one style and another among the piano sonatas, which follow each other with fewer gaps, or in the symphonies, which are less numerous. Beethoven disconcerted his public with the opening chord of the first movement of the First Symphony, a seventh, instead of a major triad, on the tonic, and he continued to disconcert them in the "Eroica" with its novel forms, and throughout the cycle of his symphonies culminating in the Ninth with its choral finale. He had been drawn to the idea of setting Schiller's ode "An die Freude" in his youth; in the Ninth Symphony his dream was triumphantly realized.

The 19th century was inclined to overemphasize the "heroic" aspects of Beethoven's work. He was held to be a Titan, a revolutionary, and it was only natural that this image of him should have been most successfully projected in certain of his symphonies. A strange tradition was established for a time favouring the odd-numbered symphonies, which were held to be forceful and heroic, as opposed to those with even numbers, considered lacking in these qualities. This distinction can of course no longer be accepted: the magnificent form in which the Second Symphony is cast, the serenity of the Fourth, the evocation of nature in the Sixth (the "Pastoral"), and the dancelike nature of the Eighth belong to the greatest manifestations of Beethoven's spirit.

The Viennese Classical School.—Haydn, Mozart and Beethoven are frequently grouped together as the Viennese classics. Though none of these three composers was born in Vienna there is some justification for thus grouping them since it was in Vienna that they each spent their most productive years, as indeed did other composers who merit the description "classical." But there the main resemblance between Beethoven and Haydn and Mozart ends. Admittedly they shared similar views on thematic development and the sonata form, but each brought an entirely individual character to his technique. Haydn is said to have thought of the slow movements of his symphonies as possessing a "moral character," a conception very far from that of Beethoven, whose musical message was dictated by an emotional state. Yet if a link is to be found between Haydn and Beethoven it is in their slow movements that it is most likely to be seen. Elsewhere Haydn's subtle humour, his use of folk song and the delightful surprises he springs on the listener were foreign to Beethoven's mind. So was the equally subtle spirit of Mozart, most convincingly revealed in the portrayals of his opera characters. To Mozart's many-sided musical personality, and particularly to his use of chromaticism, Beethoven throughout his life remained a stranger.

The Variation Form.—Variations, one of the fundamental musical forms, have been used by each of the Viennese masters in an entirely individual manner. In most of his piano variations Beethoven follows his predecessors, particularly Mozart, in the practice of maintaining the main outlines of the theme that become progressively transformed by figurations. In his later works in the variation form the figurations acquire an impressive character of their own. Beethoven was himself fully aware that his two sets of Variations, in F major, op. 34, and in E flat, op. 35, had broken new ground. The theme of the latter is also used, incidentally, in the "Eroica" Symphony as well as in a *contredanse* and in the *Prometheus* ballet music. The form of the Thirty-Two Variations in C minor almost suggests the recurring features of a *chaconne,* though there is no reason to suppose that Beethoven had this form in mind. The heights are reached in the Thirty-Three Variations on a Waltz by Diabelli, op. 120, one of the most amazing works in the variation form of all time.

Remarkable, too, are the variation movements in the instrumental works, among them those in the String Quartets, op. 18, no. 4, and op. 74, the Piano Sonata, op. 57, and the Piano Trio, op. 97. Other variation movements are the slow movement of the Fifth Symphony and the finales of the "Eroica" Symphony and the Choral Fantasia, op. 80. All these seem to have prepared the way for the transcendental Arietta in the Piano Sonata, op. 111, the wonderful slow movement in the String Quartets, op. 127 and op. 131, and the visionary use of the variation in the last movement of the Ninth Symphony.

Program Music.—Misconceptions are likely to arise about works of Beethoven bearing more or less picturesque titles such as the Sixth "Pastoral" Symphony in F (1807–08), *Wellingtons Sieg* and the Piano Sonata *Les adieux, l'absence et le retour*, op. 81a. Beethoven was in no sense of the term a composer of program music. Even in the Sonata, op. 81a, dedicated to the archduke Rudolph, who had fled from Vienna before the advancing French army, the only realistic effect is the passage in the first movement suggesting horn calls. Nor, apart from the bird songs at the end of the slow movement, can the "Pastoral" Symphony be considered a descriptive work in a realistic sense. The storm section of the finale, even though it depicts thunder and wind, belongs to the category of pure music. Possibly Beethoven foresaw the purely picturesque interpretation this work was likely to receive since he specified that it had been conceived *mehr Ausdruck der Empfindung als Malerei* ("more as an expression of feeling than of painting"). It is true that the first section of *Wellingtons Sieg* (originally conceived for the mechanical "Panharmonicon" of J. N. Mälzel, inventor of the metronome) is program music though the manner in which the theme "Rule Britannia" is made to dominate that of "Malbrook s'en va-t-en guerre" is its formal basis. Nor are there realistic associations in the remainder of the work. It is easy to see how a few isolated examples of this kind led musicians in the 19th century to bestow all sorts of fanciful interpretations on Beethoven's works. Titles were invented or borrowed from dramas, novels and poems. Fortunately the 20th-century view of Beethoven rejected all such sentimental associations, and Igor Stravinsky voiced a widespread feeling when he declared that it could make no difference musically if the "Eroica" Symphony had been inspired by a republican or an imperial Napoleon.

The form of Beethoven's overtures was dictated by the nature of the themes that they introduced. The forms of both the *Egmont* and *Coriolan* overtures are remarkable in this respect and so is the overture *Leonore* no. 2, the themes of which, borrowed from the opera *Fidelio*, are developed in such a way as to foreshadow the plot. In a work such as this may be seen the beginnings of the symphonic poem. Apparently, however, Beethoven was dissatisfied with it. In a later version, the great *Leonore* no. 3 overture, he returns to a more orthodox form. This is now often played as an introduction to the second act. A fourth overture, called *Fidelio*, was first given in 1814 and is still played as an introduction to the opera.

Vocal Works.—Beethoven wrote several important vocal works. His *Lieder* such as those on texts by C. F. Gellert, op. 48 (1803), several of which have become widely known in choral versions, were cast in the customary strophic form. In the last of the Gellert *Lieder*, "Busslied," and in the fourth of his settings of Goethe's "Nur wer die Sehnsucht kennt" Beethoven approached the form of the romantic *Lied*. *An die ferne Geliebte* ("To the Distant Beloved"), op. 98 (1816), the text of which may well have touched on personal feelings at the time, is the first true song cycle. In general, it is true to say that the contours of Beethoven's long melodic lines are not easily adapted to a poetic text and it is therefore not surprising to find Beethoven admitting that he was "not fond of writing *Lieder*." A by-product in his vocal music is the numerous versions of Scottish, Irish, Welsh and other folk songs with trio accompaniment commissioned from him by the Edinburgh publisher, George Thomson.

The tremendous finale of the Ninth Symphony and the *Missa Solemnis*, op. 123, had been dimly foreshadowed in the two early cantatas and, more clearly, in the Choral Fantasia, op. 80 (1808), the oratorio *Christus am Ölberge* ("Mount of Olives"), op. 85 (1802), and the Mass in C, op. 86 (1807). The *Missa Solemnis* is an altogether exceptional liturgical work. The setting of the Agnus Dei in the form of a prayer for peace within the soul and without, the ringing trumpet calls that resound in this work and the imperious drum rolls combine to project Beethoven's innermost feelings. In the sphere of incidental music his outstanding achievement is the music for Goethe's *Egmont*. Though he made many attempts he wrote only one opera, *Leonore*, later called *Fidelio*. It was a source of great anxiety to him. Its first performance, at the Theater an der Wien in Vienna on Nov. 20, 1805, was a failure partly because of the fact that Vienna was overrun by the French and also because of the excessive length of the opera and the unfortunate casting of the principal male roles. A revised version was better received in 1806, and after further revision it was triumphantly established in the repertory in 1814. The quartet "Mir ist so wunderbar" in Act I, the recitative in the prison scene and Leonore's aria "Abscheulicher" are all superlative examples of musical and dramatic characterization. Characteristically the self-sacrificing Leonore, the tyrannical Pizarro and the long-suffering Florestan are more tellingly portrayed than the less complex figures of Marcellina and Jaquino. As if to demonstrate a consistent outlook, at the climax of the finale, "O, Gott, welch ein Augenblick!" Beethoven introduces the theme of a soprano aria in his early cantata on the death of Joseph II.

General Characteristics.—There are many distinctive features of Beethoven's musical language. Cross-rhythms with syncopations and sudden *sforzando* are immediately noticeable and also the crescendos that lead not to a fortissimo but unexpectedly and in the form of an illusion to a piano or pianissimo. The rhythmic regularity alone of the so-called "Jena" Symphony, long attributed to Beethoven, should have made its authorship doubtful; it is now authoritively attributed to Frederich Witt (1770–1837). Beethoven declared that he was born to the style of "obbligato accompaniment," meaning that each instrumental part in his work, not only in polyphonic but also in homophonic textures, has an individuality of its own. His writing for wind instruments in his early works was censured by contemporary critics for this reason. Certain wind instruments are used sparingly; *e.g.*, the trumpets and trombones that appear only in the last movement and the piccolo used only in the storm of the "Pastoral" Symphony. Likewise trombones, double bassoon, piccolo, triangle, cymbals and bass drum are reserved for the finale of the Ninth Symphony. In the first movement of the Violin Concerto in D (1806) and the scherzo of the Ninth Symphony the timpani have a melodic function. Beethoven also follows the practice of Haydn and Mozart of splitting a theme into its component motives, which are then developed independently and ultimately allowed to coalesce into new themes. The first movement of the Piano Sonata, op. 2, no. 1, and the Quartet, op. 18, no. 1, contain examples of this procedure. The first movement of the Fifth Symphony is built out of a single short motive. Earlier composers practised this development of a motive at certain points in a movement; Beethoven's developments of this kind spread over a whole movement, submerging the themes themselves. Particularly characteristic, too, is the manner in which the contour of a theme is passed from one instrument to another. The nature of the theme at the opening of the first movement of the Quartet, op. 135 (1826), baffled listeners as late as the 20th century. All these elements are unified in the complex works of Beethoven's last period where every note is significant.

With this greatly enriched technique Beethoven was able to plan works of much wider scope. Themes are sharply contrasted, and bold harmonies mark the nodal points in the structure. His innovations were not immediately accepted. The abrupt harmonic sequence shortly before the repeat in the first movement of the "Eroica" Symphony was long felt to be problematic. In the end, however, these new procedures were seen to be indispensable to Beethoven's highly individual conception of musical form. Finally, Beethoven extended the short coda of his predecessors into a lengthy autonomous section crowned by a brilliant conclusion, and he transformed the minuet, until then a traditional dance movement, into his characteristic scherzo in quick tempo, of which the finest example is that of the Ninth Symphony.

The Sketchbooks.—Beethoven's method of work greatly differs from that of most other composers. More than 5,000 pages of his all-important sketches have been preserved. From these it can be seen that he was in the habit of noting down ideas as they occurred to him, referring to them later and adapting them as the occasion demanded. Each section of a composition was written out, but certain passages appear in several versions with remarks such as "good" or "better." Beethoven's sketches thus seem to have had several purposes. They were in the first place reminders. Since he usually worked at several compositions at the same time, an appropriately chosen sketch would help him to maintain a sense of unity. Furthermore Beethoven's musical imagination was constantly alive and may well have obstructed an intellectual development of his material. His sketches would thus have acted as a necessary brake on his overflowing inspiration and obliged him to maintain his ideas within a given framework.

Another question arises from a study of the final manuscripts. Beethoven was concerned with composition as an act of creation right until the last notes of a work were set down on paper. Many composers go through a difficult period of gestation but once the work is exteriorized its visual notation presents no further problem. Beethoven's mind did not work in this way. He did not first translate music into terms of visual notation; somehow or other the sound of the music and its visual representation were one. A study of his manuscripts shows how the character of his music appears from the very way it is written out. Prominent sections are noted down boldly and emphatically while subsidiary sections are merely scribbled off. Slow sections are spread out over a considerable space while fast-moving accompaniment figures are illegibly jumbled together. Beethoven's manuscripts thus provide invaluable indications. The first movement of the Piano Sonata, op. 27, no. 2, the "Moonlight," is laid out, apart from one or two corrections, in a broad confident manner, while the following Allegretto has an almost affected appearance. In the finale, where an exceptional amount of space is given to a pause, the writing with its strange slants becomes almost wild. None of this is evident, of course, from the printed page. The manuscripts alone, or facsimiles of them, hold the true secrets of his work.

Though many of his works were not appreciated in his day and lesser works by his contemporaries were sometimes better received, Beethoven was freely recognized as the foremost composer of his time. So much is evident from his invitation to Kassel resulting in his contract with the princes Lobkowitz and Kinsky. He was made an honorary citizen of Vienna and an honorary member of the Gesellschaft der Musikfreunde. The festival cantata he was commissioned to write for the congress of Vienna placed him, in the eyes of the assembly, on an international level. Societies in Amsterdam, Neth., Styria, Aus., Laibach, Yugos., and Stockholm, Swed., presented him with honorary titles; the king of France sent him a golden medal; the Philharmonic society in London commissioned a symphony from him and presented him on his deathbed with the gift of the first complete edition of the works of Handel. All his major works were published as soon as they were written, and he was the first composer to have the score and the parts of his symphonies published simultaneously. Before that time symphonies had been conducted from the first violin part. Beethoven's symphonies required a conductor solely in charge of the orchestra and with the full score before him.

Beethoven's fame after his death continued to grow and his influence branched out in many directions. On Schubert it was not entirely beneficial, and Mendelssohn and Schumann were nurtured on Bach rather than on Beethoven. But the link was firmly established with Brahms, particularly in his symphonic works. It was long before Beethoven's late quartets began to exert an influence, possibly not before the later quartets of Béla Bartók.

Throughout the first half of the 20th century, and particularly after World War II when the size of the musical public rapidly increased, Beethoven's achievement continued to make its full impact. Beethoven cycles became an established, often an indispensable, feature of concert seasons, and it was with Beethoven's nine symphonies rather than with classical or later romantic works that the virtuoso conductor triumphed. Between 1799, the year of Beethoven's first symphony, and 1828, when Schubert wrote his great C major symphony, roughly 1,000 symphonies were written; of these, except for some of the Schubert symphonies, only those of Beethoven remained in the repertory. No other music offered quite their challenge. Arthur Nikisch, Felix von Weingartner, Arturo Toscanini, Wilhelm Furtwängler and Otto Klemperer have been among the legendary Beethoven conductors. The chamber works, notably the 17 string quartets, were similarly consecrated by performances in the form of cycles. Indeed, it was largely the vogue of the Beethoven cycles that promoted the organization of a type of festival, common in Germany at the beginning of the 20th century and later in other countries, devoted to the entire works of a chosen composer.

Summary List of Works.—*Instrumental Works in Sonata Form.*—Nine symphonies, the last with chorus; triple concerto, op. 56, for piano, violin, cello and orchestra; 6 piano concertos (including an early work, *c.* 1784, of which only the piano part is preserved); violin concerto, op. 61; wind octet, op. 103; septet for strings and wind, op. 20; 2 sextets for strings and wind; 3 string quintets; quintet for piano and wind; 4 piano quartets; 17 string quartets including the *Grosse Fuge,* op. 133; 10 piano trios, some for wind instruments; 7 trios for strings and wind; 10 violin sonatas; 5 cello sonatas; horn sonata; sonata for piano duet; 32 piano sonatas.

Variations and Smaller Works.—*Wellingtons Sieg,* op. 91, for orchestra; 6 concert overtures; 2 scores of ballet music; orchestral dances and marches; 2 sets of variations for piano trio; 3 sets of variations for cello and piano; 2 sets of variations and marches for piano duet; 23 sets of variations for piano; bagatelles, rondos, fantasia, dances and other small pieces for piano; duos for strings and wind; pieces for mandolin, guitar, organ and musical clock.

Vocal Works.—Two masses, in C major, op. 86, and the *Missa Solemnis,* op. 123; the oratorio, *Christus am Ölberge,* op. 85; the opera called *Leonore* in its first and second versions and *Fidelio* in its third version. Four scores of incidental music and other pieces for stage works; 3 cantatas in several movements and 4 in one movement; arias for one, two and three voices with orchestra. Italian and German songs for several voices; canons; about 150 non-German folk songs for piano, violin and cello; about 80 *Lieder* for voice and piano including "Adelaide," the Gellert *Lieder,* "An die Hoffnung" and the cycle *An die ferne Geliebte.*

See also Index references under "Beethoven, Ludwig van" in the Index volume.

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BEETLE, the common name for any insect of the order Coleoptera. Beetles can usually be recognized by the presence

of four wings, of which the front pair are modified into horny covers (elytra, sing. elytron) that hide the rear pair and most of the abdomen and usually meet down the back in a straight line.

Beetles are exceedingly numerous and take many forms. They include some of the largest insects and some of the smallest: *Dynastes hercules,* the rhinoceros beetle, may reach a length of 7 in. (usually about 2 in. in the U.S.) and a South American long-horned beetle, *Titanus giganteus,* may measure close to 6 in.; some African and South American scarab beetles are nearly as big as a man's fist, and others are so small as to be nearly invisible to the naked eye, as small as $\frac{1}{100}$ of an inch long.

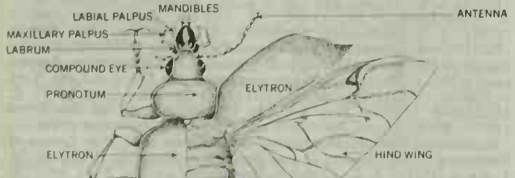
Occurrence.—In the animal kingdom beetles form by far the largest major group or order. At least 250,000 kinds are known, of which more than 25,000 inhabit North America. They thus constitute more than a quarter of all the kinds of animals.

Beetles may be found almost anywhere. Most of them feed either upon other animals (are predaceous) or upon plants (phytophagous), but some eat decaying matter of various kinds as well as a variety of other organic substances. They may be found in soil, in decaying plant or animal matter, in tissues of plants or on the exterior and in fungi. Many beetles are found crawling or flying in search of prey, swimming in or on the surface of ponds and lakes and creeping even in rock crevices in the intertidal zone along seashores. They live from the equator to the arctic regions —in deserts, jungles, forests, prairies and rocky peaks. Some beetles inhabit hot springs up to 120° F. and saline and alkali waters. Certain kinds live as "guests" in the nests of social insects, as parasites in the bodies of other insects and on the skin of some mammals. Several are pests inhabiting many materials that man has stored up for his future use. The only major niche that beetles have not invaded is the sea, where insects are almost entirely replaced by their crustacean relatives.

General Structure.—Many structural modifications are found among the beetles, with a corresponding variety of habits and habitats. So varied are both the structure and behaviour that it is very difficult to make any general statement on these topics. For example, a few beetles have no elytra and some have no wings at all.

As in all adult insects the segmented body consists of three primary body regions: head, thorax and abdomen. In beetles, however, two of the three thoracic segments are attached to the abdomen, the third (prothorax) being isolated as the region between the head and trunk, covered by a dorsal plate, the pronotum. The body covering (exoskeleton) varies from very horny and rigid to soft and flexible, but it usually consists of hard plates separated by flexible membranes.

The antennae are usually 11-segmented, but vary widely in form. The jaws (mandibles) may be relatively large, as long as the rest of the body, or almost completely absent; usually they are triangular in shape, suitable for biting or chewing. The paired maxillary and labial palpi (sing. palpus) are usually small and are used for feeling or handling food, but in some beetles one or the other pair may be greatly enlarged. The compound eyes are usually prominent, sometimes reduced or absent, and occasionally divided. Simple eyes (ocelli) are rarely present. An incised neck is sometimes evident, but in many beetles the head is recessed into the prothorax or under the pronotum.



FROM E. O. ESSIG "INSECTS OF WESTERN NORTH AMERICA" BY PERMISSION OF THE MACMILLAN CO., PUBLISHERS

FIG. 1.—STRUCTURE OF A GROUND BEETLE, FAMILY CARABIDAE

The prothorax is generally very distinct, the mesothorax and metathorax being hidden under the elytra along with most of the abdomen. The pronotum may be four-sided, very wide or very long, and sculptured with lateral spines or grooves and pits. The front legs emerge from cavities in the underside which may be confluent or separated by other parts. The cavities may be open behind or closed by other sclerites (plates). The mesothoracic spiracle (respiratory opening) is often visible just behind the base of the front legs. The mesothorax bears the elytra or wing covers and the second pair of legs. The metathorax bears the flying wings and the third pair of legs.

The legs are modified in various ways, for running, swimming, jumping, digging or clasping. In some beetles wings are not capable of producing flight, but in many others they are powerful and sustain strong flight. Small beetles are common flying in swarms particularly at dusk.

The abdomen is composed of ten segments, but often some of these are not externally visible. From five to eight segments can usually be seen, with short apical appendages evident in some beetles. Each abdominal segment has a pair of spiracles, the openings into the air-tube (tracheal) system.

Geographical Distribution.—As mentioned earlier Coleoptera are the most widely distributed of all large orders of insects; no other order has invaded the land, air and fresh water to so great an extent. Many of the dominant families, such as the Carabidae (ground beetles), Curculionidae (snout beetles, or weevils) and Scarabaeidae (scarabs, chafers), are almost as widely distributed as the order itself. On the other hand, the Dytiscidae (predaceous diving beetles) are more abundant on the northern continents, while the Cicindelidae (tiger beetles), Buprestidae (metallic wood borers), Cerambycidae (long-horned beetles, or longicorns) and Lucanidae (stag beetles) are essentially tropical families, becoming scarcer in more temperate zones. Some of the smaller families, however, are very restricted in their range; the Proterhinidae (closely allied to the weevils), for example, being almost confined to the Hawaiian Islands, and the aquatic family Amphizoidae occurring only in parts of North America and Tibet. Certain species of beetles of diverse families seem to be more tolerant of climatic differences than others, and about 270 kinds are common to Europe, North America and northern Asia. Many have become widely spread by man, and more than 100 species, especially those affecting grain and other stored products, are now cosmopolitan.

The study of island life yields some interesting features regarding the distribution of beetles. Thus in the Madeira Islands T. V. Wollaston as early as 1870 found 695 species of Coleoptera; of these, nearly 300 kinds are peculiar to those islands, although allied to European species. In the Hawaiian Islands W. E. Sharp mentions 428 species, among which 352 species had not so far (1910) been found elsewhere. Thus the peculiar species may have formerly existed elsewhere, migrated to the islands mentioned and since that time become extinct in their original homes; or they may have been evolved within the islands—the latter supposition being the more probable.

Geological Distribution.—The oldest known fossils of beetles come from the Upper Permian rock strata (about 200,000,000 years old) of Australia and the U.S.S.R. and consist of elytra only; the remains are not sufficient to establish the relationships of these beetles but some of them show affinities with the existing coleopterous family Hydrophilidae (water scavenger beetles). A great number of fossil remains of true beetles have been found in later strata, the Triassic of Queensland, Austr., and of Switzerland. Some of these fossils are leaf beetles and weevils. The English Jurassic beds have yielded remains of bark beetles. In the Miocene rocks of Florissant, Colo., and in the Prussian amber (Oligocene) many fossils referable to living genera have been found, including about 400 species of weevils.

Natural History.—Beetles and their larvae live and feed in almost all the diverse ways found among insects. The carnivorous

habit of seeking and devouring living prey occurs in the ground beetles, tiger beetles, lady beetles or ladybirds and in predaceous diving beetles. In these instances the beetles and their larvae have similar habits.

In certain rove beetles of the genus *Aleochara*, in the ground beetle *Lebia scapularis* and in the curious *Metaecus paradoxus* (family Rhipiphoridae) the larvae are true parasites and the adult beetles free-living—a habit that is rare among Coleoptera. *Metaecus* occurs in England and its newly hatched larva is a minute black, active creature that, by some unknown means, finds its way into wasps' nests. There it becomes an internal parasite of wasp larvae and subsequently bores its way out of its host, finally devouring the remains. A vast number of beetles and their larvae feed directly upon plants; this is the case with the whole family of the Chrysomelidae (leaf beetles) and with the weevils. Others, such as the long-horned beetles, bark beetles and metallic wood borers, feed in the larval stages upon the wood or bark of trees. Wireworms, injurious larvae of the Elateridae, and chafer larvae feed on the roots of various crops. Weevils have very diverse habits and no parts of plants, from the roots to the seeds, are exempt from the attacks of one or more species.

There is a great and diverse assembly of beetles, and more especially their larvae, that feed entirely upon decaying organic matter of various sorts. Thus the Silphidae include many carrion feeders and are well exemplified by the burying beetles; hosts of rove beetles frequent refuse of all kinds, and many Scarabaeidae live in dung. Many beetles and their larvae live in grain and other stored products, and some attack hides, furs, museum specimens, tobacco and drugs.

Apart from the more usual habits it is interesting to note certain exceptional modes of life found among beetles. There are genera and even whole families that live in the nests of ants or of termites. There are others that inhabit the extensive limestone caves of Europe and North America, whereas certain blind ground beetles are only found beneath huge boulders deeply embedded in the earth. There are also species that inhabit the seashore and are submerged by the tides. A few rove beetles live as external parasites around the anus of South American mammals.

Means of protection against enemies are varied among Coleoptera. Some are cryptically coloured and closely resemble their surroundings: in the African longicorn *Petrognatha gigas* the whole upper surface resembles dead velvety moss, and its irregular antennae are very much like dried tendrils or twigs. Many weevils fall and feign death at the least alarm and, folding their limbs closely around the body, look like seeds or particles of soil, thus escaping observation. Certain beetles, especially those living in ants' nests, resemble ants, and the common wasp beetle of Europe, *Clytus arietis*, both in its movements and coloration, closely resembles a wasp (for further instances of this kind *see* MIMICRY). Other beetles obtain some measure of protection possibly from their repellent appearance, or from their evil-smelling or distasteful secretions, either in the form of exudations of blood from definite parts of the body, or as the product of special fetid glands. The so-called bombardier beetles of the Carabidae have the property of secreting an evil-smelling defensive fluid from the anal end of the body. In some cases this fluid volatilizes into a gas which looks like a minute jet of smoke when it comes into contact with the air, and its caustic properties act as a repellent to other insects or foes. Finally a number of beetles secure protection in virtue of their general agility: many ground beetles and tiger beetles run rapidly and the latter also take to wing with great readiness, whereas the flea beetles have remarkable powers of leaping.

Many beetles produce sound, usually brought about by the friction of one part of the body (the "scraper") against another part (the "file"). These stridulating organs were studied by Darwin and later, in 1900, by C. J. Gahan. They are generally present in both sexes and probably serve for mutual sexual calling. In some beetles there is a filelike area on the head which is rasped by the anterior margin of the prothorax. Among the longicorns the sound is produced either by rubbing the hind margin of the prothorax over a striated area on the mesothorax, or by rubbing the femurs of the hind legs against the margins of the elytra.

Stridulation, however, is not confined to adult beetles, but occurs in certain larvae also. Thus in some larvae of the superfamily Scarabaeoidea there is a series of ridges or tubercles on the coxae of the middle pair of legs, and the hind legs are modified in various ways as rasping organs. In the cockchafer larva and larvae of other chafers a ridged area on the mandible is rasped by a series of teeth on the maxillae. Stridulation in larvae is independent of sex and it has been suggested that it is to warn neighbouring larvae, inhabiting burrows in wood, etc., to avoid getting in each other's way.

Apart from recognition by sound, some other beetles emit a bright light for the same purpose. The source of the light is in special luminous organs that consist of an outer, light-producing layer and an inner, reflector layer. The outer layer is supplied with oxygen by means of air tubes (tracheae) and the reflector layer contains many urate crystals that appear to act as a background, scattering the light and preventing its dispersion internally. The light is produced as the result of the oxidation of the compound luciferin in the presence of the enzyme-like substance luciferase; this reaction takes place in the outer layer of the luminous organ. It has been suggested that this luminescence does not reside in the actual cells of the tissue concerned but is caused by the presence within the tissue of special luminous bacteria (for chemical details of this form of luminescence *see* BIOLUMINESCENCE).

Luminous beetles belong to the families Lampyridae (fireflies), Phengodidae, Drilidae and Elateridae (click beetles and wireworms); a familiar example of the first-mentioned family is the common European glowworm (*Lampyris noctiluca*) whose wingless female emits a bright light near the hind end of the body; the winged male exhibits a much feebler light. The Elateridae include beetles of the genera *Pyrophorus* and *Photophorus*, both sexes of which are winged and luminous. (*See* also FIREFLY.)

Economic Importance.—Many beetles are injurious, either as larvae or adults. Among those which attack farm crops, the wireworm (*q.v.*) is important. Wireworms are most prevalent in newly plowed grassland and attack the supervening crops, particularly cereals and roots. Flea beetles of the family Chrysomelidae cause great damage to plants of the turnip tribe, both the beetles and their larvae feeding upon the leaves and other plant parts. The asparagus beetle (*Crioceris asparagi*), belonging to the same family, is a familiar pest of that vegetable in Europe and North America (fig. 2). Related to it is the Colorado potato beetle (*q.v.; Leptinotarsa decemlineata*), which is destructive to potato foliage in the eastern half of North America; later it became established in the Bordeaux district of France. The Japanese beetle (*q.v.*) (*Popillia japonica*), one of the chafers, was accidentally introduced into New Jersey from Japan about 1916 and extended its range throughout eastern North America, where the beetle is injurious to the foliage of fruit and other trees and its underground larvae damage lawns and golf greens. The common white grubs, larvae of the May or June beetles such as *Phyllophaga*, attack the roots of grasses, potatoes, strawberries, cotton, etc.; the adults may feed on the foliage of trees.

Many weevils are highly injurious; for example, the boll weevil

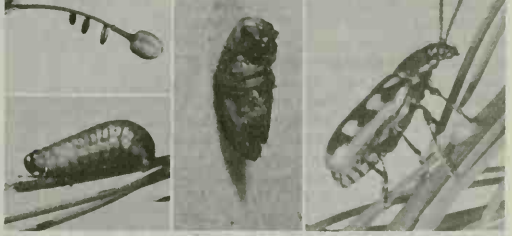


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FIG. 2.—ASPARAGUS BEETLE, FAMILY CHRYSOMELIDAE: (TOP LEFT) EGGS; (BOTTOM LEFT) LARVA; (CENTRE) PUPA; (RIGHT) ADULT

(*Anthonomus grandis*) is the most serious enemy of the American cotton crop. It entered Texas about 1892 from tropical America, subsequently infesting almost the whole cotton belt. (*See* Boll Weevil; Cotton.)

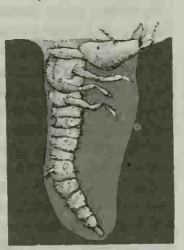
Larvae of many longicorns are destructive to living and dead timber, and species of *Anobium* and *Xestobium*, the deathwatch (*q.v.*) beetles, bore into furniture and the rafters of public buildings. The powder-post beetles (Lyctidae and Bostrychidae) have similar habits; one species, the lead-cable borer (*Scobicia declivis*), which is common in California and Oregon, eats holes through the lead sheathing of aerial telephone cables and sometimes causes short circuits or considerable damage because of the admission of moisture through the holes.

Many beetles, notably the granary weevil (*Sitophilus granarius*) and the meal worms and their allies, of the family Tenebrionidae, also attack stored grain, meal and other dried products. (*See* Flour Beetle.) Many beetles are household pests, members of the family Dermestidae being the most important in this regard. Of these, the black carpet beetle (*Attagenus piceus*) is the most destructive in North America; it chiefly attacks textiles of rough finish, including carpets and upholstery; another species (*Thylodrias contractus*) is a common pest in museum collections, where it attacks dried insect specimens.

The above remarks serve to show the many injurious species of Coleoptera; nevertheless, there are others that have been employed by man to his benefit, particularly lady beetles, or ladybirds (Coccinellidae), and ground beetles (Carabidae). The Australian ladybird (*Rodolia cardinalis*) has been imported into most citrus-growing countries of the world for the purpose of controlling the fluted scale. Another Australian ladybird (*Cryptolaemus montrousieri*) has a similar habit of preying upon mealy bugs (Coccidae), and its introduction into the Hawaiian Islands and California has achieved a remarkable degree of success. The European ground beetle (*Calosoma sycophanta*) has been introduced into North America, where it preys upon the caterpillars of the gypsy moth and brown-tail moth. Several species of the family Histeridae (*Plaesius javanus*, *Pachylister chinensis* and *Oxysternus maximus*) have been used to control the banana-root borer (*Cosmopolites sordidus*), the common housefly and the palm weevil (*Rhynchophorus palmarum*), respectively, in various parts of the world.

A few beetles are of medical importance. Rove beetles of the genus *Paederus* and blister beetles (Meloidae) produce a substance that causes blistering when the insects come in contact with or are crushed on the human skin; in some parts of the world there may be seasonal epidemics of blistering dermatitis concurrent with the season of abundance of these beetles. The drug cantharidin is a blister-producing agent that is obtained from one of the blister beetles, the Spanish fly (*Lytta vesicatoria*). A few scarabaeid beetles, chiefly of the genus *Onthophagus*, gain entrance to and infest the bowels of children in India and Ceylon; the condition, called beetle disease, is not serious. Other beetles serve as the intermediate host of certain parasitic worms (*e.g.*, the tapeworm *Hymenolepis diminuta*) that are ordinarily parasites of rats or other animals, but which occasionally infect man.

Plant diseases may be transmitted by beetles; for example, the cucumber beetles (*Diabrotica vittata* and *D. 12-punctata*) and the Colorado potato beetle have been reported to transmit the viruses of cucurbit mosaic and spindle tuber of potatoes, respectively. *See* also Insect for a general account with some information on beetles.



(ABOVE) FROM S. W. FROST, "INSECT LIFE AND INSECT NATURAL HISTORY," REPRINTED THROUGH PERMISSION BY DOVER PUBLICATIONS, INC.; AND A. D. IMMS, "INSECT NATURAL HISTORY," WILLIAM COLLINS SONS & CO., LTD. (BELOW) FROM O. J. SPRAGUE AND O. W. GELONG, "AN INTRODUCTION TO THE STUDY OF INSECTS"

FIG. 3.—TIGER BEETLE, FAMILY CICINDELIDAE: (ABOVE) LARVA IN BURROW; (BELOW) ADULT

Control.—Control of pestiferous beetles embraces most of the same physical, chemical and biological methods used against many other insects (*see* Entomology: *Principles of Insect Control*).

CLASSIFICATION

About 135 families of beetles are known. Of these more than 120 occur in the western hemisphere and at least 110 in the U.S. and Canada. The American forms of the order Coleoptera may be classified into 3 suborders and 22 superfamilies. Some of the major families are mentioned below in the framework of this classification.

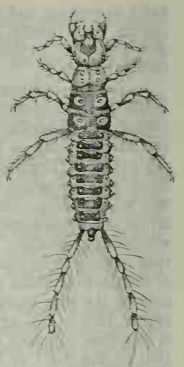
Suborder Archostemata

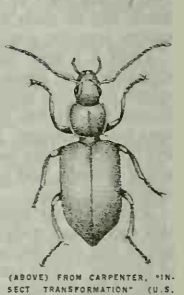
Only one small and rare family, Cupesidae, belongs in this suborder, members of which are believed to be representative of a primitive type of beetle. They occur under bark or in decaying logs and are rarely seen.

Suborder Adephaga

A single group of families forms this suborder, with the Carabidae, or ground beetles, most conspicuous. They are principally distinguished by the structure of the underside of the prothorax and of the first visible abdominal segment; most of the families are easy to recognize from their general form and habits.

The Cicindelidae (fig. 3) are called tiger beetles because of their voracious hunting habits. The larvae live in burrows in the ground, from which they venture to capture their prey with large sickle-shaped mandibles. The adults also have prominent mandibles and are commonly seen flying along sunny paths or sandy banks. They fly very strongly, but usually alight within a few feet. At least 125 kinds are known from North America.





(ABOVE) FROM CARPENTER, "INSECT TRANSFORMATION" (U.S. DEPARTMENT OF AGRICULTURE); (BELOW) FROM SHARP, "FAUNA HAWAIIENSIS," CAMBRIDGE UNIVERSITY PRESS

FIG. 4.—GROUND BEETLE, FAMILY CARABIDAE: (ABOVE) LARVA; (BELOW) ADULT

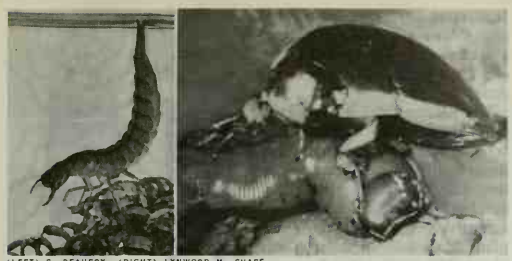
The Carabidae, or ground beetles (fig. 4), form one of the largest families of beetles. They are very common under stones, bark, moss, etc., particularly in damp places. Some of them are among the largest American beetles; they are usually black or inconspicuously coloured. They usually feed on other insects and small worms, and generally are harmless to man and his property. About 25,000 kinds are known, of which more than 2,000 occur in North America. (*See* Ground Beetle.)

The Dytiscidae (fig. 5) is the family of predaceous diving beetles. Their hind legs, with fringes of hairs, are used as oars for swimming. The larvae are aquatic and have large sickle-shaped jaws, with which they prey on other forms of aquatic life such as other insects, tadpoles, small fish and even each other. There are more than 2,000 species, of which nearly 400 live in North America.

Other families in this suborder are the Gyrinidae, or whirligig beetles, which pirouette on the surface of the water; the Haliplidae, or crawling water beetles; the Rhysodidae, or wrinkled bark beetles; the Amphizoidae, which are found only in western North America and Tibet.

Suborder Polyphaga

About 90% of the beetles belong to this suborder. These beetles cannot be distinguished from members of Adephaga by readily visible features but differ in the structure of the prosternum and the first abdominal sternite. The suborder is represented in North America by numerous families grouped into the following 20 superfamilies.



(LEFT) S. BEAUFOY; (RIGHT) LYNWOOD M. CHACE

FIG. 5.—PREDACEOUS DIVING BEETLE, FAMILY DYTISCIDAE: (LEFT) LARVA, HANGING HEAD DOWNWARD, AWAITING PREY; (RIGHT) ADULT FEEDING ON A LEECH

Staphylinoidea.—The Staphylinidae (fig. 6) are often called rove beetles, though the family includes many forms for which this name is inappropriate. This is one of the largest families of beetles and is probably the most difficult of all to describe in general terms. Simple characters that will distinguish it in taxonomic keys have not been found. Among its more than 20,000 species there are carnivores, a few scavengers, pollen feeders, true parasites, physogastric forms that live in termite nests, ant guests that look so much like ants that only an expert can tell them apart and many more. They are found wherever decaying matter occurs, usually preying on other insects present. Most of them have greatly shortened wing covers that leave much of the abdomen exposed. The wings are folded in a complex but characteristic pattern under the elytra when not in use. Many rove beetles are strong fliers, and when they occur in swarms they are often mistaken for gnats.

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FIG. 6.—ADULT ROVE BEETLE, FAMILY STAPHYLINIDAE

The Silphidae include the large carrion beetles and the burying beetles. The latter, usually large, black and red or black and orange beetles, undermine the soil beneath a small dead animal until the carcass is completely buried. Eggs are then laid on the carcass, which the larvae upon hatching use for food.

Here also, among a dozen small families, are the Ptiliidae, which include the smallest beetles—about $\frac{1}{4}$ mm. long (about $\frac{1}{100}$ in.).

Hydrophiloidea.—A single family, the Hydrophilidae, belongs here. These are the water scavenger beetles which may be very large and similar in habits to the Dytiscidae, except that the adults are scavengers. One group in this family lives on land, principally in manure and other decaying vegetable matter. They are small and seldom seen.

Histeroidea.—The family Histeridae includes small beetles that are usually glossy black, hard and compact. They mostly live in dung and decaying matter, where they go to find other insects as prey. The head is deeply sunken into the prothorax, resulting in a very stocky and compact shape. About 3,000 species are known, of which 400 occur in North America.

Scarabaeoidea.—The families Passalidae, or bessbugs, and the Lucanidae, or stag beetles (fig. 7), are principally found in rotting wood. They are conspicuous beetles, approaching two inches in length. The stag beetles may have very long jaws, sometimes branched like the antlers of a stag—hence the common name. The flying adults are often attracted to lights on summer evenings.

The Scarabaeidae includes the scarabs, May or June beetles, chafers (fig. 8), dung beetles, etc. They are mostly compact and hard, but vary in size from one-eighth inch to the heaviest-known insect—an African beetle nearly five inches long (fig. 9). The group is distinguished by the unusual antennae, in which the last three segments are expanded into flat plates that fit together to form a club. Here belong the sacred scarab of ancient Egypt and

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FIG. 7.—STAG BEETLE, FAMILY LUCANIDAE: (LEFT) LARVA; (CENTRE) ADULT MALE, WITH LARGE MANDIBLES; (RIGHT) ADULT FEMALE

the brilliant gold and silver shining leaf chafers (subfamily Rutelinae). This is one of the most popular families with collectors, because of the large size, great variety of colouring and extreme beauty of some forms. The Scarabaeidae includes some beetles that are serious pests, such as the Japanese beetle. More than 15,000 species are known, of which about 1,500 occur in North America. (*See* SCARAB; CHAFER.)

Dascilloidea.—The family Dascillidae are small soft-bodied plant beetles that occur chiefly on plants in moist regions. All four families in this superfamily are uncommon and not usually rated as pests.

Byrrhoidea.—About four small families are placed in this superfamily. They are inconspicuous and not often noticed, being small, convex, black beetles that are usually found under debris or bark.

Dryopoidea.—This small group includes most of the water beetles that are not put in the suborder Adephaga; it includes the families Dryopidae, Elmidae, Limnichidae, Psephenidae, etc. They do not swim but crawl on the bottom and under stones. The larvae of Psephenidae are called water pennies because they are flat and almost circular, adhering to the undersides of stones.

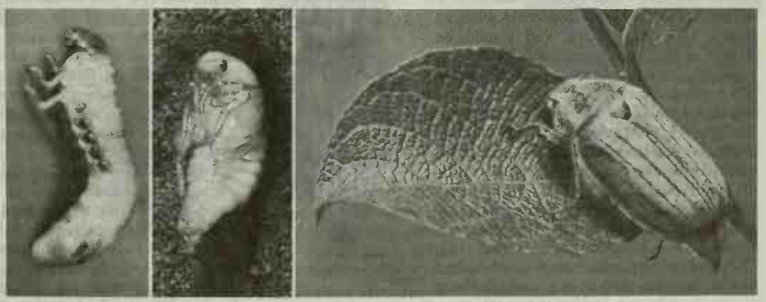

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FIG. 8.—COCKCHAFER, FAMILY SCARABAEIDAE: (LEFT) LARVA; (CENTRE) PUPA; (RIGHT) ADULT

Elateroidea.—The Elateridae is an important family of slender but hard beetles that has many conspicuously coloured and large members in tropical regions. In North America they are usually small or moderate in size, known as click beetles, or snapping beetles (fig. 10). When turned on their backs, they suddenly snap their pronotum and head against the ground, thus bouncing into the air and often falling right side up. The larvae are known as wireworms; they are serious pests, living on roots of beans, potatoes, cotton and corn and other cereals. Almost 600 kinds occur in North America. (*See* WIREWORM.)

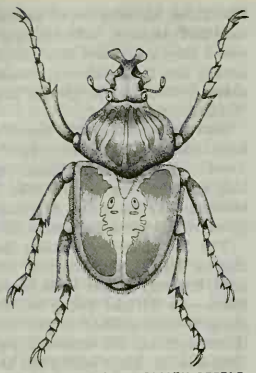

FIG. 9.—AFRICAN GOLIATH BEETLE, FAMILY SCARABAEIDAE, ONE OF THE LARGEST INSECTS

The Buprestidae is a family that includes many of the most beautiful of all beetles. They are called the metallic wood-boring beetles (fig. 11), but it is the larvae that bore. The larvae are often called flat-headed borers to distinguish them from the roundheaded larvae of the long-horned beetles (Cerambycidae). The colour of the adult is usually iridescent or metallic. In the tropics there are kinds about one-eighth inch long and beautiful giant species up to three inches long. They are popular with collectors, are often used in jewelry and for ornament and sometimes are serious pests of trees and shrubs. About 8,000 species are known, of which about 400 occur in North America.

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FIG. 10.—EYED CLICK BEETLE, FAMILY ELATERIDAE

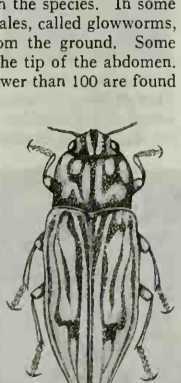
Other families in this group are the Cebrionidae, Cerophytidae, Melasidae, Plastoceridae, Trixagidae and Rhipiceridae, all of which are seldom seen.

Cantharoidea.—The Lampyridae is the family of the fireflies, or lightning bugs (fig. 12). These common beetles are known nearly everywhere for their display of flashing yellow lights on summer evenings. The light is emitted by a special organ at the ventral tip of the abdomen. The beetle can control the flashing, which is normally rhythmic according to a characteristic pattern depending on the species. In some species only the males are winged; the females, called glowworms, look like larvae and give their flashes from the ground. Some other beetles produce light, but not from the tip of the abdomen. About 2,000 species are known, of which fewer than 100 are found in North America. (*See* FIREFLY.)

The Cantharidae, or soldier beetles, have leathery elytra as do the Lampyridae, but do not produce light. They feed mostly on other insects, including pests such as aphids and mealy bugs, and should be classed as primarily beneficial. More than 1,300 species are known, of which nearly 200 occur in North America.

Other families of the Cantharoidea are the Lycidae, or net-winged beetles, looking more like insects of the order Neuroptera than like beetles; the Phengodidae, which may be luminescent in all stages; and the Drilidae, whose larvae feed on snails.

Cleroidea.—The family Cleridae consists of the checkered beetles (fig. 13). They are usually rather small, soft-bodied beetles found in the soil or elsewhere about the nests or burrows of other insects, upon whose eggs and larvae they feed. As some feed upon injurious bark-beetle grubs, they are to be considered as beneficial. About 2,500 species are known; 200 are in North America.

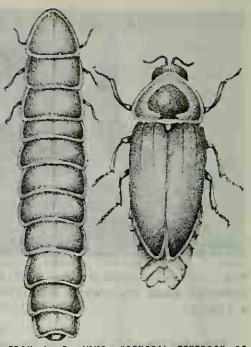


BY COURTESY OF J. N. KNULL, THE OHIO STATE UNIVERSITY STUDIES

FIG. 11.—METALLIC WOOD-BORING BEETLE, FAMILY BUPRESTIDAE

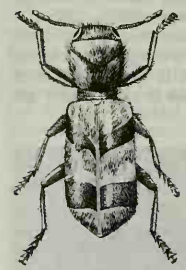
The Dermestidae is a family of pests troublesome in stored materials and in museums and houses. They are small, often less than one-quarter inch long, but both larvae and adults feed extensively on dead animal and plant material. Although only about 550 species are known—150 in North America—they do more than their share of damage.

The Malachiidae, Melyridae and Dasytidae are all called soft-winged flower beetles. They are small, usually brightly coloured, and may show unusual developments of the antennae; some species have saclike orange-coloured structures along the sides of the abdomen. One of the members of the family Ostomatidae attains nearly an inch in length, is bright blue-green, and is common under dead bark; others of the family are pests in granaries.



FROM A. D. IMMS, "GENERAL TEXTBOOK OF ENTOMOLOGY" (METHUEN & CO.)

FIG. 12.—FIREFLY, FAMILY LAMPYRIDAE: (LEFT) WINGLESS, LARVALIKE FEMALE; (RIGHT) MALE



BY COURTESY OF J.H. KNULL AND THE OHIO BIOLOGICAL SURVEY

FIG. 13.—CHECKERED BEETLE, FAMILY CLERIDAE

Bostrychoidea.—The Ptinidae, or spider beetles (fig. 14), are very small, but can do great damage in stored food, in museums and in old wooden buildings. The Anobiidae, called deathwatch or drugstore beetles, are also small. They live in many vegetable materials including stored food, drugs and tobacco. Some Anobiidae larvae that burrow in dry wood of furniture, house beams, etc., make a faint ticking sound superstitiously thought to presage a person's death. (*See* DEATHWATCH.)

The Bostrychidae and Lyctidae are the powder-post beetles, so called because they bore into dry wood and leave powdery droppings. They may completely destroy large timbers and leave it perforated as if it had been riddled by fine shot. One western U.S. species is unique in its habit of boring into lead cables, causing moisture to short-circuit the wires; it is therefore known as the lead-cable borer or short-circuit beetle.

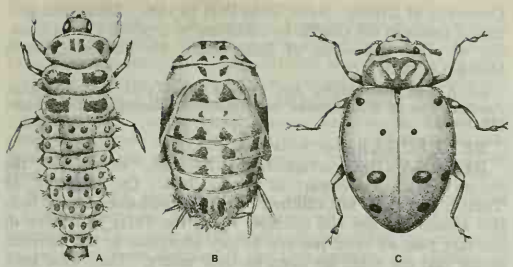
Lymexylonoidea.—This group includes the small families Lymexylonidae, or timber borers; the Micromalthidae, which have an unusual life cycle that includes reproduction by the larval stages; and the rare Telegeusidae, which resemble small rove beetles.

Nitiduloidea.—The Nitidulidae, or sap beetles, are usually small and oval and sometimes have the elytra abbreviated so as to expose the tip of the abdomen. They are common around decaying fruits, sap and fungi, and some are found on dead and dried animals, in flowers or under loose bark. Some of them are very similar in appearance to some rove beetles. About 2,500 species are known, of which 150 occur in North America.

BY COURTESY OF U.S. DEPARTMENT OF AGRICULTURE

FIG. 14.—SPIDER BEETLE, FAMILY PTINIDAE

Cucujoidea.—The Cucujidae, or flat bark beetles, usually feed on mites and small insects, but a few feed on stored grain. They are extremely flat and often are reddish, brownish or yellowish in colour. The bark-dwelling species may be one-half inch long, but the stored grain feeders are usually less than one-quarter inch long. There are known only about 1,000 species, with 100 in North America.



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BY COURTESY OF U.S. DEPARTMENT OF AGRICULTURE

FIG. 15.—LADYBIRD BEETLE, FAMILY COCCINELLIDAE: (A) LARVA; (B) PUPA; (C) ADULT

The Anthicidae are called antlike flower beetles. They are usually less than one-quarter inch long and are clearly divided into three body regions as are ants. In *Notoxus* the pronotum is prolonged forward in a sort of horn, with the head hanging down at an unusual angle.

Other families in this group are the Languriidae, or lizard beetles; Cryptophagidae, or silken fungus beetles; Phalacridae, or shining flower beetles; Orthoperidae, or fringe-winged fungus beetles; Lathridiidae, or minute brown scavenger beetles; Biphyllidae; and Byturidae.

Coccinelloidea.—The Coccinellidae comprise the lady beetles, often called ladybird beetles or ladybugs. They are usually almost hemispherical beetles, often yellow or orange and marked with black. Lady beetles are very common and by some are thought to be good-luck omens. The larvae are elongated and soft-bodied, often seen crawling on walks and buildings as well as on plants. They live mostly on other soft-bodied insects, such as aphids, and thus are beneficial. A few are plant feeders that become serious pests, such as the Mexican bean beetle. About 3,000 species are known, of which about 400 occur in North America. (*See* LADYBIRD.)

The Erotylidae, or pleasing fungus beetles, are small and rarely seen in North America, but in the tropics they attain a large size (about one inch), and are brightly coloured and very conspicuous, with the elytra tremendously arched over the back, enclosing a large air space. More than 2,500 species are known, with fewer than 100 in North America.

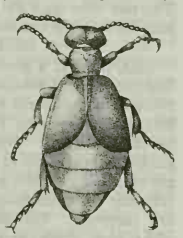
The Endomychidae, or handsome fungus beetles, are similar in many respects to the Coccinellidae and comprise about 1,140 species.

Colydioidea.—This group includes such little-known families as the Mycetophagidae, or hairy fungus beetles; Colydiidae, or cylindrical predaceous bark beetles; Discolomidae; Murmidiidae; and Bothrideridae. All of these species are inconspicuous forms unlikely to be encountered by anyone but an entomologist.

Mordelloidea.—The Mordellidae are called tumbling flower beetles because of their reactions when disturbed. They are mostly small forms with a silky appearance and a body tapering to a point beyond the elytra; their shape is distinctive, and the family is easily recognized. It is the only family in this superfamily and consists of about 800 species.

Meloöidea.—Here occur some of the most unusual of any beetles. Some kinds have a complicated life history called hypermetamorphosis, in which the last larval stage differs in form from the earlier stages. Some members are parasitic inside other insects, and some have females that are wingless and look like larvae.

The family Meloïdae includes the blister beetles and the oil beetles (fig. 16). Blister beetles, often about one-half inch long, are soft-bodied with leathery wings. When these beetles are crushed on human skin, a chemical called cantharidin, contained in their body fluid, produces large blisters.



AFTER A. O. IMMS, "INSECT NATURAL HISTORY," WILLIAM COLLINS SONS & CO., LTD.

FIG. 16.—OIL BEETLE, FAMILY MELOIDAE

Oil beetles are usually larger and very full-bodied, with the short elytra somewhat overlapping at their origin. The name oil beetle comes from the oily exudation emitted from the joints of the legs when the beetles are disturbed. More than 2,000 species are known, including 200 from North America.

The Rhipiphoridae is a small family, also remarkable in having larvae that are parasites in insects, such as wasps and cockroaches. The elytra are reduced, and hypermetamorphosis occurs. These beetles are very similar in many ways to the order of insects known as Strepsiptera, or twisted-winged insects. This resemblance and other evidence indicates that the strepsipterans should be regarded as a family, Stylopidae, in the Meloöidea.

Tenebrionoidea.—The Tenebrionidae are called darkling ground beetles. This is a large and varied family with 10,000 known species, 1,400 in North America. They are mostly black or brown, seldom colourful, and range from one-quarter inch or less to nearly two inches. Some have the elytra completely fused down the middle. They are mostly scavengers of plant material and thus may be pests in stored grains and vegetables. But the noxious species are few, and the rest are substantially harmless.

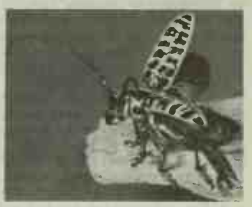
ALEXANDER B. KLOTS

FIG. 17.—DARKLING GROUND BEETLE, FAMILY TENEBRIONIDAE, ASSUMING A POSTURE OF DEFENSE

The many other smaller families in the Tenebrionoidea include the Oedemeridae, Cephaloidae, Pedilidae, Scalidiidae, Pyrochroidae, Pythidae, Othniidae, Serropalpidae, Scraptiidae, Lagriidae, Nilionidae, Monommidae, Cisidae and Alleculidae.

Phytophagoidea.—This is by far the largest superfamily, containing also the three most important groups of pest beetles. Practically all the species, both as larvae and adults, feed on plants or plant material, many of them on crop plants.

The family Cerambycidae comprises the long-horned wood borers (fig. 18), whose larva are called roundheaded borers. Some of the most striking and beautiful beetles, as well as the longest over-all, are included in this family. They usually have long antennae (or feelers), rather long legs and a hard, slender body; many of them are good fliers. Most are flower feeders as adults and some do not feed at all; the larvae, however, bore in wood, damaging the timber and girdling the branches, and feed on roots, cones, etc. At least 20,000 species are known, of which 1,200 occur in North America.



JOHN N. GERARD

FIG. 18.—COTTONWOOD BORER, FAMILY CERAMBYCIDAE, WITH ELYTRA RAISED PREPARATORY TO FLIGHT

The Chrysomelidae are the leaf beetles. They are usually less than one-half inch long, are variously shaped and frequently brightly coloured or spotted. The adults are good fliers that feed principally on flowers and leaves; the larvae may feed on foliage, making tunnels in the leaves (miners), may feed on roots, or may bore in stems. Nearly all are classed as pests, many serious ones. Among the 24,000 species, with 1,000 in North America, are the tortoise beetles, flea beetles and many kinds of leaf beetles.

The Bruchidae or Mylabridae are the bean and pea weevils. They are small and inconspicuous, but do much damage to growing peas or stored peas and beans. The larvae bore in seeds and leave conspicuous holes. After emerging from peas or beans stored indoors, the beetles are often seen at windows in an attempt to escape.

The family Curculionidae is by far the largest family of all animals. It includes about 50,000 species, with nearly 2,000 in

North America. These are the true weevils, or snout beetles, in which the head is prolonged into a snout that may be as slender as a needle and longer than the entire body. The true weevils range in length from less than one-eighth inch to over two inches. Both adults and larvae feed in or on plants; they attack roots, leaves, fruits and seeds. Common species feed on roses and other flowers, on sweet potatoes, cotton bolls, plums and other fruit and on stored grain and many other common plants and plant products. (*See* WEEVIL.)

BY COURTESY OF U.S. DEPARTMENT OF AGRICULTURE

FIG. 19.—CLOVER LEAF WEEVIL, FAMILY CURCULIONIDAE

The Scolytidae are the bark beetles, which include shot-hole borers, engraver beetles and timber beetles. These are small cylindrical beetles, usually brown or black, that mine beneath the bark of trees. Trees are frequently killed by the beetles' burrowing in the cambium layer of the bark. The smaller European bark beetle (fig. 20) (*Scolytus multistriatus*) has been one of the chief carriers of Dutch elm disease (*see* ELM: *Dutch Elm Disease*).

BY COURTESY OF KASTON AND THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

FIG. 20.—SMALLER EUROPEAN ELM BARK BEETLE, FAMILY SCOLYTIDAE, CHIEF VECTOR OF DUTCH ELM DISEASE

Other families in this group are the Anthribidae, or fungus weevils; Brentidae, which are sometimes so elongate that a two-inch beetle may be less than one-eighth inch in diameter; and Platypodidae, or flat-footed ambrosia beetles which bore into wood and cultivate fungus in their tunnels for food for their larvae.

See also Index references under "Beetle" in the Index volume.

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Special: W. S. Blatchley and C. W. Leng, *Rhynchophora or Weevils of Northeastern America* (1916); W. J. Chamberlin, *The Bark and Timber Beetles of North America North of Mexico* (1939); J. C. Bradley, *Manual of the Genera of Beetles of America North of Mexico* (1930); J. G. Edwards, *Coleoptera or Beetles, East of the Great Plains* (1949), *A Bibliographical Supplement* (1950).

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BEETS, NICOLAAS (1814–1903), Dutch pastor and writer, whose *Camera Obscura* is a classic of Dutch literature, was born at Haarlem, Sept. 13, 1814. As a student at Leiden, he was influenced by reading Byron and was one of the first to write romantic poetry, avoiding the hackneyed poetic vocabulary and imagery of the classical school. His poetry—*José* (1834), *Kuser* (1835) and *Guy de Vlaming* (1837)—played a part in the controversy between the classicists and the romantics. While still at Leiden, he also wrote the sketches, tales and essays collected as *Camera Obscura* (edited under the pseudonym Hildebrand, 1839; 3rd definitive ed. 1851). These continued the Dutch tradition of painting domestic scenes in a realistic manner, but combined with it the whimsical humour he had learned from reading Sterne, Lamb and Dickens.

Beets was ordained in 1839 and held pastorates at Heemstede (1840–53) and Utrecht (1854–74). He was professor at the State University of Utrecht, Neth., from 1874 to 1884. During his successful career in the church, he continued to produce a great quantity of prose and verse, of little value. He died at Utrecht, March 13, 1903.

See A. van Duinkerken, *Het Tweede Plan* (1945); K. Heeroma, *Jaarboek van de Maatschappij der Nederlandse Letterkunde te Leiden* (1947–49). (J. C. B. C.)

BEET SUGAR: *see* SUGAR and BEET.

BEFANA (Ital., corrupted from *Epifania*, "Epiphany"), the Italian female counterpart of Santa Claus. On Epiphany, or Twelfth Night, she fills children's stockings with presents. Tradition relates that she was too busy to see the Three Wise Men of the east pass on their journey to pay adoration to the Saviour, saying that she could see them on their return. They went back another way, and Befana was punished by having to look for them forever. The sacred or secular song traditionally sung on her visit is the Befanata.

BEGAS, REINHOLD (1831–1911), German sculptor who dominated Prussian sculpture from 1870 onward, was the younger son of Karl Begas, the painter; he was born at Berlin on July 15, 1831, and died there on Aug. 3, 1911. He received his early education (1846–51) in the ateliers of C. D. Rauch and L. Wichmann. During a period of study in Italy, from 1856 to 1858, he was strongly influenced by the study of Michelangelo and by his admiration for the art of the baroque period. After the execution of the group "Borussia," for the façade of the exchange in Berlin, he was, for a few months in 1861, professor at the art school at Weimar. The statue of Schiller for the Gendarmen Markt in Berlin was his work. Among his chief works during this period were the colossal statue of Borussia for the Hall of Glory; the Neptune fountain in bronze on the Schlossplatz; the statue of Alexander von Humboldt, all in Berlin; the sarcophagus of the Emperor Frederick III in the mausoleum of the Friedenskirche at Potsdam; the national monument to the Emperor William; the statue of Bismarck before the *Reichstag* building and several of the statues in the Siegesallee. Begas was a versatile artist.

Although his preference was for mythological and decorative subjects, of which his "Mercury and Psyche" (1874) is a good example, he was the most famous German sculptor of his time in portraiture, and executed busts of many of his great contemporaries.

BEGGAR-MY-NEIGHBOUR, a card game, the outcome of which is wholly determined by the luck of the deal. An ordinary pack is divided equally between two players, and each holds his packet face down. Cards are turned up alternately from the top of the packets and placed in a single pile on the table, until an ace, king, queen or knave appears. The opponent must cover such a card with four plain cards for an ace, three for a king, two for a queen, one for a knave. If in so doing he turns an ace, king, queen or knave himself, he stops, and the obligation is reversed.

Whenever the full quota of plain cards is played to such a card, the player of the card takes all the cards from the table and places them underneath his packet, then makes a new lead. The one who gets all the cards into his hand is the winner. (A. H. MD.)

JOHN H. GERARD

CARMEN BEGONIA, HORTICULTURAL VARIETY OF BEGONIA GRACILIS

BEGONIA, a genus (family Begoniaceae) of succulent herbs, vines or undershrubs with about 800 species growing in tropical moist climates. Innumerable garden hybrids and varieties are grown chiefly in the greenhouse for their coloured foliage; many are tuberous. The flowers are white, rose, scarlet or yellow and are unisexual, the male containing numerous stamens, the female having a large inferior ovary and

two to four branched or twisted stigmas.

The rex begonia and *B. cucullata* (*semperflorens*) are the commonest in cultivation and are usually raised from stem cuttings. Others are propagated by leaf cuttings, tuber cuttings or seed. Hybridizing by the usual methods is easy because of the large size of the flowers and the interfertility of many species.

For information on cultivated begonias *see* Helen K. Krauss, *Begonias for American Homes and Gardens* (1947). The *Begonian*, published monthly by the American Begonia Society, is useful to all growers. (L. B. Sm.)

BEGUINES, pious women who, although not under vow, lived a kind of communal life in *béguinages* where each had her own apartment. The origin of the word is disputed, but the movement started in southern Belgium in the 12th century. In addition to religious factors, the surplus of marriageable girls and widows in the upper classes, caused by the crusades, led to the establishment of this mode of life, which, although found principally in the Low Countries, spread to France, Germany and elsewhere in Europe. A revival took place in 17th-century Belgium, and some Beguines remain in Belgium and the Netherlands.

The male counterparts of the Beguines were called Beghards. They were often considered to be heretics or to have heretical leanings.

See E. W. McDonnell, *The Beguines and Beghards in Medieval Culture* (1954). (E. A. R.)

BEHAGHEL, OTTO (1854–1936), German linguist, whose major works were his studies of the German language, was born on May 3, 1854, at Karlsruhe. He was educated at the Gymnasium there and at Heidelberg and Göttingen universities; later he was professor successively at Heidelberg, Basel and Giessen universities. Behaghel was editor of the journal *Germania* and co-editor of the *Literaturblatt für germanische und romanische Philologie*. His *Die deutsche Sprache* (1886; 9th ed. 1953) and *Geschichte der deutschen Sprache* (1901; 5th ed., 1928) are standard treatises; his *Deutsche Syntax* (4 vol., 1923, 1924, 1928, 1932) is a massive compilation and classification of examples of German linguistic usage from the 8th century to the present. He died on Oct. 9, 1936, at Munich.

Bibliographies of Behaghel's work appear in two volumes published in his honour: *Beiträge zur germanischen Sprachwissenschaft*, edited by Wilhelm Horn (1924) and *Germanische Philologie*, edited by Goetze, Horn and Maurer (1934). (My. F.)

BEHAIM (Behem), **MARTIN** (1436?–1507), German navigator and geographer, best known as the constructor of the Nürnberg globe, was born at Nürnberg, according to one tradition, about 1436, but as late as 1459 according to F. W. Ghillany. He first visited Portugal in connection with the Flemish trade and gained some reputation as a scientist on his claim to have been a pupil of the astronomer Regiomontanus. He became a member of the council which advised John II on navigation. His alleged introduction of the cross-staff into Portugal is a matter of controversy, and his improvements of the astrolabe were possibly no more than the replacement of cumbersome wooden models by handy brass instruments. His claim to have accompanied Diogo Cam (*q.v.*) on his second expedition to west Africa is now considered groundless; it is thought that he sailed only to the nearer coasts of Guinea, possibly with José Visinho or João Affonso d'Aveiro (1484–86).

In 1486 Behaim married a daughter of Jobst van Huerter, the captain donatory of Fayal in the Azores, and thereafter resided there. In 1490 Behaim visited Nürnberg and, with the help of the painter B. Glockenthon, constructed a terrestrial globe, the earliest extant. Behaim's representation of the world was surprisingly out of date, the more particularly in view of his Portuguese connections. His delineation leans heavily upon the Ptolemaic tradition. He does not show accurately the Portuguese discoveries, and his outline of west Africa is amazingly incorrect. Many fabulous islands are depicted in the Atlantic ocean. Finished in 1492, Behaim's globe has been cited as representing the geographical ideas of Columbus—it shows the east Asian coast only 80° distant from the Azores—but no contact between the two men has been established although they were in Portugal at the same time. It is generally agreed that Behaim took no part in the Portuguese unveiling of the new world. He died at Lisbon on Aug. 8, 1507.

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BEHAM, HANS SEBALD (1500–1550), German engraver and painter, was the most prolific of the so-called Little Masters of engraving, a group which also included his younger brother, Barthel Beham (1502–1540), and Georg Pencz (*c.* 1500–1550). All three artists, noted for their brilliant work on extremely small copper plates, grew up in Nürnberg under the influence of Albrecht Dürer's late classical style. It is likely, but not certain, that they worked in Dürer's studio. In 1525 the trio was banned from that city for independent religious views, but not for long. Later, Beham moved to Frankfurt am Main. His 252 engravings include biblical and mythological subjects, allegories, genre scenes and ornaments. Of particular charm are the genre scenes, such as the set entitled "Peasant Festival" (1537). Some of his woodcuts were of very large sizes, intended as wall decorations.

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BEHAVIOUR may be defined as the externally apparent activity of a whole organism. Its essential characteristic is movement, which is found in most animals and some plants, and it is the result of external and internal changes called stimuli.

Behaviour may be classified in many ways, each independent of the rest. It may be organized into complex patterns either by the biological process of hereditary or by the psychological process of learning or both. The extreme cases are called innate (or instinctive) behaviour and learned (or conditioned) behaviour, respectively; but most behaviour is affected by both types of organization.

Behaviour is closely related to function. There are four primitive kinds of behaviour having obvious adaptive results: ingestive behaviour, including eating and drinking; shelter seeking; sexual behaviour; and investigatory or exploratory behaviour. In addition to these, certain types of behaviour are found chiefly in the more complex animals, including man: agonistic behaviour, including fighting and escape behaviour; allelomimetic behaviour or mutual imitation, including the co-ordinated movements of flocks and herds; care giving or epimeletic behaviour; and care soliciting or et-epimeletic behaviour. Eliminative behaviour, concerned with disposal of bodily wastes, has importance in some animals.

Behaviour may be described as social or nonsocial depending on whether its function is related to other members of the same species. Social behaviour in turn may be described according to the individual performing the activity, as in maternal behaviour, infantile behaviour, etc. Behaviour is playful if it has no apparent function other than activity itself, and this is characteristic of the young of social mammals. Behaviour is called normal or abnormal according to the degree of adaptation produced. Most authorities agree that there is continuous variation between normal and abnormal behaviour.

Behaviour may be classified according to the kind of stimulus which elicits it, in which case the behaviour may be called a tropism (*q.v.*) or taxis. For example, a moth which flies toward the light exhibits a positive phototropism or phototaxis. It is also described in terms of the motor organs used, as in manipulative behaviour, prehension, mastication, etc. Behaviour varies according to the parts of the central nervous system which control it, the simplest sort being reflex behaviour, characterized by simple and relatively invariable reactions. Certain forms of more complex behaviour may be called voluntary or conscious, as opposed to involuntary or unconscious behaviour. Both voluntary and involuntary behaviour are affected by learning.

In general, behaviour is always partly determined by heredity, in the sense that each species has its characteristic types of behaviour. It tends to be adaptive and, correlated with this, tends to be variable. Finally, it is always affected by internal as well as external causes.

The principal practical problem of behaviour is control. The methods used have wide applications in human behaviour, in the management of domestic and game animals and in the control of pests. In most human societies sexual and fighting behaviour are highly regulated by law and custom. Failure of these methods produces the serious problems of divorce, prostitution, juvenile delinquency and crime; too severe control may also produce various forms of maladaptive behaviour and mental illness. Groups as well as individuals may create behaviour problems: group persecution and war, for example.

Basic research on these problems seeks to find the causes of behaviour: heredity, physiological causes such as hormones, the psychological factors of stimulation and learning, social environment and social organization and, finally, the general physical and biological environment. The applications of this research are chiefly directed toward the alteration of individual behaviour by training, drugs and surgery. Selective breeding is useful only in domestic animals.

The solution of behaviour problems through alteration of the social, biological and physical environment is equally fundamental, and such methods are beginning to be developed.

In short, control measures must permit flexibility and freedom of action, lest they create more problems than they solve, and positive methods are more effective than negative ones. Behaviour is a complex phenomenon with many causes, and its problems therefore have many alternative solutions. *See* ANIMAL BEHAVIOUR; CHILD PSYCHOLOGY AND DEVELOPMENT; PSYCHOLOGY; PSYCHOLOGY, COMPARATIVE; *see* also Index references under "Behaviour" in the Index volume.

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(J. P. Sc.)

BEHAVIOUR DISORDERS. The variety of terms used for this category of neurotic disorder—psychopathic personality, impulse-ridden personality, moral insanity, fate neurosis and neurotic character—indicates that until comparatively recently it was not a clearly defined or understood group. Some psychiatrists considered it as a kind of wastebasket collection of patients who did not fit into well-defined disease entities. The advancement of psychodynamic understanding, however, made a clearer definition of these patients possible.

Diagnosis.—Patients with behaviour disorders are distinguished from other neurotic sufferers by the fact that they express their unadjusted and unacceptable emotional tensions not by circumscribed neurotic symptoms but by their behaviour in relation to other people (interpersonal relationships). Unlike patients who suffer from neurotic symptoms, they act out their neurotic impulses. They are not satisfied with gratifying these impulses symbolically in fantasy; they are actors on the stage of life, and their disturbed behaviour affects those with whom they come in contact. Patients suffering from a compulsion neurosis, for example, express their hostile unacceptable impulses either by isolated fantasies or by compulsions to touch certain objects or to avoid touching them. Patients who are called neurotic characters express unacceptable hostile impulses by destructive acts that have practical consequences. The neurotic person fights out the conflicts caused by unacceptable impulses in his fantasy and by apparently meaningless peculiarities of routine performances (washing his hands excessively, etc.) that have no significance for anyone other than the neurotic sufferer himself. Patients with behaviour disorders have dramatic life histories; their mode of expression is action. Like all neurotic personalities, these patients, more than healthy persons, are influenced by unconscious tendencies that their conscious personalities cannot accept.

All this may be stated simply: the real neurotic is a rather inhibited person, while the neurotic character is the opposite; he is a man of action. The first distinction, accordingly, is between symptom neuroses and behaviour disorders.

The latter group includes a great variety of personalities, among which three large subgroups may be distinguished: the neurotic offenders, the eccentrics and the persons who again and again become involved in similar conflicting interpersonal situations and therefore may be described as suffering from a fate neurosis. Examples of the last subgroup are people who repeatedly embark on unsuccessful marriages ending with the same type of incompatibilities; who make and break friendships in the same repetitive manner; who repeat failures in their professional careers in a remarkably stereotyped fashion. Sigmund Freud first described, in a most impressive way, those patients who because of their deep-seated guilt feelings can never allow themselves to succeed in anything, who cannot tolerate success and who either destroy their achievements by unconsciously intended errors or react to success with severe depression.

On first inspection this group appears to consist of an extremely heterogeneous array of people. In spite of this great variety, however, certain common psychodynamic features are typical for them. Their neurotic acting out is characterized by three major features: irrationality, stereotyped repetition of behaviour patterns and self-destructiveness. The irrationality of behaviour is the result of the prominence of unconscious motivations. The stereotyped repetition of behaviour patterns, or symptomatic behaviour, also is explained from the same cause, since unconscious motivations cannot be corrected by conscious adaptations. These stereotyped irrational behaviour patterns are equivalent to neurotic symptoms; neither neurotic symptoms nor such unconsciously determined behaviour can be changed at the sufferer's choosing.

The third characteristic, self-destructiveness, is the result of unconscious guilt feelings, which were for a long time overlooked. Psychopathic personalities in earlier days were characterized by lack of conscience, of moral feelings; hence the old expression "moral insanity." Freud was the first to understand the significance of guilt feelings in neurotic delinquents; he spoke of crimes committed from a sense of guilt. These persons have deep-seated guilt feelings, usually derived from the Oedipus complex and emanating mostly from unconscious fantasies of early childhood, and they try to rid themselves of the pangs of conscience by displacing the source of their unconscious guilt feelings to some tangible conventional offense. By stealing or swindling they perpetrate a forbidden act that is much less objectionable than those forbidden impulses harboured in the unconscious. Punishment for such persons represents atonement for a smaller crime than the one about which they unconsciously imagine.

Because these psychodynamic processes, which have been described as "bribing one's conscience," were not understood, these offenders appeared incorrigible. They remain incorrigible, however, only as long as society conforms to their neurotic pattern by relieving their unconscious guilt feelings through punishment. Punishment atones for their crime, and by provoking punishment they relieve their guilt and can freely commit new offenses. This game of crime and punishment is endless. Only psychiatric therapy can break the pattern. Such people are emotionally sick and like other neurotics must be treated by psychotherapy. Because the nature of their neuroticism endangers society, they should be incarcerated until they are cured. Paroling them after they serve a part of their punishment, or letting them return to society after they have fully served their punishment but remain essentially unrelieved from their neurotic conflicts, necessarily leads to recidivism.

Only for practical reasons should these neurotic offenders be classified separately from those suffering from behaviour disorders that do not result in antisocial behaviour. A more harmless group, the eccentrics, also act on unconscious, mostly unacceptable, motivations that they express by pursuing seemingly senseless or exaggerated predilections. In this group belong some passionate collectors who will bankrupt themselves to obtain rare pieces for their collection; gamblers; and daredevils—climbers of exceptionally dangerous mountain peaks, adventurous explorers and hunters, racing car addicts and so on. Some of these persons may obtain fame by their bravado and stunning performances, in which, however, they always risk their physical or financial security.

Neurotic characters, because of their dramatic life histories, are favoured subjects of poets and novelists. Dostoevski's Dimitri Karamazov and Raskolnikov are classical examples of "fate neurosis" and of the neurotic offenders, while Balzac's Uncle Pons is

the masterful portrayal of an eccentric.

The influence of guilty conscience is clearly present in all three types. Deep scrutiny of the motivation of the neurotic offender always reveals the hidden desire to be caught and punished. His unconscious wish for atonement makes the neurotic offender overlook details that lead to his apprehension. It is not unusual for them to give themselves up and confess their deeds to obtain relief from the pangs of conscience.

Self-destructiveness in eccentrics manifests itself in their constant endangering of their lives or financial security. They play with danger and can satisfy their grandiose, fundamentally asocial, self-seeking tendencies only if they pay the price by constantly exposing themselves to potential destruction. This is most clearly seen in the gambler who cannot leave the gambling table as long as money is left in his pocket. Only recognition of this unconscious tendency as resulting from guilty conscience can explain the self-destructive and irrational nature of such behaviour. In fate neuroses the self-destructiveness is responsible for the stereotyped vicissitudes of life.

It is important to realize that as in all classifications the pure types are rare. Most persons with behaviour disorders also show some neurotic symptoms, although the behaviour disorder is more pronounced. And similarly, some persons who suffer from neurotic symptoms may also show irrational, unconsciously determined, behaviour in their important interpersonal relationships. In spite of this qualification, the three groups of behaviour disorders are easily distinguished by their emphasis on action, in contrast to the symbolic gratification in fantasy of neurotics suffering from well-defined psychopathological symptoms.

Treatment.—The treatment of behaviour disorders is, from a practical point of view, a most important chapter of psychiatry. The principal approach is psychotherapy, which may be combined with vocational rehabilitation, occupational treatment and re-education.

The neurotic offenders, in particular, confront society with a perplexing problem. From the point of view of psychiatry they belong to the large group of mentally disturbed persons, as do neurotics and psychotics. The neurotic offenders, however, because they endanger the security of society, belong also to the field of jurisprudence. They constitute a joint responsibility of these two disciplines. After the 1930s there was a growing trend toward recognizing the need for psychiatric evaluation and treatment of these cases. Penal codes all over the world were still based on pre-Freudian psychology, which did not know of the existence of unconscious motivations. In the United States, until comparatively recently, the McNaghten rules, formulated as a result of the murder trial of Daniel McNaghten in England in 1843 (*see* INSANITY: *McNaghten Rules*), were followed in all states except New Hampshire. These rules permit the plea of insanity only if a person cannot distinguish between right and wrong. For the large group of neurotic offenders this rule is meaningless. Their intellectual judgment might be completely unimpaired, but their conscious mind has no access to unconscious motivations and has no rule over them in spite of being fully capable of distinguishing between right and wrong. The neurotic offender is a victim of his irrational unconscious impulses, and he cannot apply his value judgment to guide his behaviour.

In 1954 the McNaghten rules were superseded in the District of Columbia when Judge David Bazelon in the U.S. court of appeals of the District of Columbia in the case of *Durham* v. *U.S.* applied the ruling of New Hampshire, which was first applied in that state as early as 1807. Judge Bazelon stated that he considered the McNaghten rules obsolete in view of the modern advancements of dynamic psychology. The Durham ruling states that if a defendant's act is a product of a mental disease he is not guilty. Accordingly, his treatment belongs to the field of medicine.

It must be borne in mind, however, that even though the neurotic offender may be not guilty from the point of view of law he still constitutes a great menace to society. Consequently, during his psychiatric treatment society must be protected from his delinquent activities. In practice this implies a more severe treatment than the present legal procedure. It implies that the segregation (incarceration) of such a person should be indeterminate and should depend upon psychiatric recovery. It must be borne in mind also that there are a considerable number of incurable cases who after serving their penalty and returning to society constitute the same menace as they did before incarceration. The subjective sense of justice of the people might be satisfied by the fact that the criminal served his punishment, but the most important goal, the protection of society, is achieved only by an indeterminate sentence. The incurable neurotic or psychiatric delinquent whose disease endangers society must remain segregated forever. Incurable, of course, means only a prediction of probability, the correctness of which must be checked again and again by repeated examination of the imprisoned, mentally disturbed delinquent. It is obvious that the neurotic delinquent can be treated effectively by psychotherapy only if during treatment both he and society are protected by compulsory segregation from the consequences of his "acting out." However, patients suffering from behaviour disorders that are not antisocial often require hospitalization during the first phase of their psychotherapy because they are unable to control their symptomatic behaviour, which frequently endangers their own existence. After they have developed a strong rapport with their therapist this emotional bond in most cases suffices to curb their acting out in life while they are in treatment. After successful termination of the treatment this emotional bond to the therapist is no longer needed, and they acquire the capacity to find socially accepted outlets for their now sufficiently domesticated drives.

Etiology.—Most psychiatrists believe that in principle all behaviour disorders originate as psychoneuroses characterized by well-defined neurotic symptoms; early experiences in the family situation are of outstanding significance. This raises, however, a fundamental question: what are the specific factors that cause one person to develop a behaviour disorder and another person neurotic symptoms?

The social condition of the family has been considered an important factor, particularly in the causation of delinquent behaviour. In underprivileged groups there is a greater tendency for the family's social condition to cause unadjusted asocial impulses on the realistic level of action. Economic needs both reinforce antisocial trends and serve as their subjective justification. Also, a person living in a delinquent environment will readily identify himself with the attitudes prevailing in this group. All this, of course, will lead to a behaviour disorder only if the person who is exposed to these environmental influences is an acting out type. Otherwise he may just as well develop neurotic symptoms under the impact of the same experiences and environmental influences.

Is there a characterological "acting out" type of personality? This question has not been answered satisfactorily. A. M. Johnson's and S. A. Szurek's observations would indicate that some parents unwittingly impart to their children their own repressed unconscious delinquent tendencies and encourage their "acting out." Sheldon and Eleanor Glueck, on the other hand, by the statistical approach found several indications for a basic constitutional factor that expresses itself not only psychologically but also in certain features of physical build (mesomorphic or athletic types).

In the 19th century, particularly under the influence of Cesare Lombroso, inherited constitution was primarily emphasized. The advent of psychoanalysis and dynamic psychiatry called attention to environmental factors, and heredity went into oblivion. The controversy of environment versus heredity is based on the fallacy of expecting an "either/or" type of answer. Constitutional factors transmitted by the genes represent a universal factor that partially, at least, determines the effect of later environmental influences. Behaviour disturbances, like neuroses and psychoses, are the results of both hereditary and environmental factors.

See PSYCHOLOGY, ABNORMAL: *Abnormalities of Behaviour;* PSYCHOTHERAPY.

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BEHAVIOURISM is a conception of psychology, first systematically stated by John B. Watson (*q.v.*) in 1913, which holds its subject matter to be the objectively observable actions of organisms. The organism is seen as "responding" to conditions (stimuli) set by the outer environment and inner biological processes. Traditionally, psychology had been conceived as the science of consciousness, experience or mind, and while bodily activities had not been excluded, their paramount interest was considered to lie in their relations to mental phenomena. The characteristic method of psychology was thus introspection. Behaviourism, in the words of Watson, "attempted to make a fresh, clean start in psychology, breaking both with current theories and with traditional concepts and terminology" (John B. Watson, *Psychology From the Standpoint of a Behaviorist,* 3rd ed., p. 4, Lippincott, 1929). Introspection was to be discarded; only such observations were to be considered admissible as could be made by independent observers upon the same object or event—exactly as in physics or chemistry. In this way psychology was to become "a purely objective, experimental branch of natural science." However abstract these proposals may seem, they have had a revolutionary influence on modern psychology and social science and on man's conception of himself.

Watson's objectivist leanings were presaged by many developments in the history of thought and were in fact symptomatic of strong trends that had been emerging in biology and psychology since the late 19th century. But his desire to "bury subjective subject matter" was registered so persuasively as to enlist widespread co-operation. Between the early 1920s and mid-century, behaviourism in the methodic sense dominated U.S. psychology and had wide international repercussions. Though the chief alternatives to behaviourism (*e.g.,* Gestalt psychology and psychoanalysis; *q.v.*) promulgated methods which use experiential data, even these positions accommodated to the objectivist emphasis by a steadily increasing stress on the need for objective validation of experientially based hypotheses.

Behaviourism, however, is not merely a methodic platform or a general redefinition of the task of psychology. It is also the name for a varied class of programs, hypotheses and theories put forward by different persons in attempted fulfillment of such a task. Both as a method and as a conglomeration of hypotheses and theories, behaviourism led to much experimentation and a vast mass of results.

The period 1912–30 (roughly) may be called that of classical behaviourism. Watson was then the dominant figure, but many others were soon at work giving their own systematic twists to the development of the program. Classical behaviourism was polemical and programmatic. It was polemical in that a noisy residual battle was fought against introspective psychologists. It was programmatic in that most systematic work involved positing rather loosely stated hypotheses designed to show how phenomena formerly believed to require introspective study (*e.g.,* thinking, imagery, emotions, feeling) might be handled in terms of stimulus and response.

From 1930 through the late '40s the phase of neobehaviourism may be distinguished. The mantle of Watson passed to Clark L. Hull, who tried to translate the general methodic program of classical behaviourism into a detailed, experimentally based theory of adaptive behaviour. The aim was to achieve a statement of fundamental quantitative laws from which might be rigorously deduced the main phenomena of behaviour. The transition from classical to neobehaviourism was influenced by the importation from the philosophy of science of a set of prescriptions (*e.g.,* the analyses of logical positivism) concerning the nature of sound scientific theory. Hull's effort may be seen as guided by this so-called hypothetico-deductive view of theory. Hull did not dominate the interval to the extent that Watson did the classical period. Men like Edward Chace Tolman, E. R. Guthrie, Egon Brunswik, B. F. Skinner, Kenneth W. Spence and Neal E. Miller had important influence. Many neobehaviourists diverged markedly in specific problems and concepts, their work being related only by adherence to objectivist method. In general, the era was characterized by the effort to formulate more concrete analyses and "laws" of behaviour than did classical behaviourism. If the results still remain programmatic, this is not for want of trying.

A third phase beginning about 1950 may be distinguished. During this phase may be seen a tendency toward liberalization of behaviourist doctrine, methodic and conceptual, a concern on the part of many behaviourists with problem areas (*e.g.,* perception) formerly bypassed because of the odour of mentalism, and growing hospitality to use of introspective methods by persons who previously had not considered them legitimate.

HISTORICAL BACKGROUND

The establishment of psychology as an independent experimental science is usually placed in 1879, when the first psychological laboratory of appreciable significance was founded at Leipzig by Wilhelm Wundt. Wundt's systematization of the new psychology defined the horizons of orthodoxy in German psychology for many years. His position gathered international force through the influence of the many foreign students who came to work in his laboratory. One of these was Edward Bradford Titchener, who brought the new psychology (called by him structural psychology) to Cornell in 1892, and whose work soon became a reference point for orthodoxy in the United States. During Watson's formative years (early 1900s) structural psychology was already under questioning, but it still formed the background against which other theoretical positions were defined.

The Wundt-Titchener conception held the task of psychology to be a kind of introspectively based "chemistry" of consciousness. The aim of introspection was narrowly conceived as the analytic reduction of experience, no matter how complex, to a combination of ultimate elements. These were (1) sensations, such as redness, hardness or warmth; (2) the relatively faint copies thereof called images; and (3) feelings, such as pleasantness and unpleasantness. Though such a method had played a role in the gaining of much 19th-century knowledge of sensory mechanisms, results attained by it were often not reproducible by different investigators. When reproducible, they were not always illuminating. Knowledge did not seem to accumulate in the progressive manner desirable in science; instead, much effort was given to debate over questions which seemed never to approach resolution.

This state of affairs produced restlessness in many students. From the late 1890s, more and more workers in such fields as animal psychology, measurement of individual differences, study of rote learning and motor skill, and applied psychology were led by the demands of their problems to bypass the strictures of introspective psychology. Others, like the functionalists, with some of whom (*e.g.,* James Rowland Angell and John Dewey) Watson studied at The University of Chicago, had begun to question Titchener's position and had suggested a point of view recommending the study of mental functioning as it mediates man's adaptations to the environment. But Watson considered functionalism to be an inadequate compromise. In his first (and by far his most reserved) publication on behaviourism (1913) he submits that psychology "has failed signally . . . during the fifty-odd years of its existence as an experimental discipline to make its place in the world as an undisputed natural science." Further: "The time seems to have come when psychology must discard all reference to consciousness; when it need no longer delude itself into thinking that it is making mental states the object of observation." (John B. Watson, "Psychology as the Behaviorist Views It," *Psychological Review,* vol. 20, p. 163, 1913.) A new era had begun.

Many developments in the history of thought may be seen as precursors of behaviourism, and some may be said to have led up to it in a fairly definite way. Among the former may be mentioned

materialist and mechanist philosophy, especially in the modern period (*e.g.*, Thomas Hobbes in the 17th century; the English empiricists and associationists of the 18th and 19th centuries; and such materialist philosophers of the French enlightenment as J. O. de Lamettrie and P. J. G. Cabanis); the dominance of the mechanical world view in the physical science of the 18th and 19th centuries and its penetration into biology; the positivism of the French sociologist-philosopher August Comte, who explicitly repudiated introspection as a basis for psychology as early as 1838. More important are the influences which played upon Watson in a relatively direct way; some of these are cited below.

Animal Psychology.—Darwin's theory of evolution stressed psychological as well as structural continuities between animals and men, and he made important contributions to animal psychology in such works as *Expression of the Emotions in Man and Animals* (1872). The Darwinian impetus to animal psychology is reflected in the observational and experimental work of such English investigators as George J. Romanes, C. Lloyd Morgan and Leonard T. Hobhouse. In 1898 experimental animal psychology began in the United States with Edward Lee Thorndike's studies of the learning of cats and chicks in problem boxes (*e.g.*, devices in which the animal may escape confinement and receive reward by some such responses as pulling a loop of string, moving a latch, etc.). The animal research rapidly proliferated in the work of such U.S. investigators as W. S. Small, Robert M. Yerkes and H. A. Carr. By the time Watson was ready to codify his behaviourist program, there existed a large experimental literature to which he himself had significantly contributed. Not only were the animal methods objective; it also had become apparent that inferences from the objective findings to the associated animal consciousness, as demanded by introspective doctrine, typically added nothing to the observed data. Behaviourism is first and foremost an extension of the methods of animal psychology to the study of man.

Objectivistic Biology.—Several lines of work within physiology and zoology which had stressed objectivist and mechanist concepts should be cited. Though continuous with the trends which had produced U.S. animal psychology, the main line of descent of the latter was via Darwin and the evolutionist students of animal behaviour.

In 1890 Jacques Loeb began to develop his theory of tropisms or forced movements, which seeks an explanation of animal behaviour in purely physico-chemical terms. Loeb, a German who had moved to the United States, was one of Watson's professors at The University of Chicago. Herbert Spencer Jennings, another biologist who investigated the behaviour of lower organisms from an objective point of view, also influenced Watson.

It is customary to cite also a group of German zoologists, notably Theodor Beer, A. Bethe and Jakob von Uexküll, who in 1899 proposed an elaborate objectivist terminology for the analysis of animal behaviour.

Russian reflexology (I. M. Sechenov, I. P. Pavlov and V. M. Bekhterev) impressively antedates behaviourism by calling for an objective psychology (human as well as animal), in the case of Sechenov as early as 1870. More importantly, there was a direct fusion of this tradition with behaviourism when, beginning in 1915, Watson undertook to integrate the conditioned reflex methods and principles of Pavlov and Bekhterev into his program.

U.S. Philosophy.—Important philosophical developments beginning in the late 19th century predisposed toward behaviourism. Pragmatism as developed by William James, Charles Saunders Peirce and John Dewey stressed that the meaning and truth value of propositions can be assessed only by determining their consequences for action. This suggests an objective criterion for the validation of knowledge—essentially what behaviourism proposes for the specific case of psychological knowledge. James and Dewey were initially psychologists but turned increasingly to philosophy. Both wrote papers in the early 1900s which called ruling concepts of "consciousness" in question. Also in the early 1900s, certain members of the realist and neorealist school (*e.g.*, F. J. E. Woodbridge, W. T. Bush and R. B. Perry) analyzed the concept of consciousness with objectivist overtones. Such papers of E. A. Singer as "Mind as an Observable Object" (1911) anticipated the main Watsonian emphases with special vividness.

CLASSICAL BEHAVIOURISM

Classical behaviourism (1912–30) is best understood as a set of orienting attitudes toward the business of psychology rather than as a worked-out set of explanatory principles or theory. Though common to many, these were translated into systematic thinking differently by different workers. Since Watson was the pacemaker, early behaviourism is best presented by citing common orienting attitudes but explaining each as developed by Watson.

Objectivism.—The insistence on objective techniques for securing data, and the corollary rejection of introspection, has been seen as definitive of behaviourism. Most of the time, Watson defended the central thesis on methodological grounds, but sometimes a metaphysical judgment is suggested to the effect that "mind" or "consciousness" does not exist.

S-R Orientation.—All lawful psychological statements are to be expressed in terms of stimulus and response. In Watson's words: "the goal of psychological study is the *ascertaining of such data and laws that, given the stimulus, psychology can predict what the response will be; or . . . given the response, it can specify the . . . stimulus.*" (John B. Watson, *Psychology From the Standpoint of a Behaviorist*, 1st ed., p. 10, Lippincott, 1919.)

The terms stimulus (*S*) and response (*R*) have a definite meaning in physiology. An *S* is a measurable physical energy (*e.g.*, a given wave length of light) which can excite specialized receptors (*e.g.*, the cells of the retina) of a sense organ (*e.g.*, the eye). *R* is defined in terms of the contraction of muscle spindles or the secretion of glands. The causal connection between *S* and *R* is mediated by passage of nerve impulses through the intricate structures of the nervous system.

According to Watson (1919) we "use the term *stimulus* in psychology as it is used in physiology. Only in psychology we have to extend somewhat the usage of the term." When "the factors leading to reactions are more complex, as, for example, in the social world, we speak of *situations*." Analogously, "we employ in psychology the physiological term 'response,' but again we must slightly extend its use." We may deal with "simple responses," like the "movements which result from a tap on the patellar tendon [knee jerk] . . . but more often with . . . complex responses." "In the latter case we sometimes use the popular term 'act' or adjustment, meaning . . . that the whole group of responses is integrated in such a way (instinct or habit) that the individual does something which we have a name for, that is, 'takes food,' 'builds a house,' 'swims,' 'writes a letter,' 'talks.'"

Watson makes it quite evident that the main interest of psychology is in the relations between what he here calls situations and adjustments, not simple stimuli and responses. Often, however, he slurs over this distinction, citing, for example, as stimuli "words and sentences of a language" or "the printed score of a symphony," and as responses "building a skyscraper, drawing plans, having babies and writing books . . . ." The assumption is that such complex stimuli and responses are always analyzable into combinations of simple ones, and the hope is that the laws worked out for simple stimuli and responses will hold for the complex. The problems thereby raised have plagued all other behaviourist writers.

Peripheralism.—Watson's program necessitated that he consider how phenomena traditionally classed as mental might be treated in objective *S-R* terms. Most of his positive systematic ideas are thus attempts to show that processes formerly conceived as determined primarily by the brain could be better understood if allocated mainly to receptors, effectors and their most direct nerve connections. Such a tendency to stress, in psychological explanations, events at or near the boundaries of the organism is called peripheralism.

Sensation and perception are brought to the "outside" merely by denying that such processes mediate between stimulation and response. The strategy is to extend to the human case the methods

for studying sensory acuity in animals. In such work the experimenter, for instance, puts an animal in a situation in which, by punishing one response (say running down an alley toward light of one wave length) and rewarding another (running down an alternate alley toward light of a different wave length), he finds whether the differential response can be learned. If so, it adds nothing, Watson would maintain, to say that the animal "sees" two different colours: all that can be observed is that the animal responds differently to a specified stimulus difference. Watson argues that precisely the same methods may be used in studying human sensory capacity and that it does not matter whether the subject registers differential response by some gross movement or by spoken words. (Such an analysis of the subject's report was often criticized by nonbehaviourists after 1913, when it was first suggested.)

Imagery and thinking were for Watson "the inner stronghold of a psychology based upon introspection." (John B. Watson, *Behavior: An Introduction to Comparative Psychology,* p. 16, Henry Holt and Company, Inc., 1914.) He was thus led to the bold maneuver of transferring thought processes to the periphery. Thinking and imagery are equated with "faint reinstatements" of the original muscular responses involved in speech and other motor behaviour. Such "minimal" responses (*e.g.,* slight movements of the larynx and tongue, gestural movements, etc.) are called collectively implicit behaviour, in contrast to gross motor responses (*e.g.,* walking, reaching, overt speech), which are called explicit. Implicit responses come, by a complex process of learning, to take the place of overt speech and thus of the objects and nonverbal action systems for which words themselves are substitutes. Contrary to some representations, Watson does not reduce thinking to "laryngeal activity" or "subvocal talking" per se: abbreviated components of nonverbal acts of any type may come to "represent" those acts (or others) in thinking.

Thinking, like other forms of behaviour, is always an *S-R* process. Very important in this and other hypotheses of Watson is the use made of movement-produced stimulation. Muscles are supplied with specialized receptors (kinesthetic) which are activated by local contraction. Thus, the kinesthetic "return" from muscular movement provides a stimulus which can call forth (by innate linkage or previous learning) another movement, and so on indefinitely. Sequences of thinking and indeed all serial behaviours may thus be conceived as bound together by kinesthetic stimuli.

Other well-known peripheral hypotheses concern feeling and emotion. Watson sought to account for the feelings of pleasantness and unpleasantness by reducing them to implicit responses within "the reproductive organs and . . . related erogenous zones" (*e.g.,* slight tumescence versus shrinkage of the genitals). Emotion was defined as a diffuse "*'pattern-reaction' involving profound changes of the bodily mechanism as a whole, but particularly of the visceral and glandular systems.*" (John B. Watson, *Psychology From the Standpoint of a Behaviorist,* 1st ed.) Different emotions were presumed to be correlated with distinct patterns of bodily activity.

Emphasis on Learning.—Traditional psychology had approached learning as subsidiary to sensory and perceptual problems. But an *S-R* psychology, by sidestepping perception, is prone to place central emphasis on learning. Moreover by 1913 learning had proved to be a field eminently open to objective study—whether the task was reception of Morse code by man or escape from problem boxes by animals. Behaviourism became primarily a learning psychology and remained so throughout its history.

After casting about for suitably objective laws, Watson fixed on the conditioned-reflex principles of Pavlov and Bekhterev. The basic principle is that if a stimulus is repeatedly presented along with another stimulus (unconditioned *S*) that already reliably evokes a given response (unconditioned *R*), that response will come to be evoked by the new stimulus. The new or conditioned stimulus has become a substitute for the unconditioned stimulus and is now said to evoke a conditioned response. Pavlov had studied the detailed laws of such stimulus substitution with respect to salivary secretion in dogs (in the typical case, the unconditioned stimulus is food in the mouth, the conditioned stimulus, a tone or light which by repeated pairings with food comes independently to elicit salivation). Bekhterev had studied motor conditioning (*e.g.,* foot withdrawal, the unconditioned *S* being electric shock).

In 1916 Watson reported joint work with K. S. Lashley on human salivary and motor conditioning and recommended the use of the methods, then little known outside Russia. Thereafter, he assigned progressively greater importance not only to the utility of the methods (*e.g.,* for the study of animal sensory acuity) but also to the value of conditioning principles for the explanation of behaviour. By 1924, after his well-known experiments on the conditioning of fear in children (Watson and Rayner, 1921), he was prepared to phrase all problems of learning in terms of conditioning. From then on, the dominant effort in U.S. learning theory was to explain all facts of learning by principles based wholly or largely on facts and methods of conditioning.

Environmentalism.—Popularly, Watson is best known for his denial of instinct and his insistence that "there is no such thing as an inheritance of *capacity, talent, temperament, mental constitution* and *characteristics.*" (John B. Watson, *Behaviorism,* rev. ed., p. 94, W. W. Norton & Company, Inc., 1930.) Actually, such claims appear only in certain nontechnical writings such as the book *Behaviorism,* written after he had resigned his professorship at Johns Hopkins and entered the advertising business. Watson left the academic life under circumstances which could well have embittered him, and academic restraint thereafter seemed to lose much of its attractiveness. His earlier technical writings show careful consideration of the nature of animal and human instinct (defined as a "hereditary pattern reaction") and of unlearned behaviour equipment in general.

From the beginning, though, Watson tended to stress environmental modifiability of behaviour as against determination by constitutional structure. This was entirely in accord with the spirit of the times: for instance, a marked "scientific progressivism" which placed practical control of phenomena above all else. And the very factors which made learning the central category of behaviourism would guarantee the influence of environment to be emphasized. Although there is no necessary connection between other orienting attitudes and environmentalism, a liberal definition of the extent to which behaviour may be shaped by environment has been the rule among behaviourist writers.

Other Theorists.—The above five orienting attitudes are evident in the writings of other prominent classical behaviourists, among them Edwin B. Holt, Albert P. Weiss and Grace A. de Laguna. Other theorists, such as K. S. Lashley, E. R. Guthrie (and his collaborator Stevenson Smith), E. C. Tolman, Walter S. Hunter, J. R. Kantor and Floyd H. Allport, overlapped the classical and neobehaviourist periods in their writings. Among these, Hunter, Kantor and Allport made major contributions in the classical phase, while Guthrie and Tolman are known mainly as neobehaviourists. Lashley and Tolman are highly atypical as either classical behaviourists or neobehaviourists. Lashley, a brilliant student of Watson, concluded, after years of psychophysiological research on the relations between brain functions and learning in animals, that the concept of stimulus-response and the conditioned reflex had little scientific value. Indeed, his research forced him to views compatible with Gestalt theory (the chief rival to behaviourist formulations), with the exception that he steadfastly remained an objectivist. Tolman, too, relates to behaviourism only via insistence on objective method, and holds a theory which, though different from Lashley's, is also congenial with Gestalt emphases.

Classical behaviourism led to much experimentation and ingenious refinement of objective method. Though Watson's chief interest, during the peak period of his theorizing, was in human genetic studies (*e.g.,* development of emotional reactions in infants), most of the classical research was done on animal learning. Conditioning studies using the Russian and modified techniques burgeoned. One research sequence, prompted specifically by Watson's theory of thinking, involved attempts to measure by mechanical and electrical means the anticipated implicit speech and general

muscular movements. This stream of work trickled out in the mid-1930s, the results being ambiguous.

During the classical period, behaviourism was under sharp criticism initially by structural psychologists and functionalists, and soon also by purposive psychologists such as William McDougall, Gestalt theorists such as Max Wertheimer, Kurt Koffka and Wolfgang Köhler, and by others. Yet when Watson in 1924 said, "Most of the younger psychologists realize that some such formulation as behaviorism is the only road leading to science," he was correctly reporting the trend. (John B. Watson, *Psychology From the Standpoint of a Behaviorist*, 2nd ed., p. vii, Lippincott, 1924.) Though behaviourism did not go unchallenged in later years, the vast majority of psychologists (especially in the United States) counted themselves behaviourists. Moreover, behaviourism was the only movement in modern psychology other than psychoanalysis to attain appreciable popular influence. The simplistic nature of the doctrines lent them to the type of dramatic exposition at which Watson was truly great. The unbounded optimism concerning the prospects for healthy shaping of human behaviour and society was irresistible.

NEOBEHAVIOURISM

The history of neobehaviourism after 1930 is almost coextensive with the history of basic psychology in that interval. Only a few trends can be cited.

The dominating aim was to develop the orienting attitudes of behaviourism into concrete and rigorous theory. Throughout its short history, scientific psychology had modeled its procedures on established sciences such as physics. In the 19th century this meant the extension of experimental method to subjective phenomena; for early behaviourism it meant the use of experimental method exactly as in physics (objectively). By the late 1920s there was much objective experimentation but few bodies of clearly stated predictive principles comparable to the crowning achievements of physics: its theories. Instead, experimentation sometimes seemed aimless, theoretical hypotheses only loosely related to data, and debate idle.

In this climate psychologists became aware of the bold codifications of the nature of theoretical science being made by philosophers of science (*e.g.*, logical positivists such as M. Schlick and Rudolf Carnap) and certain methodologically oriented scientists (*e.g.*, the physicist P. W. Bridgman). This "new" view held forth an ideal of rigorous theory and seemed to define a route toward its achievement. In barest outline, it asserts theory to be a hypothetico-deductive system. Laws or hypotheses believed fundamental are asserted as postulates, and the consequences of these (theorems) are deduced by strict logical and mathematical rules. The theorems are then to be tested by experiment. Positive results increase the probability of the hypotheses; negative results call them into question. Scientific theories differ from logical and mathematical systems only in that their basic terms are given empirical reference (made to describe the world) by operational definitions (Bridgman) which state the observational conditions under which the terms may be applied. A science aims toward explicit and, if possible, quantitative hypothetico-deductive organizations of events in its domain.

In broad aspect, neobehaviourism is a marriage between behaviourism and the "new" model of science. The general orienting attitudes are to be implemented by translation into theory in accord with the dictates of the model.

In 1929 Clark L. Hull began to advocate such a program and to work toward a comprehensive theory of behaviour. He was soon joined in this effort by students and associates at Yale, notably Kenneth W. Spence, Neal E. Miller, Carl I. Hovland and John Dollard. Though only Hull, his co-workers and a few others wrote theory in literal hypothetico-deductive terms, the objectives and imagery of the "new" view of science were shared by other neobehaviourists, as indeed by most psychologists. All, for instance, insisted on the operational definition of concepts, via reduction to concrete experimental operations under which presence or absence of the specified defining property could be noted. Almost all considered quantification of laws, and formal hypothetico-deductive statement, desirable, even if not immediately feasible. Even non-behaviourists—among them the influential "field" theorist, Kurt Lewin—worked within the hypothetico-deductive framework.

This brief discussion will stress contributions of Hull, Tolman, Guthrie and B. F. Skinner. But most experimental psychologists in this interval were neobehaviourists, at least in the sense of commitment to objectivism. Spence and Miller should be cited as leading contributors to the Hullian tradition and, after Hull's death in 1952, the main developers of his branch of neobehaviourism (reinforcement theory). Egon Brunswik's important objective approach to the analysis of perceptual achievement should be noted. The work (beginning in the late '40s) of the statistical learning theorists, such as William K. Estes, who brought neobehaviourism to new heights of mathematical elaboration, should be acknowledged. Outstanding philosophers of science and psychological methodologists who were active in defining the new view of science and analyzing theory are Herbert Feigl and Gustav Bergmann in philosophy and Spence and Paul E. Meehl in psychology.

Salient features of neobehaviourism follow.

1. The metaphysical overtones of classical behaviourism were eliminated. The position is well conveyed by Hull (1937):

> What, then, shall we say about consciousness? Is its existence denied? By no means. But to recognize the existence of a phenomenon is not the same thing as insisting upon its basic, *i.e.*, logical, priority. Instead of furnishing a means for the solution of problems, consciousness appears to be itself a problem needing solution. (Clark L. Hull, "Mind, Mechanism, and Adapted Behavior," *Psychological Review*, vol. 44, p. 30, 1937.)

2. Watson had emphasized the extension of animal *methods* to human behaviour study, as evidenced in his work on child development. The neobehaviourist tendency was to extend *laws* of animal behaviour (mainly learning) to the human level. Such theorists as Hull, Guthrie, Skinner and Tolman derived their fundamental principles from detailed study of animals (mainly rats) in "standard" learning situations, and generalized—with some, but often slight, allowance for biological differences—to human behaviour, or even behaviour in general.

3. Watson's simple *S-R* framework became subspecified. For instance, Watson had given little theoretical attention to such internal behaviour determinants as motives or drives (such factors as hunger, pain avoidance, sex, curiosity, needs for approval, achievement, etc., which energize behaviour and determine its goal direction). Neobehaviourists introduced motivation into the causal equation for behaviour in a variety of ways. Indeed, such theorists as Hull and Tolman introduced a long chain of concepts, each representing some inferred process within the organism, as intervening between stimulus and response (intervening variables). Thus Hull had a variable to represent the strength of the relevant habit, the intensity of all present drives, the amount of inhibition working against the response, etc. Tolman had an even more elaborate array representing motivation, "means-end readinesses," "expectancies," anticipated "values," etc., of the organism. These variables, however, were presumed objectively calculable from relevant information about past behaviour of the organism and the present stimulus situation.

4. Watson's emphasis on Pavlovian conditioning principles as the basis of learning gave way to a variety of emphases in which classical conditioning was (*a*) subsumed under more general principles, (*b*) supplemented or (*c*) reinterpreted. This went hand in hand with diversification of basic research methods, each neobehaviourist preferring a somewhat different method or group of them. Hull, for instance, sought his main principles in trial-error learning situations (*e.g.*, simple mazes, boxes in which rats must press a lever to obtain food pellets, etc.) which make goal attainment or reward contingent on learning specified responses. He regarded such instrumental learning as fundamental; thus his major law of learning stipulated that *S-R* associations are formed only when the pairing of *S* and *R* is followed by reduction of need (principle of reinforcement). This principle represented an objective version of Thorndike's influential "Law of Effect" (1898 and after), which held *S-R* connections to be strengthened by satisfaction and weakened by discomfort or annoyance (an approach

to learning long regarded as an alternative to a conditioning approach). Hull maintained that the facts and generalizations of Pavlovian conditioning could be subsumed under the reinforcement principle, particularly when it is realized that the so-called unconditioned stimulus (*e.g.*, food in mouth) is always correlated with need reduction (*i.e.*, reinforcement). Because the conditioning situation could thus be conceived in reinforcement terms and because it involved an experimental arrangement of extreme simplicity, Hull regarded conditioning findings as valuable for suggesting basic explanatory principles. Many of his theoretical assumptions, including such principles as generalization (spread of the conditioned reaction from the stimulus of training to a similar stimulus), inhibition (factors, such as discontinuance of reward, which may weaken an extant conditioned response) and others, were based wholly or partly on results from the conditioning laboratory.

Skinner supplemented Pavlovian conditioning principles in that he recognized two primary types, each having special laws. Respondent (type *S*) conditioning is similar to the Pavlovian case, depending only upon temporal propinquity of stimuli. He was more interested in operant (type *R*) conditioning, in which instrumental behaviour is strengthened by presentation of a so-called reinforcing stimulus. The conceptualization differed from Hull's in that operant behaviour was said to be emitted rather than elicited by identifiable stimuli, and in other ways (*e.g.*, reinforcement is not equated with need reduction). Skinner devised the standard apparatus in which rats depress a lever to obtain small pellets of food. This and similar Skinner boxes (*e.g.*, for pigeons) later devised were used by many other neobehaviourists (*e.g.*, Estes, William N. Schoenfeld, Fred Keller). In them the conditions of operant behaviour have been analyzed in remarkable detail.

Guthrie stayed close to the facts of Pavlovian conditioning but reinterpreted its main principles. His major rule was that a recurring stimulus pattern acting at the same time as a response will tend to produce that response. Pavlov and others had assumed that *S* is conditioned to *R* gradually in repeated trials. Guthrie assumed that the associations producing the observed correlation of *S* and *R* gain full strength in a single trial, and showed ingeniously how apparent gradual acquisition could result from uncontrolled stimulus variability in conditioning experiments. With his principle of association and accessory assumptions concerning the role of kinesthetic stimulation and other matters, he constructed explanations of many learning phenomena.

Tolman, a theorist very different from the above-mentioned three, was a neobehaviourist only by commitment to objectivism. He reinterpreted classical conditioning principles, but more freely than Guthrie, in that they were translated into a system which conceived learning as resulting in something more like the commonsense notion of knowledge than direct *S-R* connections. For Tolman, the conditioned stimulus is a sign leading to the expectation that the unconditioned stimulus (significate) will follow without further activity by the organism. The sign produces preparatory behaviour (*e.g.*, salivation) appropriate to the significate. This type of learning is considered secondary to instrumental learning: here what is learned are "expectancies" that a given class of behaviours (*R*) will get the organism from the sign (*S*) to the significate (*S*). Such learning results in an *"SRS"* expectancy. Tolman based the details of his theorizing on instrumental learning situations, mainly simple mazes.

5. Watson's hypotheses were rather loosely stated suggestions. Neobehaviourists—whether hypothetico-deductive or informal—developed more specific theoretical analyses. Even if large generalizations were made too readily, there was a closer relation between hypothesis and experimentation.

In the course of this specification of general behaviourist ideas, peripheralist hypotheses were refined and multiplied. Hull in particular made provocative analyses of the role of kinesthetic stimulation in complex sequential behaviour; the role of drives and of implicit mechanisms such as the anticipatory goal response (*e.g.*, salivation, incipient chewing) in generating stimuli which could account for purpose, goal-directedness, certain aspects of thinking and other matters. Guthrie, too, explored the consequences of similar mechanisms (some as early as 1921).

6. Classical behaviourism never made up its mind as to whether it was concerned primarily with gross actions of the total organism in relation to complex "situations," or with stimuli and responses defined at physiological levels of specificity. Actually, it was concerned mainly with the former, but Watson did not always clearly say so. It was thus construable as a "muscle-twitch" psychology which reduced the field to physiology. Neobehaviourism tried to be more consistently psychological in outlook. Psychology was said (by Tolman and others) to be concerned with "molar" (*i.e.*, gross, flexible, goal-oriented) behaviour rather than with underlying physiological details. Many neobehaviourists considered physiology irrelevant. Others insisted that the levels of discourse of psychology and physiology be cleanly separated, and that psychology must go forward independently before a serviceable neurophysiology could develop. Yet no great clarity was achieved about such matters, in that neobehaviourists often drew upon real or fancied physiological materials. Nor was the ambiguity of classical behaviourism concerning the definition of *S* and *R* (especially the relation between physical *S* and situational *S* and between physiological *R* and behavioural *R*) eliminated.

LIBERALIZATION OF BEHAVIOURISM

Such general emphases of neobehaviourism as those mentioned above remained relatively stable until the mid-1940s, but they came increasingly under question after that time. Partly this resulted from failure of neobehaviourist systems to realize the theoretical and practical objectives announced in the 1930s. This was a failure made the more poignant by the need for humanly relevant psychological knowledge of a world that had emerged from war into an atomic era, and by the hopes for usable theoretical principles on the part of the vastly increased number of applied psychologists thereby called into existence.

This interval saw profound changes in psychology, in the course of which neobehaviourist positions were modified and liberalized. The pressures toward liberalization were partly internal to behaviourism, arising from the interaction between theory and research (especially where theoretical ideas were extended to complex human problems). But many extrinsic developments invited or enforced modifications of neobehaviourism. Among them were:

1. A growth in influence of established nonbehaviourist formulations (*e.g.*, Gestalt and related viewpoints; psychoanalysis and other personality theories stressing experiential analysis.

2. Resurgence of interest in such bypassed areas as instinctive behaviour, perception, complex motivational processes and thinking.

3. Revived concern with the physiological basis of behaviour—both reflecting and augmenting significant new knowledge about the nervous system.

4. Growing from the newly fashionable research areas, a wider excursion of theoretical ideas (*e.g.*, in perception the work of James Gibson and Ivo Kohler; in physiological psychology, D. O. Hebb; in study of instinctive behaviour, the awakening of animal psychologists to the ideas of Konrad Lorenz and the European ethologists).

5. Development of new approaches to behaviour analysis (*e.g.*, sensory processes, communication, simple learning) via formal and mathematical models—among them cybernetics, servo theory and information theory—drawing on modern systems engineering and probability mathematics.

6. Most general (and perhaps most significant), a growing recognition that wide-scope hypothetico-deductive theory is for the distant future, if indeed it is at all appropriate to such a science as psychology.

In responding to such trends, liberalized neobehaviourism all but lost its identifying characteristics. This was evident, for instance, in the 1959 volumes of *Psychology: A Study of a Science*, in which many influential theorists, including neobehaviourists, presented detailed retrospective analyses of their positions. Major orienting attitudes of classical behaviourism or neobehaviourist modifications thereof could be seen to be watered down to a point where distinctiveness was threatened. For instance, Guthrie, whose career overlapped classical behaviourism and neobehaviourism, once

and for all abandoned the persistent behaviourist hope that stimuli may be uniformly reducible to physical description, and response reducible to movement in space (*i.e.*, reducibility to Watson's "simple" stimuli and responses). Rather, "we find ourselves inevitably describing [stimuli] in perceptual terms"; moreover "it is . . . necessary that they have meaning for the responding organism." With regard to response, "we cannot reduce the classes of psychological facts which . . . we must deal with to component movements in space." (E. R. Guthrie, in *Psychology: A Study of a Science*, ed. by S. Koch, vol. ii, p. 165, McGraw-Hill, 1959.) In assuming that stimuli and responses depend for their identification on the perceptual sensitivities of human observers, Guthrie gave up one of the chief objectivist criteria of behaviourism—reducibility of observations to "pointer readings," as in physics and chemistry.

In the same volume, the important neobehaviourist N. E. Miller gave painstaking and insightful attention to central (*i.e.*, brain dependent) processes, and remained a peripheralist only to the extent of phrasing them in terms of the "central response," a type of "response" certainly not (in Miller's application) identifiable with muscle contraction or gland secretion. Indeed, he pointed out that this concept allows "the theory to exploit images, . . . perceptual responses, . . . and the possibility that central responses can contribute to the focusing of attention." (Neal E. Miller, in *Psychology: A Study of a Science*, ed. by S. Koch, vol. ii, p. 242, McGraw-Hill, 1959.) Tolman, in his contribution to the study, re-evaluated his objectivistic theory of purposive behaviour, indicating repeatedly that his major theoretical concepts (intervening variables) came from his "own phenomenology," and expressing serious doubts as to whether such concepts could even be applied objectively (*i.e.*, according to fixed rules which link them to behavioural pointer readings).

The above scattered points are representative of many others made by these men and converged upon by other contributors to *Psychology: A Study of a Science*. They were confirmed in the general literature and in a growing disposition among younger behaviourists to concentrate research on such formerly eschewed areas as perception, language behaviour, thinking and so-called mediational processes in general.

Though psychology remains conceptually heterogeneous, it has moved toward unity on such fundamental methodic questions as what constitutes legitimate data. The strange kind of scientific purism that would disallow direct use of experiential data has been proved self-defeating by the history of behaviourism. The attack of behaviourism on the artificial introspection of structural psychology was just, and per se wholesome; the extension to nonelementaristic varieties of introspection which attempt to fix the organized structures, transitions and meanings of experience is not. Such experiential analysis must initially define the main problems of psychology, concerning action as well as experience. Further, it can suggest explanatory hypotheses and in important instances provide evidence in terms of which hypotheses are tested. Introspection oriented toward these ends was inevitably part of the psychological enterprise even during the hegemony of behaviourism, but it was rendered furtive by prevailing doctrine. In consequence, the psychology of creative problem solution, of art, ethics, religion and other characteristically human matters was neglected, such subjects being disdainfully relegated to the humanities.

Meanwhile, it became unfashionable to consider the many weighty questions that must be asked concerning the integration of behavioural and experiential data, optimal techniques for experiential observation and for definition of experiential variables, etc. Psychology was beginning to make progress on such issues, and the simplification of man's image of himself that behaviourism had bequeathed to the 20th century was beginning to be rectified. Happily, behaviourism itself was participating in the task.

See CONDITIONING; LEARNING; PSYCHOLOGY; PSYCHOLOGY, HISTORY OF; PSYCHOLOGY, SOCIAL; *see* also references under "Behaviourism" in the Index volume.

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BEHBEHAN, the chief town of a large district (Shahrestan-e Behbehan) in Khuzistan, southwest Iran, is situated at the southern edge of a cultivated plain in the foothills of the Zagros mountains, about 5 mi. S. of the Marun river. Pop. (1956) 29,947. The district extends to Mt. Dinah (or Dinar) and is largely mountainous, with tribal populations. The town has recovered from earlier decay, partly because of the development of the neighbouring oil fields of Aqa Jari and Gach Saran. It lies on the ancient route from Elam, roughly conterminous with modern Khuzistan, through Fahlian into the heart of the old Persis, now Fars, with its former centres Persepolis and Estakhr. The road is motorable from Ahvaz to Behbehan, and there is a more difficult branch road to Kazerun. Nearby are ruins including those of the ancient city of Arajan and of two bridges, one of which consisted of a single arch 80 paces in span and of almost equal height. (H. Bo.)

BEHEADING, a mode of executing capital punishment. It was in use among the Greeks and Romans, and the former, as Xenophon says at the end of the second book of the *Anabasis*, regarded it as a most honourable form of death. So did the Romans, by whom it was known as *decollatio* or *capitis amputatio*.

The head was laid on a block placed in a pit dug for the purpose—in the case of a military offender, outside the entrenchments; in civil cases, outside the city walls, near the *porta decumana* (one of the main gates of the military camp). Before execution the criminal was tied to a stake and whipped with rods. In earlier years an ax was used; later a sword, which was considered a more honourable instrument of death, was used in the case of

Roman citizens. It was with a sword that Cicero's head was struck off by a common soldier.

Beheading is said to have been introduced into England from Normandy by William the Conqueror. The first person to suffer was Waltheof, earl of Northumberland, in 1076. An ancient manuscript relating to the earls of Chester states that the serjeants or bailiffs of the earls had power to behead any malefactor or thief, and gives an account of the presenting of several heads of felons at the castle of Chester by the earl's serjeant. It appears that the custom also attached to the barony of Malpas. The liberty of Hardwick, in Yorkshire, was granted the privilege of beheading thieves. (*See* GUILLOTINE.)

But beheading was usually reserved for offenders of high rank. In the reign of Edward II, Thomas of Lancaster was sentenced to be hanged, drawn and beheaded, but because of his high birth was pardoned all but the beheading. From the 15th century onward the victims of the ax include some of the highest personages in the kingdom. Simon, Lord Lovat, was the last person beheaded in England (April 9, 1747). The execution of Anne Boleyn was carried out not with the ax, but with a sword, and by a French headsman specially brought over from Calais. In the case of the 4th Earl Ferrers (1760) his petition to be beheaded was refused and he was hanged.

Executions by beheading usually took place on Tower hill, London, where the scaffold stood permanently during the 15th and 16th centuries. In the case of certain prisoners of state, *e.g.*, Anne Boleyn and Lady Jane Grey, the sentence was carried out within the Tower, on the green by St. Peter's chapel.

Beheading was only a part of the common-law method of punishing male traitors, which was ferocious in the extreme. According to Walcot's case (1696), I. *Eng. Rep.* 89, the sentence (translated from the Latin) was "that he be hanged by the neck and dropped to the ground alive and that his private parts be cut off and that his bowels within his belly be taken and put upon a fire and burned while he lives and that his head be cut off and that his body be divided into four parts to be placed where it may please his majesty the king to assign them." There is a tradition that Thomas Harrison, the regicide, after being disembowelled, rose and boxed the ears of the executioner. In 1814 the king was empowered by royal warrant to substitute hanging as the ordinary mode of executing criminals; but as late as 1820 in the case of the Cato Street conspiracy (33 Howell, *State Trials*, 1,566), after the traitors had been hanged as directed by the act of 1814, their heads were cut off by a masked man. Drawing and quartering were not abolished until 1870.

A low block, such as would be used for beheading, is believed to have been employed sometimes, and certain authors incline to the view that such a block was the one used at Charles I's execution. The more general custom, however, seems to have been to have a high block over which the victim knelt. Such is the form of that preserved in the armoury of the Tower of London (*q.v.*), which is undoubtedly the block upon which Lord Lovat suffered. The ax which stands beside it was used to behead him and the other Jacobite lords. On the ground floor of the King's house, at the Tower, is preserved the processional ax which figured in the journeys of state prisoners to and from their trials, the edge turned from them as they went, but almost invariably turned toward them as they returned to the Tower. The ax's head is 1 ft. 8 in. high by 10 in. wide, and is fastened into a wooden handle 5 ft. 4 in. long. The handle is ornamented by four rows of burnished brass nails.

In Scotland they did not behead with the ax or with the sword, as under the Roman law and formerly in the Netherlands and France, but with the maiden, an early form of guillotine.

Beheading is now very rare in European countries, most of which have abolished or limited capital punishment (*q.v.*), but it was practised very extensively by the Chinese war lords, especially by Sun Chuan-fang in Shanghai. Beheading was the method of execution prescribed by the German penal code until the death penalty was virtually abolished after World War II. During the National Socialist regime the penalty was imposed in an extended range of cases. (P. E. L.)

BEHEIRA: *see* BUHAYRAH, AL.

BEHETRÍA, the Spanish name for a form of land tenure in medieval Castile that gave the tenant the right to choose and change his lord at will, and without loss of goods. The term was used to refer both to the institution and to lands over which it operated. The inhabitants of a *behetría de mar a mar* could choose anyone as lord, but more often the choice had to be made among members of a particular seignioral family (*behetría de entre parientes*). A register, the *Becerro de las Behetrías*, compiled in the mid-14th century, shows that at least 600 places in Castile chose their lord under this system. It existed also, but much more rarely, in Portugal, León and Galicia. The practice may have originated in the need to encourage settlers by special privileges in the 9th and 10th centuries, though some attribute it to the scarcity and mobility of landlords during the early years of the Reconquest. (P. E. R.)

BEHN, APHRA (1640?–1689), known as "the Incomparable Astrea," English dramatist, novelist and poet, the first English woman to earn her living as a writer. Her parentage and the date and place of her birth have never been established. It was long supposed that her father was a barber named James Johnson, of Canterbury, but it was subsequently presumed that an entry in the parish register at the church of SS. Gregory and Martin, Wye, Kent, for July 10, 1640, referred to her baptism: "Peter ye son and Ayfara ye daughter of John and Amy Amis." This legend, which originated in a manuscript note by Anne, countess of Winchelsea (1661–1720), was perpetuated by Sir Edmund Gosse and repeated by later biographers. A partial examination into the unscholarly confusion arising out of the parish register at Wye may be found in V. Sackville-West's monograph on Aphra Behn and also in the preface to Montague Summers' edition of her works (see *Bibliography*). Later information shows that both these children, Ayfara and Peter, died and were entered in the burial register at Wye a few days later. Aphra Behn's origin must therefore remain a mystery.

Possibly the Amis couple produced another daughter whom they also named Ayfara or Aphra. All that is known for certain is that some unidentified child named Aphra traveled with a couple named Amis to Surinam (Dutch Guiana), then an English possession, from which she returned in 1658 when it was handed over to the Dutch. In Surinam Aphra learned the history and acquired a personal knowledge of the African prince Oroonoko and his beloved Imoinda, whose adventures she related in her novel *Oroonoko* (1688; reprinted 1930). She married a London merchant of Dutch extraction named Behn. Her wit and abilities brought her into high estimation at court and after her husband's death in 1666 Charles II employed her on secret service in the Netherlands during the Dutch War. She received no reward, however, and a period of the utmost poverty followed—she was imprisoned for debt for a short time—and this led to her writing as a means of supporting herself. In 1670 her first play, *The Forc'd Marriage*, was produced. She was most successful as a writer of witty and vivacious comedies, of which *The Rover* (two parts, 1677 and 1681) is an excellent example; but her versatility, like her output, was immense. She was well read and often adapted the works of the older dramatists, *The City-Heiress* (1682), based upon Thomas Middleton's *A Mad World, My Masters* (1608), being a case in point; but although she frequently borrowed, some of her most notable triumphs were absolutely original. Although the dramas comprise the bulk of her work, her prose works of fiction are of equal and perhaps greater interest from the point of view of literary history. *Oroonoko* exerted unquestionable influence on the development of the novel and Macaulay admitted that, in spite of the coarseness which disfigures her work, the best of Defoe was not beyond her reach. Besides plays and tales, she published translations and poems. Her poems, most unequal in merit, have perhaps been underestimated; the best known, with its grand first line, "Love in fantastic triumph sate," has taken its place as an anthology piece, but others also deserve consideration.

Mrs. Behn attained great popularity and had become the centre of much scandal before her death in London, April 16, 1689,

when, strange to relate, she was buried in Westminster abbey.

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BEHRENS, PETER (1868–1940), German industrial designer and architect whose work epitomized German architecture at the beginning of the 20th century, was born on April 14, 1868, in Hamburg. After attending the Fine Arts school at Hamburg, he went to Munich in 1897 during the time of the renaissance of arts and crafts in Germany. In 1900 the grand duke of Hessen called him to his newly founded artists' colony at Darmstadt, where he built his own house (1901) with all its furnishings. In 1903 he became director of the arts and crafts school in Düsseldorf.

In 1907 the most important event of his career occurred. Emil Rathenau, general director of the A.E.G. (Allgemeine Elektrizitäts-Gesellschaft—one of the largest electrical manufacturing concerns in the world), appointed him as artistic adviser for all A.E.G. products. Rathenau was a farsighted industrialist who recognized industry's need of the refining hand of an artist. It was in Berlin that Behrens found himself. Up to that time he was a mediocre painter producing woodcuts, book covers, ceramics, interiors, fabrics, carpets, etc. Now he concentrated intensely on creative work in the industrial sphere from the hexagonal trade-mark of the A.E.G. to the shapes of carbon-arc street lamps and a new conception of industrial building. Between 1909 and 1912 he built the A.E.G. factory complex. His turbine assembly works with its glass curtain wall was the most influential building in Germany at that time. Walter Gropius, Ludwig Mies van der Rohe and even Le Corbusier then worked in his office.

Behrens' later activities also included factory and administrative buildings: the Mannesman Werke in Düsseldorf (1913), Farbwerke at Höchst (1924) and the classical German embassy at St. Petersburg (1913). From 1922 to 1927 he was professor at the Academy of Fine Arts in Vienna. His later buildings demonstrated his idea that a building complex must have a heavy massiveness. He died in Berlin on Feb. 27, 1940. (S. GN.)

BEHRING, EMIL VON (1854–1917), German bacteriologist and winner of the Nobel prize for medicine in 1901 who is considered the founder of immunology as a science. He was born at Hansdorf in west Prussia on March 15, 1854, the day following the birth of Paul Ehrlich. After qualifying in medicine at Berlin he entered the army medical corps, becoming (1888) lecturer at the Army Medical college in Berlin.

Not until 1889, when he was 35 years old, did he become assistant at Koch's Institute for Infectious Diseases at Berlin. In 1890, while working with the Japanese investigator Shibasaburo Kitasato (*q.v.*) in Koch's laboratory, he showed that it was possible to provide an animal with passive immunity against the disease known as tetanus, or lockjaw, by injecting into it the blood serum of another animal infected with tetanus. The immunity was efficient against 300 times the fatal dose of tetanus. The paper of Behring and Kitasato was the first to use the word antitoxic. Soon after, Behring showed that immunity could also be obtained against diphtheria by injecting serum from an animal that had previously been injected with living cultures of the diphtheria bacillus. He extended Pasteur's theory of attenuated viruses to the science of toxins and antitoxins. This epoch-making discovery was soon given practical application. It was found possible to induce a degree of immunity even after the onset of the disease. The first human case was a child in a clinic at Berlin in 1891.

Diphtheria antitoxin was placed on the market in 1892. In a few years its administration had become a routine part of the treatment of the disease. For this work, he shared with Pierre Roux the 25,000 fr. prize of the Paris Academy of Medicine and the 50,000 fr. prize of the Institute of France.

In 1894 he became professor at Halle and in 1895 at Marburg. Ill-health forced him to give up the teaching function attached to the directorship of the Institute of Hygiene at Marburg. He became financially interested in the manufacture of antitoxic serum by the Farbwerke Höchst, which built and equipped admirable laboratories for him in which he conducted researches involving, it is stated, 7,000,000 oz. of cultures of the bacillus of tuberculosis. He devised a vaccine for immunization of calves against tuberculosis. This was used largely in Russia, Sweden and the United States, but the results did not survive the test of time and experience in providing immunity against this disease. He died at Marburg from pneumonia on March 31, 1917.

He wrote, among other works, *Die Blutserumtherapie* (1892); *Ätiologie des Tetanus* (1904); *Einführung in die Lehre von der Bekämpfung der Infektionskrankheiten* (1912).

BEHRING, VITUS: *see* BERING, VITUS JONASSEN.

BEILBY, SIR GEORGE THOMAS (1850–1924), British industrial chemist, was born in Edinburgh, Scot., on Nov. 17, 1850. After graduating at Edinburgh university, he entered the oil shale industry and greatly increased the yield of paraffin and ammonia by introducing the continuous retort. He next turned to cyanide production by the action of ammonia on a mixture of carbon and potassium carbonate. The rapid destruction of metals by ammonia led him to study the flow of solids, and he inferred that when a solid is caused to flow, as in polishing, the crystalline surface is broken down to a harder and denser layer. This suggested an explanation of the hardening of metals under cold working, for such layers, formed on surfaces of slip within the crystals, would increase resistance to further flow. Although much criticized, this theory gave a valuable stimulus to research. Beilby served on various royal commissions dealing with the supply and use of fuels and, as first director of the Fuel Research board (1917), was concerned with the production of oil from coal. He was president of the Institute of Chemistry (1909–12) and of the Institute of Metals (1916–18), was a fellow of the Royal society (1906) and was knighted in 1916. He died at Hampstead, London, on Aug. 1, 1924. (C. W. D.)

BEIRA, an ancient principality and former province of north-central Portugal, extending from the banks of the Douro as far south as the upper course of the Tagus. This historic unit was divided in 1835 into the districts of Aveiro, Coimbra, Viseu, Guarda and Castelo Branco. In 1936 three new provinces were created out of its area: Beira Alta, Beira Baixa and Beira Litoral (*qq.v.*). (J. M. Ho.)

BEIRA, a seaport of Mozambique (Portuguese East Africa), and administrative headquarters for the *intendencia* ("district") of Manica e Sofala, lies at the mouth of the Pungwe (Punguè) and Buzi rivers, 528 mi. N. of Lourenço Marques. It is linked by railway with Cape Town (2,037 mi.) via Umtali, Salisbury (374 mi.) and Bulawayo (675 mi.). Pop. (1950) 42,539, of whom 31,210 were Africans; 6,574 Europeans; 2,901 Asians; and 1,854 mixed. Beira is the chief port for the Rhodesias and Katanga (Republic of the Congo), via the Beira and Mashonaland and Rhodesian railway. The completion of a railway to the Zambezi in 1922 made it also the port for Nyasaland. The town is built on a sandspit extending into the river and is connected to the port by light railway lines. The climate is fairly healthy; the annual temperature averages 75.58° F. and rainfall 62 in. There is a considerable business community, largely British; of the three banks, two are British. It is increasingly popular as a holiday resort for Rhodesians and there are golf links just outside the town.

At the river mouth there is a lighthouse with a 16-mi. radius, and the channel leading to the port is well buoyed and lighted. Vessels of 24-ft. draft can enter the port at high tide. There is good anchorage in 5 fathoms (18–27 ft. at low-water spring tides) 135 yd. from the shore; the bottom is of soft mud but safe in fine weather. The maximum depth in the harbour is 32 ft., and minimum 12 ft.; the depth at the customs wharf varies up to 20 ft. On Portella bar, and in Rambler channel, there is 12-ft. depth at lowest spring tides and 18-ft. depth at low tide (neaps). There are three quays with berthing accommodation: the Pungwe quay (889 yd.) permits five large vessels to berth simultaneously and has more than 20 electric cranes; the Chiveve quay (488 yd.) with steam cranes is used by coasting ships; the other quay is used for the handling of ores and liquid fuels. The port has had

a free general warehouse system since 1944.

The importance of Beira port is due to its position as nearest to the principal producing centres of central Africa and equidistant from the ports of central and northern Europe, whether by Cape or Suez routes. Its traffic was adversely affected by the completion in 1902 of the Salisbury-Cape Town railway, and Port Elizabeth also competed successfully for Rhodesian trade. But railway rates and port and customs dues were reduced in 1905, and in 1907 a branch of the Rhodesian customs was opened at Beira, following the precedent of Lourenço Marques; these measures were successful in reattracting the transit trade of the interior. In addition to the important transit trade to Rhodesia, Katanga and Nyasaland, Beira also handles an increasing volume of traffic for Mozambique's hinterland, and is being increasingly used for transshipment of cargo for the smaller coast ports. The principal exports are ores (chromium, copper, amianthus, zinc), tobacco, sugar, maize, tea, cotton, hides and skins. The main imports are liquid fuels, fertilizers, wheat, railway material, automobiles and trucks, textiles, and wine and other beverages.

Beira *intendencia* was administered by the Mozambique company under an 1891 charter for a term of 50 years, renewable on its expiry in 1941. The Portuguese authorities refused to renew it, however, and took over the administration of the district in 1941. The company continued its existence, enjoying certain concessions and maintaining its establishments. Beira occupies the site of an old Arab settlement. The present port owes its existence mainly to a clause in the Anglo-Portuguese agreement of 1891 providing for the construction of a railway between Rhodesia and the navigable waters of the Pungwe. At first the railway began at Fontesvilla, about 50 mi. up the river, but was later brought down to Beira. The Portuguese government bought out the port on July 28, 1948, at a cost of about 600,000,000 escudos (£7,500,000). It has since been administered and developed by the Directorate of Port, Railways and Transportation services. On April 7, 1949, the government also acquired the Beira railway at a similar cost and by the early 1960s the tonnage handled at the port had greatly increased.

See also PORTUGUESE EAST AFRICA. (A. A. G. P.)

BEIRA ALTA, a province of northern Portugal, coincides roughly with the administrative districts of Viseu and Guarda. Pop. (1950) 691,713; area 3,682 sq.mi. Framed by the mountains of Estrêla in the south, Caramulo (3,514 ft.), Arada (3,661 ft.) and Montemuro (4,534 ft.) in the west, it is drained by the upper basins of the Mondego and Vouga, and in the east by the Coa, a tributary of the Douro. It consists of high, forested plateaus in the west and bare monotonous uplands in the east. Despite its average elevation of about 1,500 ft. it is densely populated in the more humid western plateaus, with impressive flights of cultivated terraces on the deep valley slopes, which produce chiefly maize, cabbage and vines. Viseu (pop. [1950] 13,099) is the largest of the numerous centres of the west; Guarda (*q.v.*) (7,814), the eastern capital, is the seat of an old bishopric and an important centre of communications. East of Guarda conditions are more arid and poorer generally.

(J. M. Ho.)

BEIRA BAIXA (lower, *i.e.,* eastern Baixa), a province of east-central Portugal, which coincides roughly with the administrative district of Castelo Branco. Pop. (1950) 355,806; area 2,897 sq.mi. Much of the province consists of a monotonous landscape of undulating plateaus and extensive waste called *charneca.* The plateaus rise gradually for about 45 mi. N. of the Tagus and stretch 35 mi. from the Zêzere valley to the Spanish frontier. To the northwest it is dominated by the mountain blocks of Estrêla (6,532 ft.) and Guardunha (4,026 ft.). Between them, in the upper Zêzere, Cova de Beira is a rich agricultural basin, watered by irrigation. Covilhã (pop. [1950] 20,514) is its market centre, famed for textiles and a winter sports resort. The southern plateaus are poorer, resembling the features of Alentejo (*q.v.*), to which they are transitional. The Idanha scheme to irrigate about 35,000 ac. from the Carmona dam on the Ponsul river was developed in the 1960s.

Castelo Branco (*q.v.*) (13,177), the southern capital, is an old fortress town guarding the routes to the international frontier.

(J. M. Ho.)

BEIRA LITORAL, a province of north-central Portugal, includes the administrative district of Aveiro and parts of those of Coimbra and Leiria. Pop. (1950) 969,166; area 2,933 sq.mi. It stretches for about 70 mi. along the coastal plain from the ria of Aveiro to south of the Mondego valley. Inland it follows the edge of the interior mountains and the middle basin of the Mondego as far as the Dão confluence. It has varied landscapes: the sandy wastes and pinewoods of the coastal Gandara; Ria (the "little Holland" of Beira) with its salt pans, rice fields and the lagoon of Aveiro; the interior Bairrada with vineyards covering its limestone hills; and the intermixture of forests and cultivated fields in the middle Mondego basin. Aveiro (pop. [1950] 13,397), an old fishing port, and Figueira da Foz (11,104) are the chief coastal settlements. Coimbra (*q.v.*) (42,640), the capital, is on a hill site overlooking the Mondego, where it breaks out from the mountains. Its famous university was originally founded in 1290. The lower town has woolen, leather and food industries. (J. M. Ho.)

BEIRUT (BAYRŪT; BEYROUTH), the capital and chief port of Lebanon, lies on St. George's bay on the northern side of a triangular promontory backed by the Lebanon range. It was there, according to legend, that St. George slew the dragon. Pop. (1953 est.) 296,000, including suburbs 434,000 (*i.e.,* about one-third of the total population of Lebanon). Muslims form about one-third of the population, Maronites, Greek Orthodox and Armenian Orthodox forming the other major groups.

Modern Beirut.—Few traces remain of the old city which, until about 1835, was a completely fortified town, about ¼ mi. square, surrounded by gardens. In the first half of the 19th century Ibrahim Pasha (1789–1848) began to demolish the walls, and later in the century the great aqueduct of Herod the Great was broken down and the sea castle and Turkish fortress disappeared.

Toward the end of the century the city began to expand rapidly and in 1895 new harbour works and the railway to Damascus were completed. In 1916 Jemal (Cemal) Pasha cut wide streets through the old quarters. After World War II Beirut grew again, spreading along the hillsides to the east and west. Although there are many modern buildings, the general architectural effect is chaotic. The Christian quarter spread to the east and the Muslim quarter to the south. Many gardened villas overlook the town from the encircling wooded hills.

Beirut has little industry (mainly beer, canning and confectionery); it functions principally as the financial, commercial and transit centre for the Levant region. It is also one of the most active religious and cultural centres in the middle east, and is the seat of archbishops and bishops of several Christian communions. In addition to the extensive American University of Beirut, founded in 1866 and standing on the promontory of Ras Beirut, there are the French (Jesuit) University of St. Joseph (1881), the Lebanon university (1951) and the Académie Libanaise (1937). Elementary and secondary education is provided by many foreign missions (American, French and English) and by Lebanese denominational and lay schools, both private and state-owned. There is an archaeological museum, a racecourse, golf links and stadiums, and a bathing beach at Khaldeh.

The harbour, consisting of two artificial basins, was greatly developed under the French mandate (1920–41) and later. Protected by the northern mole (approximately 4,000 ft.) it can accommodate 17 large ships, 7 of them berthing alongside the quay (approximately 7,000 ft.). The port has a free zone for handling transit goods, and refrigerating depots.

Beirut is linked by good roads with its hinterland north, east and south, and is connected by a coastal railway (1942) with Tripoli (Tripolis), Homs and Aleppo to the north and Haifa to the south. There has, however, been no traffic with Haifa since the creation of the state of Israel in 1948. Another railway links Beirut wtih Damascus. The international airport, 10 mi. from the city, is an important link in the world's air routes. (E. S. AH.)

History.—Beirut appears first in history in a list of Thutmose

III (early 15th century B.C.). In the epoch recorded by the Tell el-Amarna (*q.v.*) tablets (*c.* 1400 B.C.) its ruler was Ammunira, who contributed to the correspondence and was apparently a loyal vassal of the pharaohs. It was a Phoenician city, though it is not named in the Old Testament; the context forbids its identification either with Berothai (II Sam. viii, 8) or with Berothah (Ezek. xlvii, 16). According to Strabo (xvi, 735) Beirut was taken and destroyed by Tryphon in his struggle with Demetrius II for the Seleucid throne (140 B.C.).

Marcus Agrippa, lieutenant of Augustus, captured the city in 15 B.C. and made it a military colony, Berytus, with the full title Colonia Julia Augusta Felix Berytus, with the added privilege of the *jus Latinum* (Latin rights). Herod the Great showed it favour by erecting many fine buildings. Herod Agrippa I (*c.* 10 B.C.–A.D. 44) and his son Herod Agrippa II added to its attractions a theatre and an amphitheatre. In 1927–28 there was discovered, close to the Great mosque, a colonnade of the 1st century A.D. along with an inscription recording the restoration of the building by Queen Berenice and her brother Herod Agrippa II, two funerary inscriptions and an ornate pagan sarcophagus. It was in Beirut that Titus celebrated the fall of Jerusalem and his father's birthday with gladiatorial contests. In Roman times the city was sought by many desirous of Greek learning, while its school of Roman law, founded in the 3rd century A.D., had by the time of Justinian gained a higher reputation than the schools of Rome or Constantinople.

A disastrous earthquake in 551, however, necessitated the removal of the school to Sidon. After the earthquakes Beirut was never restored to its former splendour and in A.D. 600 the great public buildings lay strewn where they had fallen (as late as 1840 ancient columns were being used as ballast in harbour works). In 635 it passed under the blighting influence of the Arab occupation of Syria.

The period of Frank domination was one of great military activity. Baldwin I captured the city in 1110 and in 1151 it was pillaged by the Egyptian fleet. From 1177 until its capture by Saladin (1187) it was the scene of incessant fighting. Saladin dismantled its defenses (1190), dreading its reoccupation by the Franks. John of Brienne (*c.* 1148–1237) restored the castle and ramparts, and the new defenses in size and magnificance excelled any that had been before.

The surrender of the city to the Muslims in 1291 marked the end of the kingdom of Jerusalem. Thereafter it was dominated in turn by Mameluke sultans of Egypt, Druze amirs of the Lebanon, and the Turks (from 1517). The most famous of the Druze amirs was Fakhr ed-Din (1572–1635), who made himself independent of the Turks, chose Beirut as his residence, fortified it and by an alliance with Venice did much to foster and develop its trade. It was he who restored the city's famous pine groves. The Turks forced their way into the city in 1763, and in 1789 Beirut was finally freed from Druze interference. Ahmad al-Jazzar of Acre (1720–1804) re-established the defenses, built a new castle on the site of the old and completed the surrounding walls, but his building was not substantial. Beirut was occupied by the forces of Mohammed Ali of Egypt in 1830–31, but in 1840 the Egyptians were dislodged, Beirut in the process being bombarded by the allied fleets (British, Austrian and Turkish), and the city restored to Turkish possession.

In World War I, during which the port fell into disrepair, the city was occupied by British and Arab forces on Oct. 8, 1918. In April 1920 it became the capital of the new state of Lebanon under French mandate. During World War II it passed into the control of the Free French and the British and in Sept. 1941 was made the capital of the independent and sovereign state of Lebanon.

(WM. C. B.)

BEISAN (Hebrew BET SHAN), a town in northern Israel, lies on the route from the Mediterranean to the Jordan via the valley of Jezreel (Esdraelon). It is the centre of a prosperous district (pop. [1962 est.] 10,900) and occupies part of the ancient and biblical city known as Beth-shan or Beit-Shean (in classical times Scythopolis or Nysa). The citadel, Tell al-Husa, or "The Mound of the Fortress," is largely artificial and is 213 ft. high and 899 ft. long. To the north of the tell is a large cemetery containing graves of all periods from the Bronze Age to the Byzantine. Excavations on this site were carried out by the University Museum of Philadelphia between 1922 and 1933 under the direction of Clarence S. Fisher, A. Rowe and G. M. FitzGerald. Their work revealed an occupation on the mound extending from the Chalcolithic to the Arab period. The most important levels are those of the Late Bronze Age, when at the time of Thutmose III and Amenhotep III of the 18th dynasty and Seti I and Ramses II of the 19th dynasty Beth-shan was within the Egyptian sphere of influence. In Level IX two temples, one to Mekal, a local god, lord of Beth-shan, and another to his consort, a form of Ashtoreth (Astarte), were uncovered. A few Egyptian steles and a panel representing Nergal were also obtained from this layer. The strong double walls of the citadel, 15 ft. thick, were probably built by Thutmose III after his success at the battle of Megiddo. The next level of importance, VII, was that of the reign of Amenhotep III, about 1400–1375 B.C., where a large fort was excavated, built of mud bricks on a stone foundation, with flanking towers about 35 ft. high. Close to this was the house of the Egyptian commandant, and a considerable section of the town plan of this period was cleared, with streets and house walls standing 6 ft. high. In Level V, that of Ramses II, the city was refortified with strong double walls and a gate with flanking walls. The two temples were also rebuilt. Among the finds were many cult objects connected with serpent worship. After the time of Ramses III the Egyptian military garrison of Aegean troops seems to have handed over the citadel to the incoming Philistines.

On Mt. Gilboa, in about 1020 B.C., the Philistines of Beth-shan defeated the Israelites, and the bodies of Saul and his sons were exposed on the walls of Beth-shan (I Chron. x, 10). About 1000 B.C. David and the Israelites took Beth-shan from the Philistines, and it remained in Israelite hands until plundered by Sheshonk I of Egypt in 926 B.C. From the 8th century B.C. until the Scythian invasion in 625 B.C. Palestine was under Assyrian domination. Whether the name Scythopolis is derived from Scythian invaders is uncertain. From 301 to 198 B.C. Palestine including Beth-shan was under the control of the Ptolemies, but there are few remains of this period except for a temple dedicated to Dionysus and Astarte. In 198 Beth-shan passed under Seleucid control as a result of the conquests of Antiochus III. In 108 B.C. the city was betrayed to the Jewish leader, John Hyrcanus. It remained in Jewish hands until 64 B.C. when it passed to the Romans. Rebuilt by the Roman proconsul in 57 B.C., Scythopolis became a self-governing town of the Roman empire and the centre of the Decapolis, rivaling Jerusalem in population and trade. During the turbulent times at the end of the Roman empire and the beginning of the Byzantine era the city prospered and became the seat of a bishopric.

In A.D. 636 Beisan fell to the Arabs; later it was captured by the crusaders, fortified by Tancred and sacked by Saladin. In 1519 it became part of the Ottoman empire and the centre of a subdistrict. Under the British mandate from 1922 to 1948 it formed part of the district of Nazareth, and is now the centre of important agricultural experiments.

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(M. V. S.-W.)

BEIT, ALFRED (1853–1906), British South African financier, was a close friend and collaborator of Cecil Rhodes (*q.v.*) and played a prominent part in the development of the Kimberley diamond fields, the Witwatersrand gold fields and the Rhodesias. He was born on Feb. 15, 1853, the son of an importer at Hamburg, Ger., went to Amsterdam to learn the diamond trade in 1871 and then to Kimberley, as an agent, in 1875. In 1880, he was made a partner in Jules Porges and company (called Wernher, Beit and company after 1889), which became a leading South African mining house. He met Rhodes in 1879 and they became lifelong friends, sharing the same ideals. Beit was indispensable to Rhodes, providing the financial talent necessary for Rhodes's ventures. Together they formed (1888) De Beers Consolidated Mines com-

pany, which administered the Rhodesias until 1923. Both were deeply implicated in the Jameson raid (Dec. 1895). When Rhodes died (1902), Beit became one of his trustees. He himself endowed a chair of colonial history at Oxford university (1905), donated £100,000 to the University of Hamburg, and bequeathed £200,000 (subsequently given to the University of Cape Town) for a Johannesburg university and £1,200,000 in trust to develop communications and education in Rhodesia. Beit, who became a British subject in 1898, died at his home in Hertfordshire on July 16, 1906. (M. F. K.)

BEJA, a group of nomadic tribes occupying, since 4000 B.C. or earlier, the mountain country between the Red sea and the Nile and Atbara rivers from the latitude of Aswan to the Eritrean plateau. The Beja have been identified with the Erembes of the *Odyssey*, the Buka and Medju of ancient Egypt and more certainly with the Blemmyes of Roman times. The pure "Hamite" stock, still found among the Beni 'Amer in the south of the area, is small, wiry, straight-nosed, curly-haired, dark-skinned, slim and muscular. Farther north it has been modified by Arab, Armenoid and Negroid elements. Beja numbered about 300,000 in the 1960s.

The best-known tribes are (1) the half-Arab Ababda of Korosko and Abu Hamed; (2) the Bisharin farther east, famous camel breeders; (3) the Amarar behind Port Sudan, purest of the northern Beja; (4) the Hadendoa south of the Amarar, Osman Digna's "Fuzzies" who broke the British square at Tamai in 1884; (5) the Beni 'Amer of Tokar and Eritrea, dominated by a foreign aristocracy barely 1,000 strong.

Apart from the Beni 'Amer, most of whom speak Tigre, the Beja retain their Hamitic tongue, To Bedawi. Christian in the 6th century, they have been Muslim since the 13th. Except for the Amarar and certain Suakinese tribes they are indifferent to education, trade or progress, solitary in habit and resentful of interference. Some cotton is grown in the Gash and Baraka deltas. *See* also AFRICA: *Ethnography (Anthropology): Northeast Africa.*

See A. Paul, *A History of the Beja Tribes of the Sudan* (1954).
(K. D. D. H.)

BÉJA (BÉDJA), a town of northern Tunisia, Africa, is situated about 62 mi. W. of Tunis. Pop. (1956) 22,668, including 2,052 Europeans, some of whom left after Tunisia gained independence. The old town lies on the flank of a steep hill and is dominated by the kasbah and still partly encircled by Byzantine walls. The Great mosque, the sooks and the modern quarters are in the lower part; the "European" town slopes down to the railway station. The town stands in a region always celebrated for its wheat, which it exports. It is also a local market for other products.

Béja is the site of the ancient Vacca or Vaga, a Punic town which became a Roman colony. It was always "the granary of Afrikiya" (Tunisia), as it was described by the Arab geographer, al-Bakri, in the 11th century, and a road junction. The Turks made it an administrative and military centre, for the control of the roads to Algeria and the surveillance of the unsubdued tribes of the mountains.

The governorate of Béja extends over a diverse region of 271,000 inhabitants: the humid plain of the north, surrounded by hills covered with cork oaks and peopled by the Nefza tribe; the fertile hills of the *bled* (rolling country), enriched by French colonization; the grain and stockraising country northeast of the High Tell, with the old town of Teboursouk (pop. 6,568); and the rich alluvial plains of the lower Siliana and the Medjerda, an important area of agricultural settlement, with the towns of Testour and Medjez al Bab. (J.-J. Ds.)

BEJA, an episcopal city, district of the same name and the capital town of the province of Baixo Alentejo (*q.v.*), Portugal. The city stands on an isolated hill, 95 mi. S.S.E. of Lisbon by rail and 115 mi. by road. Pop. (1960) 15,685. It is the ancient Pax Julia and is partly enclosed by walls of Roman origin with two Roman gateways. The citadel with four towers, among them a Gothic keep of white marble, was founded by King Diniz (1272). Grain and fruit are grown and cattle and pigs are bred on the Campo de Beja, plains lying round the city; some copper, iron and manganese are mined and cloth, pottery and olive oil are manufactured. Beja is the central market for all these products.

The administrative district of Beja coincides with the southern part of Alentejo (*q.v.*); pop. (1960) 268,911; area 3,954 sq.mi. (J. R. Mo.)

BÉJART, the name of a family of French actors associated with Molière.

JOSEPH BÉJART (*c.* 1617–1659) was a strolling player and later a member of Molière's first company (the Illustre Théâtre), accompanied him in his theatrical wanderings, and was with him when he returned permanently to Paris, dying soon after. He created the parts of Lélie in *L'Etourdi* and Eraste in *Le Dépit amoureux.*

His brother LOUIS BÉJART (*c.* 1630–1678) was also in Molière's company during the last years of its travels and created many parts in Molière's plays—Valère in *Le Dépit amoureux*, Dubois in *Le Misanthrope*, Alcantor in *Le Mariage forcé* and Don Luis in *Dom Juan, ou le festin de Pierre.* He was lamed in a brawl, and retired with a pension—the first ever granted by the company to a comedian—in 1670.

The more famous members of the family were two sisters: MADELEINE BÉJART (1618–1672) was at the head of the traveling company to which her sister GENEVIÈVE (*c.* 1622–1675), who played under her mother's name (Hervé), and her brothers belonged, before they joined Molière in forming the Illustre Théâtre (1643). Madeleine Béjart remained with Molière until her death on Feb. 17, 1672. She was an excellent actress, particularly in soubrette parts, a number of which Molière wrote for her. Among her creations were Marotte in *Les Précieuses ridicules*, Lisette in *L'Ecole des maris* and Dorine in *Tartuffe.*

Her sister, or possibly daughter, ARMANDE GRÉSINDE CLAIRE ELISABETH BÉJART (1642–1700), seems first to have joined the company at Lyons in 1653. (For a discussion of the relationship between Madeleine and Armande, *see* MOLIÈRE.) In 1662 Molière married her, he being then 40 and she 19. Neither was happy; the wife was a flirt, the husband jealous. They separated after the birth of a daughter in 1665 and met only at the theatre until 1671. But Molière could not resist her charm and they were reconciled. Her portrait is given in Act iii, sc. 9 of *Le Bourgeois gentilhomme.* Armande's first appearance on the stage was in 1663, as Élise in *La Critique de l'école des femmes.* She was out of the cast for a short time in 1664, when she bore Molière a son, Louis XIV and Henrietta of England standing sponsors. But in the spring, beginning with the fetes given at Versailles by the king to Anne of Austria and Maria Theresa, she started her long list of important roles. She was at her best as Celimène—really her own highly finished portrait—in *Le Misanthrope* and hardly less admirable as Angélique in *Le Malade imaginaire.* She was the Elmire at the first performance of *Tartuffe*, and the Lucile of *Le Bourgeois gentilhomme.*

After Molière's death Armande leased the Théâtre Guénégaud, and by royal ordinance the residue of her company was combined with the players from the Théâtre du Marais, the fortunes of which were at low ebb. The combination, known as the Troupe du Roi, at first was unfortunate, but in 1679 they secured Marie Champmeslé (*q.v.*) and absorbed the company of the Hôtel de Bourgogne. The combined company became the Comédie Française. Armande in 1677 had married Isaac François Guérin d'Estriché (1636-1728), an actor. She retired in 1694 and died on Nov. 30, 1700. *See* also MOLIÈRE.

BEJEL, first described in 1928, is a form of endemic syphilis occurring among Bedouin tribes and certain Arab villagers of Syria, Iraq and adjoining countries. The number of its victims exceeds 1,000,000 and may be many more, for it is found mostly in areas where scientific diagnosis is lacking and where populations are not accurately numbered. Few members of the infected communities escape.

Although endemic (nonvenereal) syphilis differs clinically from sporadic (venereal) syphilis, both are diagnosed by the same tests, treated by the same drugs and caused by the same parasite (*Treponema pallidum*); both elicit the same fundamental pathological changes in the tissues.

Bejel, like endemic syphilis elsewhere, is rarely transmitted congenitally or through sexual contact; it spreads by contact from child to child in an unhygienic environment. The infection appears

first as an eruption of the mouth and skin and has no more venereal origin or connotation than measles. The profuse rash, extremely contagious and persisting for a year or more, eventually fades into latency; the blood test remains positive. Later, the early stage may relapse, or latency may be terminated by the late stage, characterized by soft, gummy ulcers of the skin, the bones and the centre of the face, patchy loss of skin pigment and other conditions.

The resemblance of endemic syphilis (bejel) to venereal syphilis on the one hand and to (nonvenereal) yaws on the other suggests that it is related to both, providing a basis for the theory that these three should be considered as one disease, treponematosis. *See* also SKIN, DISEASES OF; VENEREAL DISEASES; YAWS.

See E. H. Hudson, *Treponematosis* (1946), *Non-Venereal Syphilis* (1958). (Es. H. H.)

BEK, ANTONY (*c.* 1240–1311), bishop of Durham and one of Edward I's chief counselors and agents, was the third son of Walter Bek of Eresby, Lincolnshire, tenant and high steward of the bishop of Durham. He became one of Henry III's clerks before 1264, took service under the Lord Edward (afterward Edward I), and accompanied him to the Holy Land (1270–74). He led diplomatic missions to Scotland, Gascony, France, Germany, Italy and Aragon, executed military commissions in Wales (1277, 1283), and handled numerous financial matters. Despite his notorious pluralism, Edward secured his election as bishop of Durham (July 9, 1283). After consecration (Jan. 9, 1284) he continued to serve as Edward's chief diplomatic emissary, and he fought in Scotland, leading a division of Edward's army at the battle of Falkirk (1298). He ruled his palatinate diocese with semi-regal powers, ostentatiously and arrogantly, but with energy, courage and generosity, successfully defending Durham from the metropolitan claims of the archbishop of York. He subdued the independence of the monastic prior and chapter of Durham (1300) and, although this led to collision with Edward, he escaped the consequences by political submission. He sought, with partial success, to extend his palatine authority over the whole of northern England. He died at Eltham on March 3, 1311.

See C. M. Fraser, *A History of Antony Bek, Bishop of Durham, 1283–1311* (1957). (R. F. T.)

BEKE, CHARLES TILSTONE (1800–1874), British traveler and biblical scholar, who played an important part in the final phase of the discovery of the Nile sources, was born at Stepney, London, on Oct. 10, 1800. He entered on a business career in 1820, later studied law and between 1837 and 1838 was British consul at Leipzig, Ger. His interest in ancient and biblical history led to the publication of *Origines Biblicae* in 1834, and to a doctorate in philosophy at Tübingen university, Ger. During 1840–43 Beke was in Abyssinia investigating commercial possibilities and exploring the Nile sources, and was awarded the Royal Geographical society's gold medal in 1845. The same year he sponsored the inconclusive expedition under Bialloblotsky to explore the Nile sources from the east African coast. Beke maintained that the White Nile was the main stream, with its ultimate source at least as far south as the equator, thus conflicting with Antoine and Arnaud d'Abbadie's views which favoured the Blue Nile with its main source in Abyssinia. In 1861–62 Beke traveled in Syria and Palestine, and in 1865 went again to Abyssinia, to negotiate with King Theodore for the release of the British consul and other prisoners; he was much consulted by the British government during the subsequent war. In 1873 Beke went in search of the "true Mt. Sinai" which he located at the head of the Gulf of Aqaba. He died on July 31, 1874, and was buried at Bekesbourne, Kent.

Most important among Beke's many works are *Origines Biblicae, or Researches in Primeval History* (1834), *An Essay on the Nile and Its Tributaries* (1847), *The Sources of the Nile* (1860), *The British Captives in Abyssinia* (1865) and . . . *Sinai in Arabia* . . . (1878).

See Emily Beke, *Summary of the Late Dr. Beke's Published Works* . . . (1876). (D. MN.)

BÉKÉSCSABA, a town of southeast Hungary, lies a few miles from the White Körös tributary to the Tisza and is connected by canal with the Körös river. Pop. (1960) 49,488 (mun.). Békéscsaba is a railway and road intersection point and serves as market and distributing centre to a fertile countryside. A 13th-century Roman Catholic church is evidence of long settlement, but two marked characteristics of Békéscsaba in the past have been the strength of the Slovak element (over half the population in the early 20th century) and a tradition of Lutheranism. The town has long had important hemp and flour mills. (H. G. S.)

BÉKÉSY, GEORG VON (1899–), Hungarian-born physicist who won the 1961 Nobel prize for medicine for research into the mechanism of stimulation of the human inner ear, was born in Budapest on June 3, 1899. He attended the universities of Budapest and of Berne and received a Ph.D. degree from the University of Budapest (1923). After heading the Royal Hungarian Institute for Research in Telegraphy from 1924 to 1946 he was called to the chair of physics at the University of Budapest. Following a short period at the Royal Institute of Technology in Stockholm, he moved to the United States in 1947 and became a senior research fellow at the psycho-acoustic laboratory of Harvard university.

As early as 1928 his observations led to a new hypothesis that inaugurated the era of traveling-waves theories that accounted for the phenomena of hearing on the basis of vibrations of the basilar membrane in the cochlea of the inner ear. He recognized that first of all the distribution of the vibrations produced by a sound along the length of the basilar membrane must be known. Working with cochlear models and a highly specialized instrumentarium of his own construction he was able to obtain different vibration patterns by varying the elastic properties of the basilar membrane. Traveling waves could be observed along the basilar membrane with a flat maximum that shifted its location along the membrane with a change of frequency, the place of the maximum being determined by the pitch. His work made it possible to differentiate between certain forms of deafness and to select the proper treatment more accurately.

His main contributions were collected, translated and edited by E. G. Wever under the title *Experiments in Hearing* (1960). (G. KE.)

BEKHTEREV, VLADIMIR MIKHAILOVICH (1857–1927), Russian neuropathologist, who along with Pavlov played an important role in establishing the conditioned reflex doctrine in psychology, was born Jan. 22, 1857, in Ssarali, in the province of Viatka. He studied medicine in the medicosurgical academy at St. Petersburg. In 1884 he went abroad to do research work under E. Du Bois-Reymond, W. Wundt and J. M. Charcot, and was appointed professor at the University of Kazan, where he started clinical research of mental diseases and promoted the first psychophysiological laboratory. In 1893 he became professor of the Military Medical academy in St. Petersburg and was elected director in 1905–06.

To foster psychophysiological research, he founded in 1907 in St. Petersburg a psychoneurological institute, which existed on private donations up to 1917, when an additional brain institute was formed and both were taken over by the government. He published more than 500 scientific papers on pathology and anatomy of the nervous system and founded a society of neuropathologists and the periodical *Nevrologitcheski Vestnik*. On the celebration of his 70th birthday he received the title of scientist emeritus. Bekhterev died on Dec. 24, 1927, at Moscow.

His work on *The Nerve Currents in Brain and Spinal Cord* appeared first in Russia in 1882; the second edition in 1896 has been translated into French and German (1894). *The Functions of the Nervous Centres* appeared in Russia in 1909; his *Psychology Objectively Demonstrated* was published in 1910 (Fr. trans. by N. Kotyleff, 1913); and his *General Diagnosis of the Nervous System Diseases* in 1911. He also wrote *General Basis of the Reflex Action of Man: a Treatise of Objective Biological Study of Personality.*

See CONDITIONING: *History.*

BEKKER, AUGUST IMMANUEL (1785–1871), German philologist and critic who edited an enormous array of classical authors, studied classics at Halle under F. A. Wolf. In 1810 he was appointed professor of philosophy at Berlin. For several years, between 1810 and 1821, he traveled in France, Italy, England and parts of Germany, examining classical manuscripts and

gathering materials for his editorial labours. He died at Berlin on June 7, 1871. Some detached fruits of his researches were given in the *Anecdota Graeca*, 1814–21. His industry extended to nearly the whole of Greek literature, except tragedy and lyric. His best-known editions are: *Plato* (1816–23), *Oratores Attica* (1823–24), *Aristotle* (1831–36), *Aristophanes* (1829) and 25 volumes of the *Corpus Scriptorum Historiae Byzantinae*. The only Latin authors edited by him were Livy (1829–30) and Tacitus (1831). Bekker confined himself to textual recension and criticism, in which he relied solely upon the manuscripts, and contributed little to the extension of general scholarship.

BEL, the Semitic equivalent of Sumerian ENLIL, "lord of the air"; with Anu and Ea (*qq.v.*) one of the primary triad of deities at the head of the Sumero-Akkadian pantheon and honoured especially at the city of Nippur. The name of Enlil occurs on very early pictographic tablets; his titles include "father of the gods," "king of heaven and earth," "king of all lands." In hymns and myths written in Sumerian and dating from the 2nd millennium B.C. (but deriving from earlier originals) he appears as the heavenly maker and planner and the giver of good things for men's use. He also "named" rulers and gave them victory. Another and more sinister aspect of Enlil appears in the title "king of the deluge" given to him by Gudea, priest-king of Lagasa (Lagash) in southern Babylonia about 2000 B.C.

During the 3rd dynasty of Ur (early 2nd millennium B.C.), on temple accounts from several Sumerian sites, he and his spouse Ninlil are named as objects of local cult far more frequently than any other deities. But at Ur, the capital city, such documents contain only one reference to offerings for Enlil, and none to any temple of his there. Perhaps this apparent neglect of Enlil at Ur may explain why, according to a Sumerian account, he "summoned the storm," annihilated the land and made the city of Ur a city of the dead.

The Semites, who displaced the Sumerians as rulers of Sumer and Akkad, with Babylon as their capital city, retained the name, status and cult of Enlil, calling him by their name for a god, Bel, "lord." Therefore Hammurabi begins his code with the statement that Anu and Enlil, the first and second members of the chief cosmic triad, had given sovereignty over the peoples to Marduk (*q.v.*), the "Bel" of Babylon, Hammurabi's city. He describes Enlil as "lord of heaven and earth," as the god who determines fates, the god who had given to him the "black-headed people" and had enlarged his kingdom. He invokes Enlil as the destroyer of the very name and memory of any person who does not respect Hammurabi's name and code. In subsequent myths it is Enlil who causes the deluge, and from him the Zu-bird steals the tablets of destiny. With his "great net" he catches lawbreakers. In course of time the attributes of Enlil were transferred to Marduk, who becomes the Bel of later days. Similarly, in Assyria, the chief god Ashur assumes the name Bel, and to him "the old Enlil" and other deities pay reverence.

Enlil's consort, Ninlil, lady of heaven and earth, mother of gods, lady of lands, towns and houses, is rarely separated from him. She is the Belit (*q.v.*) of Assyria and the beloved spouse of Ashur.

Enlil's *E-kur*, or "temple mount," was at Nippur. From this site, first excavated late in the 19th century, have come many literary compositions written in Sumerian. Shalmaneser I, in the 13th century B.C., built an *E-kur* at Ashur. Early in the 2nd millennium B.C., King Erishum I had built for Enlil a temple, later restored by Shamshi-Adad I, with the name "house of the wild ox of the lands." In both Babylonia and Assyria "wild ox" was an epithet of Enlil and, in its feminine form, of Ninlil.

The god of Palmyra, in Syria, though called Bel, is not the Babylonian Bel. The Greek neoplatonist Damascius (fl. 6th century A.D.) mentions "Illios," a form deriving from "Ellil"; *i.e.*, Enlil. When Greek writers refer to the Babylonian deity "Belos," they invariably mean Marduk of Babylon. *See* DANIEL, BOOK OF.

For bibliography *see* ADAD. (T. FIL.)

BÉLA III (d. 1196), king of Hungary from 1173, was the second son of King Géza II. Educated at the Byzantine court, he married Anne of Châtillon, duchess of Antioch, and in 1173 was placed by the emperor Manuel by force of arms on the Hungarian throne. Béla began by adopting Catholicism and seeking the assistance of Rome. He established close spiritual ties with the western world, particularly with France. During his reign Hungary became the leading power of south-central Europe, and he had an annual income equal to that of the kings of France or England. He made the throne hereditary by crowning his infant son Imre as his successor. The attempt to recover Dalmatia, which involved Béla in two bloody wars with Venice (1181–88 and 1190–91), was only partially successful. But he helped the Serbs of Raska throw off the Greek yoke and establish a native dynasty and attempted to make Galicia an appanage of his younger son, Andrew. It was in Béla's reign that the Western emperor Frederick I Barbarossa, in the spring of 1189, traversed Hungary with 100,000 crusaders. In his last years Béla assisted the Byzantine emperor Isaac II Angelus against the Bulgars. On his first wife's death Béla married Margaret, sister of Philip II Augustus of France. Béla was in every sense of the word a great statesman, and his court was accounted one of the most brilliant in Europe. Many leading Hungarian dignitaries were educated in Paris; and the Cistercian and Premonstratensian monks, whom he invited to Hungary, introduced more advanced agricultural practices into the country.

See HUNGARY: *History*.

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BÉLA IV (1206–1270), king of Hungary, was the son of Andrew II, whom he succeeded in 1235. During his father's lifetime he colonized and christianized Transylvania. The salient event of Béla's reign was the terrible Mongol invasion that reduced three-quarters of Hungary to ruins. When Béla received information that the Mongols contemplated the immediate conquest of Europe, he appealed for assistance to Pope Gregory IX, to Frederick, duke of Austria, and to the emperor Frederick II. In February and March 1241 the Mongols under Batu Khan burst through the Carpathian passes; in April Béla himself, after a gallant stand, was routed on the banks of the Sajó river and fled to Dalmatia. For the next 12 months the kingdom of Hungary ceased to exist. Dynastic troubles forced the Mongols to withdraw from Hungary, however, and Béla immediately began the reconstruction of his realm, which he accomplished with a single-minded thoroughness during the last 28 years of his reign (*see* HUNGARY: *History*).

Perhaps the most difficult part of his task was the recovery of the western portions of the kingdom (which had suffered least from the Mongol invasion) from Frederick of Austria, who had seized them as the price of assistance that he had promised but never given. Béla crossed the Leitha river on June 15, 1246, and routed Frederick, who was killed in the battle. In the south Béla was obliged, in 1243, to cede Zadar (Zara) to Venice; but he kept his hold on Split and his other Dalmatian possessions. His wise policy of religious tolerance in Bosnia enabled Hungary to rule that province peaceably for many years. The new Serbian kingdom founded by the Nemanyich dynasty gave him much trouble, on the other hand, and was the occasion of many bloody wars.

In 1261 the Mongols, led by Nogai, invaded Hungary for the second time but were defeated by Béla. For a time Béla was equally fortunate in the northwest, where the ambitious and enterprising Premyslid dynasty had erected a new Bohemian empire that absorbed the former territories of the Babenbergs of Austria and threatened Hungary. Béla was almost constantly at war with Otakar II for possession of Styria, which ultimately fell to the Bohemians.

Béla died on May 3, 1270. By his consort Maria, daughter of the Nicaean emperor Theodore Lascaris, he had two sons, Stephen and Béla, and seven daughters, of whom St. Margaret of Hungary was the most famous.

For bibliography *see* under BÉLA III. (GE. GR.)

BELALCÁZAR (BENALCÁZAR, BELAICÁZAR), **SEBASTIÁN DE** (SEBASTIÁN MOYANO) (*c.* 1495–1551), Spanish conqueror who opened up what is today Ecuador and southern Colombia, was born in Benalcázar, Extremadura, Spain, about 1495. Traveling to the new world in 1519, he became an officer in the forces of Pedro

Arias de Ávila and in 1524 conquered Nicaragua. He joined Francisco Pizarro's expedition to Peru in 1531, equipping his ship at his own expense, and was given command of the important supporting base at Piura. Chafing at the inactivity of this post, in 1533, at the head of 150 Spanish soldiers and some Indian allies, he set out to conquer what is now Ecuador. He defeated the Inca chief Rumiñahui and founded the cities of Quito and Guayaquil. Three years later he led an expedition in search of "Eldorado," a mythical region supposed to abound in gold. The expedition resulted in the invasion of Popayán (the southwestern part of present-day Colombia) and the founding of the city of the same name in 1537. Belalcázar then became governor of Popayán and the provinces called Equinoxiales. The close of his life was embittered by disputes with other Spanish leaders. He died at Cartagena in 1551, when en route to Spain, following indictment for the death of Jorge Robledo. (J. L. Tr.)

BELASCO, DAVID (1853–1931), U.S. theatrical producer and playwright, was born in San Francisco, Calif., on July 25, 1853. As a child actor he appeared with Charles Kean in *Richard III*, and later played in stock companies that toured the mining camps. During this period, he served also as secretary to Dion Boucicault. From 1873 to 1879 he worked in several San Francisco theatres as actor, manager and play adapter, and in the latter year toured in *Hearts of Oak*, which he wrote in collaboration with James A. Herne.

Belasco moved to New York in 1880, becoming associated there with the Frohmans as manager of the Madison Square theatre and later of the Lyceum. In 1890 he leased a theatre from Oscar Hammerstein and became an independent producer. Feeling the pressure of the Theatre Syndicate headed by Marc Klaw and Abraham L. Erlanger, he built his own theatre in 1906, naming it after himself.

Belasco was the first U.S. producer whose name, regardless of star actor or play, attracted patrons to the theatre. He chose unknown actors—Mrs. Leslie Carter, David Warfield, Blanche Bates, Frances Starr and Lenore Ulric, among many others—and elevated them to stardom. He also preferred playwrights—Henry C. DeMille, Richard W. Tully, Charles Klein and John Luther Long—whose success depended upon his collaboration. He gained a reputation for minute attention to detail, for sensational realism, for lavish settings, for astonishing mechanical effects and for courageous experimentation in lighting. In a day of careless production methods, he maintained a large permanent staff that worked constantly under his set designer, Ernest Gros, and his lighting technician, Louis Hartment, to perfect surprising effects. As a result, he brought to the theatre, in addition to the sensationalism for which he was noted, what George Jean Nathan, one of his bitterest critics, acknowledged to be "a standard of tidiness in production" that discouraged the "frowzy hustle and slipshod manner of presentation" that had previously obtained on the U.S. stage. However, though no one denied Belasco credit for the remarkable skills for which he received many honours, better critics deplored his theatricalism and his lack of taste and artistic judgment, as well as his failure to encourage the better dramatists, both American and European, who were then coming to the fore.

Belasco claimed to have been connected with the production of 374 plays, most of them written or adapted by himself. Typical of his better-known productions are *The Heart of Maryland* (1895); *Madame Butterfly* (1900), turned into the opera of the same name by Puccini; *Du Barry* (1901); *The Music Master* (1904); and *Lulu Belle* (1926). He also wrote *The Theatre Through Its Stage Door* (1919). Belasco died in New York on May 14, 1931.

See Craig Timberlake, *Life & Work of David Belasco, the Bishop of Broadway* (1954). (M. Rs.)

BELAWAN, a port of northern Sumatra, Indon. It is on Belawan, an island of mud and mangroves at the estuary of the Deli and Belawan rivers. Pop. (1961) 35,404. As the port for Medan, 16 mi. away, serving the east coast trade, it became the most important port in northern Sumatra. The harbour is handicapped by the bar of the deep Belawan river, and constant dredging is necessary to keep the channel open and to enable ships of 23-ft. draft to enter at all times, and vessels of 26-ft. draft at high tide. A feature of the modern harbour is the assortment of storage tanks for rubber latex, palm oil and petroleum. There are several thousand feet of wharves with warehouse accommodation. Imports consist of manufactured goods and foodstuffs. The hinterland grows tobacco, rubber, tea, oil palm and sisal fibres in Deli, Langkat and Serdang and these are shipped from Belawan. The older harbour, up river, provides a haven for local fishing craft and small vessels.

Belawan is connected by shipping services with Singapore and Penang as well as with Sumatran and Javanese ports. A motor road links it with Medan, and it is the terminus of the Deli railway, which crosses a bridge over the channel south of the island.

BELAYA, a river of the Bashkir Autonomous Soviet Socialist Republic, U.S.S.R., the largest tributary of the Kama, rises in the southern Urals at the foot of Mt. Iremel and flows for 882 mi. draining 54,826 sq.mi. After flowing southwestward through a narrow mountain valley, the river turns sharply to the north and the valley becomes broad and terraced. It joins the Kama, an important tributary of the Volga, above Derbeshkinskiy. Snow forms over half the water supply and in spring water levels are very high, reaching more than 30 ft. below Ufa. The average discharge is 33,549 cu.ft. per second. The river is navigable to the village of Tabynsk, although shallows in places impede navigation. Its major tributary is the Ufa river, and the town of Ufa (*q.v.*) stands at the confluence of the two rivers. (R. A. F.)

BELCHER, SIR EDWARD (1799–1877), British naval officer who made many valuable surveys for the admiralty, was born in 1799. He entered the navy in 1812 and in 1825 was surveyor in Frederick William Beechey's expedition to the Pacific and Bering strait. He subsequently commanded a surveying ship on the north and west coasts of Africa and in the British seas, and in 1836 took up the work which Beechey left unfinished on the Pacific coast of South America. In 1852 he was given command of the government arctic expedition in search of Sir John Franklin. This, which proved an unsuitable appointment, was his last commission; he was created knight commander of the Bath in 1867 and an admiral in 1872.

Belcher died in London on March 18, 1877.

Belcher published *Narrative of a Voyage Round the World Performed in H.M.S. "Sulphur," 1836–1842* (1843); *Narrative of the Voyage of H.M.S. "Samarang" During 1843–1846* (1848); and *The Last of the Arctic Voyages* (1855). (T. E. A.)

BELCREDI, RICHARD, Graf (1823–1902), Austrian statesman who worked for a federal constitution under the Habsburg dual monarchy, was born, the son of a Moravian landholder, at Ingrowitz (near Svitavy, Bohemia) on Feb. 12, 1823. After a period in the civil service (1842–48) he devoted himself to legal and historical studies. In 1855 he became district commissioner of Znaim (Znojmo, Moravia), governor (*Landeshauptmann*) of Silesia in 1860 and *Statthalter* ("imperial representative") at Prague in 1864. Favouring the Moravian conservative party and recognizing that neglect of the Slavs—particularly of the Czechs—would endanger the monarchy, Belcredi conceived that the solution of the nationalities problem should follow the model of Swiss federalism. The opportunity to make these ideas effective came when he succeeded A. von Schmerling as first minister on May 27, 1865. Convinced that a stable constitution could only be built on the foundation of traditional rights, he revoked (Sept. 20, 1865) the February patent of 1861, intended by Schmerling to constitute Austria-Hungary as a centralized, German-speaking state, and he prepared for a reconciliation with Czech demands by establishing Czech as a language of instruction in Bohemian schools. These two measures antagonized the influential German military and diplomatic group which had the emperor's confidence and, before the Austro-Prussian War of 1866, Belcredi was left uninformed of the full seriousness of the diplomatic situation. The Austrian defeat at Königgrätz (Sadowa) destroyed his position, and it was useless for him to claim that his Czech policies had maintained the integrity of the dual monarchy. Belcredi opposed the compromise favouring Hungary advocated by the empress and by F. F. Beust (*q.v.*),

the new foreign minister; when the emperor reluctantly declared himself for the compromise as the only practicable solution (on Feb. 3, 1867) Belcredi resigned.

Belcredi's ministry was the last to advocate a federal constitution on a conservative basis under which the Slavs should maintain their historic rights. The emperor forbade him to return to his home in Moravia, and from 1881–95 he was president of the administrative court. He died at Gmunden (Upper Austria) on Dec. 2, 1902.

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BELÉM, a city and port in northeast Brazil, capital of Pará state. Pop. (1960) 359,988. Belém is also called Pará and its full name is A Cidade de Nossa Senhora do Belém do Grãn Pará ("The City of Our Lady of Bethlehem of the Great River"). It is located about 80 mi. up the Rio Pará from the Atlantic between the Rio Guamá and the Bay of Guajará at 32.8 ft. above sea level.

The climate is rainy—tropical with an annual average temperature of 78.7° F., and 86 in. annual rainfall. Maximum rainfall occurs during the period from January to June when the warm moisture-laden equatorial air masses from the North Atlantic move southwestward into the interior of South America.

A Portuguese expedition headed by Francisco Caldeira de Castelo-Branco established Belém as a fortified settlement in 1616. Since this expedition started on Christmas day the new outpost was named Belém (Port., "Bethlehem"). The extension of Portuguese power along the northern coast of Brazil was the result of French attempts to secure a foothold in that area after unavailing efforts farther south. An expedition sailed from France in 1612, financed and supported by private sources, with the sanction of the French court, Marie de' Medici then being queen-regent. The French established a fort and colony on the island of Maranhão, which they called St. Louis in honour of their king Louis XIII, a name retained in its Portuguese form, São Luiz. One of the three expeditionary vessels returned to France and about 300 colonists were brought over on the next voyage. Aid from the crown did not develop and the colony was forced to surrender to a Portuguese expedition in Nov. 1615. With the founding of Belém soon thereafter, the French were driven back to Guiana, subsequently their only possession on the South American mainland. Pará territory was made a separate *capitania* in 1652, with the town of Belém as the capital, but it was reunited with Maranhão in 1654. Belém was restored as the capital in 1772 when the final separation occurred.

The 1820 liberal political movement in Portugal, supporting a constitutional monarchy, had reverberations in Belém which established a separate government and sent representatives to Lisbon. Belém did not accept the empire of Brazil established in 1822 under Dom Pedro I, or the declaration of independence from Portugal, and yielded only to force. Both Maranhão and Belém were invested by a naval expedition in 1823 under Adm. Archibald Cochrane (earl of Dundonald), then in the service of Brazil, and made a part of the empire. An uprising occurred but it was quickly suppressed. Internecine strife continued, the worst of the struggles being the Revolução da Cabanagem in 1835 when the Portuguese Indians and *Mestiços* attacked the Portuguese residents. Order was restored in 1836 after considerable loss of life.

The end of the 17th century saw the decline of the sugar industry in the region around Belém and São Luiz and this area was subsequently used for cattle grazing. During the 18th century both Belém and São Luiz prospered from the production of rice, cotton and coffee, until these commodities were produced more reasonably elsewhere in Brazil. In the 19th century Belém became the main exporting centre of the Amazon rubber industry, and in 1866 its position was further enhanced by the opening of the Amazon, Tocantins and Tapajós rivers to navigation by friendly nations. The rubber era terminated after the boom of 1910–12, but Belém continued to be the main commercial centre of northern Brazil and entrepôt for the Amazon valley.

The districts near Belém supply the local markets with foodstuffs. Many of these commodities, as well as a wide range of items from the inland territory, are sold at the Mercado Municipal of Belém.

The most valuable products exported from the Amazon by way of Belém are nuts, chiefly Brazil nuts, jute and black pepper. Japanese immigration after the 1930s was an important factor in developing jute and black pepper, notably at Tomesu-Assu just south of Belém and near Santarém. The island of Marajó, the largest fluvial island in the world (180 mi. east-west, and 100 mi. north-south), located across the Rio Pará from Belém, is believed to offer great potentiality for the expansion of livestock grazing.

Belém is the main port for Amazon river craft and is served by international and coastwise vessels. A railway extends to Bragança (145 mi.), and the Belém airport is the principal air facility in northern Brazil. It is a city of great beauty, modern and comfortable, with tree-lined streets, several plazas and public gardens and many fine buildings, both public and private. It is the diocese of a bishop and the colonial cathedral, founded in 1719, is one of the largest in Brazil. Santo Alexandro, the oldest of Belém's churches, was built in 1616. The Palacio do Governo (government palace) and the Palacete Municipal (city hall) are important government buildings.

Belém is the leading educational and cultural centre of northern Brazil with academic training available in medicine, dentistry, pharmacy, law, engineering and the fine arts. The city also affords a normal school, an institute for research on tropical diseases and the Instituto Agronômico do Norte (Agricultural Institute of the North) specializing in tropical agriculture. The Museu Goeldi, the Teatro da Paz, a classical theatre, and the Biblioteca e Arquivo Público do Pará (Pará Public library and archives) are other notable facilities. The historic stately buildings are retreating in the face of multistory buildings of contemporary design.

(J. L. TR.)

BELEMNITE, a representative of a group of extinct cephalopod mollusks, common in Mesozoic deposits (laid down from 200,000,000 to 70,000,000 years ago), allied to squid and cuttlefish (*qq.v.*). The shell (up to 18 in. long, but usually smaller) comprised a straight cone divided internally into chambers and known as the phragmocone, the whole enclosed in a horny or calcareous plate. It was probably internal as in most modern Decapoda. *See* CEPHALOPODA; MOLLUSK.

BELESME (BELLÊME), **ROBERT OF** (*c.* 1052–*c.* 1131), earl of Shrewsbury, was one of the most powerful, ambitious, cruel and irresponsible of the Norman barons. He was a son of Roger de Montgomery and of Mabel, daughter of William Talvas, from whom in 1079 he inherited the west Norman lordships of Belesme, Domfront and Alençon. He supported Duke Robert II (Curthose) of Normandy against William II (Rufus) of England in 1088 and 1090, but led Rufus' knights against Curthose and Philip I of France in 1097, and as an able military architect built the original castle of Gisors on the border between Normandy and the French king's domain. By his succession in 1098 to his brother Hugh's English fiefs, including Shrewsbury with the earldom, and the honour of Arundel, he became the most powerful vassal of the English crown. His chief rival in Normandy was Rufus' younger brother Henry, who became king of England (1100). Robert rebelled against him (1101), was deprived of his English lands (1102) and fought against Henry at the battle of Tinchebrai (1106). The French king sent him as ambassador (1112) to Henry I, who kept him prisoner until his death at Wareham in Dorset about 1131. (G. W. S. B.)

BELFAST, the capital city of Northern Ireland, is a county borough and seaport of the first rank situated on the river Lagan at its entrance to Belfast lough. It is partly in County Antrim on the northern side of the river, and partly in County Down on the southern side. Pop. (1961) 416,094. Area 25.9 sq.mi. Belfast is a modern industrial city which has little architectural distinction though there are some fine buildings including the city hall (1906), Queen's University of Belfast (founded 1845), the Presbyterian Training college (1853), the Protestant cathedral of St. Anne (the nave consecrated in 1904 but the building not yet complete), the museum and art gallery (1929) and the Royal

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BELFAST CASTLE ON CAVE HILL OVERLOOKING BELFAST; ABOUT 1870

Belfast Academical institution (1810). Just outside the borough's eastern boundary are the parliament building and Stormont castle. Several public parks and the Botanic gardens, together with playing fields, play centres and the grounds of Belfast castle, comprise 1,144 ac. of open space between the large areas of docks, shipyards, warehouses and factories. The city has a compact shopping centre and there are many hotels and restaurants. These and other amenities have made Belfast a popular holiday resort and a focal point for travel through Ulster.

From the city's airport at Nutt's Corner, in the hills 11½ mi. W.N.W., regular air services are maintained to Glasgow, Manchester, Birmingham, Liverpool and London. Steamer services run between the seaport and Heysham, Liverpool, Manchester, Glasgow, Androssan and many other ports in western Europe and America. Belfast is the centre for provincial railway and bus services.

The city's early history is obscure. In about 1177 John de Courcy, it is thought, built a castle commanding the ford near the mouth of the river (*Beal Feirste*, "the mouth of [approach to] the sandbank [or crossing]" whence its name). Repaired and rebuilt on numerous occasions, this castle appears to have survived until the beginning of the 17th century. Belfast's modern history may be said to have begun in 1611, when Sir Arthur Chichester built a new castle there. He did much to encourage the growth of the town, which received a charter of incorporation in 1613. It survived intact the insurrection of 1641 when, throughout Ulster, the Irish massacred thousands of colonists and seized some of the most important towns and strongholds. In 1648 it was occupied by George Monck, the parliamentarian commander.

By 1685 Belfast had a population of about 2,000, largely engaged in the making of bricks (there is plenty of clay in the neighbourhood), ropes, nets and sailcloth, together with weaving and, on a small scale, shipbuilding. By the late 1730s the castle had again been destroyed, but Belfast was beginning to acquire economic importance. It tended to usurp Lisburn's function as the chief bridge town on the river Lagan and largely superseded Carrickfergus as a port. Linen was the main Ulster industry, stimulated by the settlement of French Huguenot refugees under the patronage of William III at the close of the 17th century, and the spinning and weaving of linen were conducted as a cottage industry with Belfast as its chief port and market centre. Power-driven machinery was first applied in Ulster, when the first water-driven cotton mill was established at Whitehouse, near Belfast, in 1784. By 1811 there were 15 steam-driven cotton mills in Belfast, but the industry finally died out when the American Civil War cut off supplies of raw cotton. However, by this time mechanization had been applied to both the spinning and weaving of linen and Belfast was becoming one of the greatest linen centres in the world. The modern linen industry comprises many factories producing a wide variety of household textiles. Other industries, including tobacco, became established, and timber yards, sawmills, engineering works, flour mills and rope works developed.

During the 17th century many small vessels were built in Belfast, including, it is claimed, the "Eagle's Wing," a ship of 150 tons constructed in 1636 to take Ulster Presbyterians to North America. However, shipbuilding did not become really established until the late 18th century, when William Ritchie founded first a shipyard (1791) and then a graving dock (1796). Following the Industrial Revolution the chief shipbuilding firm came to be Harland and Wolff, whose yard now covers about 300 ac. and contains 18 building berths for vessels up to 1,000 ft. in length. Concurrent with, and conducive to, this growth of shipbuilding were the continued development of the port and improvement of its facilities, particularly after the establishment of the Belfast Harbour commissions in 1847. By the early 1960s there were 7 mi. of quays equipped with more than 60 dockside cranes; the harbour estate contained 13 mi. of roads and 15 mi. of railway lines. The chief imports were machinery, coal; grain, flour and feeding stuffs; iron and steel; and petroleum. Ships, aircraft, agricultural produce, livestock and linen textiles were among the main exports.

Besides the linen, tobacco, shipbuilding, engineering and rope-making industries, all of which continue to flourish, the more recently introduced industries include food processing and the manufacture of clothing and aircraft. An aircraft factory was established in the city in 1937 and became one of the largest in Europe, employing more than 8,000 people. It was responsible for developing Great Britain's first all jet-powered vertical take-off and landing aircraft. The city was severely damaged by air raids in May 1941.

Belfast's population increased greatly during the 19th century reaching almost 350,000 in 1901. It became a city by royal charter in 1888; in 1892 its chief magistrate was granted the title of Lord Mayor; and it was given county borough status in 1898. After the passing of the Government of Ireland act, 1920, Belfast became the seat of the government of Northern Ireland. The city sends 4 members to the United Kingdom parliament and 16 to the parliament of Northern Ireland. Gas, electricity and public transport services are municipally owned.

See D. J. Owen, *History of Belfast* (1921). (J. Du.)

BELFORT, TERRITOIRE DE, an administrative division of eastern France, was formed from the southern portion of the *département* of Haut-Rhin (*q.v.*), formerly part of Alsace-Lorraine (*q.v.*), the rest of which was ceded to Germany in 1871 but recovered by France in 1919. It is bounded on the south by Switzerland, and by the *départements* of Doubs, Haute-Saône, Vosges and Haut-Rhin on the southwest, west, north and northeast and east, respectively. With an area of only 235 sq.mi. it is one of the smallest *départements* of France. In 1954 it had a population of 99,427, of whom 41,197 were in the town of Belfort. The territory is in the archbishopric, and comes under the court of appeal and the *académie* of Besançon. The northern part is occupied by the southern face of the Vosges, rising to 4,094 ft. in the Ballon d'Alsace, the southern part by the wooded hills around Delle that are the northernmost parts of the Jura. Between the Vosges and the Jura stretches the Trouée (depression) de Belfort, 15–20 mi. wide, connecting the valleys of the Rhine and Rhône, and traversed by the link canal as well as by important railways and roads. From early times the gap has been a great routeway from north to south, the historic Gate of Burgundy or Belfort gap, and the fortress town of Belfort owes its strategic importance to command of this route. Arable land, pasture and forest each occupy about one-third of the territory. There are important textile and engineering industries, especially at Belfort. Delle and Beaucourt are smaller centres with varied manufactures. (Ar. E. S.)

BELFORT, capital of the *département* of Territoire de Belfort, eastern France, stands on the Savoureuse river, 66 km. (41 mi.) W. of Basel by road. Pop. (1954) 41,197. It commands the

important strategic gap known as the Trouée de Belfort between the Vosges and the Jura. The river divides the town into the old and new quarters. The old, or fortified, quarter is on the east bank and contains the castle and public buildings, the church of St. Christophe (1727–50) in the classical style and the *hôtel de ville* (1721–24) in front of which is the majestic Lion of Belfort, 22 m. (72 ft.) long and 11 m. (36 ft.) high, of Vosges sandstone, created by F. A. Bartholdi (*q.v.*) to commemorate the siege of 1870–71. The museum has important archaeological collections. Belfort has electrical, metallurgical and textile industries, and carries on a trade in the wines of Alsace, brandy and cereals. It is on the main railway from Paris to Basel and Italy.

Gallo-Roman remains have been found in the district, but Belfort was not mentioned until the 13th century, when in possession of the counts of Montbéliard who granted the citizens a charter in 1307. It passed later to the archdukes of Austria. By the treaty of Westphalia (1648) the town was ceded to Louis XIV, who gave it to Cardinal Mazarin. Five times invested in the 17th century, it again suffered siege in 1814, 1815 and 1870. In World War I Belfort remained just behind the French lines, but in World War II it was occupied by the Germans from June 1940 to Nov. 1944.

Siege of Belfort, 1870–71.—For the events before the siege, *see* FRANCO-GERMAN WAR. Even before the investment Belfort was cut off from the rest of France by General von Werder's corps. The siege corps was commanded by Gen. H. L. U. von Tresckow and numbered at first 10,000 men with 24 field guns, seemingly adequate for the reduction of the 17th-century works built by Sebastien de Vauban. But the defender, Col. Pierre Denfert-Rochereau, a skilled military engineer with advanced ideas, increased his meagre force to 17,600 men and fortified the ridges commanding the town, the Perches on the east, and Bellevue and Des Barres on the west. The Germans attacked on Nov. 3, 1870, but met stiff resistance. Their main attack began one month later from the west between Essert and Bavillers, and ten days later Bosmont, to the southeast, was captured. Danjoutin, south of the Perches ridge, was stormed on the night of Jan. 7–8, 1871. Typhus and smallpox had broken out among the French, and the victory of von Werder at the Lisaine put an end to hope of relief. The siege corps was heavily reinforced and Perches ridge was captured on Feb. 8. The Germans could now shell the centre of the town, but the general armistice on Feb. 15 brought operations to an end. The garrison had lost 4,750 men and 336 citizens, while German losses were about 2,000 men.

BELFRY, originally a movable wooden tower employed in sieges for attacking and scaling city or castle walls; also a watch-tower, particularly one that had an alarm bell. In modern usage the word signifies any bell tower, attached or detached, and also the tower chamber where bells are placed. *See* also CAMPANILE.

BELGAE, the name given by Julius Caesar to the inhabitants of Gaul north of the Sequana and Matrona (Seine and Marne) rivers. Their claim to be of "German" stock means only that they had crossed the Rhine later than other Celts (*see* CELT); and Caesar exaggerates the difference between their culture and that of the rest of Gaul. The evidence suggests that they penetrated into these areas about 150 B.C.; the newcomers continued the *vases carénés* or "pedestal urns" of the so-called "Marne" civilization (*see* LA TÈNE), but introduced cremation. The most highly developed Belgic culture is found among the more southerly tribes, such as the Atrebates and Bellovaci (in northern France); the Nervii and other northern tribes (in modern Belgium and southern Netherlands) retained elements of Hallstatt culture (*see* HALLSTATT) at a time when most of Gaul was passing through the late La Tène period.

The Belgae of Gaul formed a coalition against Caesar after his first Gallic campaign, but were subdued in the following year (57 B.C.), the Atuatuci being enslaved. The Eburones in the north revolted in 53 and slaughtered 15 Roman cohorts; in revenge they were practically exterminated, and new tribes such as the Cugerni and Toxandri crossed the Rhine to replace them. (For the subsequent prosperity of the whole Belgic area under the empire, *see* GAUL.)

During the first half of the 1st century B.C. Belgae from the Marne district, with their pedestal urn culture, had crossed to Britain and had formed the kingdom that in 55 B.C. was ruled by Cassivellaunus (*q.v.*), in Kent, Hertfordshire and parts of Essex. The contact between this kingdom and the Gallic Belgae is given by Caesar as one of his reasons for crossing to the island in 55 and 54 B.C. After his Gallic victories (54–51 B.C.) further settlers (including his enemy Commius, king of the Atrebates) took refuge across the channel. Belgic domination spread to Hampshire, Berkshire and west Sussex, and Belgic culture is found in most of lowland England. The subsequent Belgic kingdoms can be identified by the coinage, which started about this time. The three most important were centred on Colchester, St. Albans and Silchester; and of these the first two were united later under Cassivellaunus' great-grandson Cunobelinus, who ruled from about A.D. 5 to just before the emperor Claudius' invasion of Britain in 43.

In decorative art (including coin types) the British Belgae showed themselves increasingly receptive of romanizing influences, and there was a steady stream of Roman imports. The chief Belgic contribution to southern England was the introduction of the heavy plow, which cleared many lands previously intractable.

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BELGAUM, a town and district of Mysore state, India. The town stands nearly 2,500 ft. above sea level, 245 mi. S. of Poona by rail. Pop. (1961) 127,885. A 16th-century fortress contains two interesting Jain temples. The town is a centre of trade and of cotton weaving, and also has clay, soap, pottery and metal utensil works and a tannery. Its southern suburb Shahapur is known for gold and silver work, besides silk and cotton weaving. The ancient name of Belgaum was Venugrama, said to be derived from the bamboos characteristic of its neighbourhood. There is an airport at Sambre, 7 mi. away.

BELGAUM DISTRICT had a population (1961) of 1,983,811 and an area of 5,163 sq.mi. North and east the country is open and well cultivated, but the west is intersected by spurs of the forested Western Ghats (Sahyadri). Crops include millet, rice, cotton and sugar cane. There is a sugar factory and manufacture of cotton cloth. A line of the Southern railway crosses the district.

The ancient site Halsi, according to 5th century A.D. inscriptions on copper plates discovered there, was once a capital of the Kadamba dynasty. From mid-6th century to about 760 the country was held by the Chalukyas of Badami. After passing through many hands it became in 1818 part of Dharwar district under the East India company. In 1836 this was divided into two districts, Dharwar and Belgaum; it remained in Bombay until the linguistic reorganization of states in 1956. (V. V. B.; P. B. D.; M. S. H.)

BELGIAN CONGO, the former Belgian colony in central Africa that in 1960 became the Republic of the Congo; from 1885 to its annexation by Belgium in 1908—the period when it was virtually the personal property of King Leopold II—it was called the Congo Free State. This article deals with the history of the country to June 30, 1960, when it became an independent republic; for its later history, and for geography and details of population, *see* CONGO, DEMOCRATIC REPUBLIC OF THE.

Early History.—The Republic of the Congo owes its existence as a political unit to the initiative of one man: Leopold II, king of the Belgians from 1865 to 1909. What existed before his time in the Congo river basin, and what had always existed, as far as is known, was a number of scattered independent tribal groups of varying size. Nothing seemed to indicate that these would ever be united. In the equatorial forest region these groups were generally very small, but in the northern and southern savanna regions they were sometimes larger and might even be called kingdoms. One of these kingdoms was called Congo, and gave its name to the river. At the time of its greatest extension, however, in the 16th century, it covered only a part of the present lower Congo (from Stanley Pool lake downstream) and the northern

part of the present Angola. In the 19th century, the kingdom had completely disintegrated and was only a historical memory. Leopold II was driven toward central Africa by his belief in his country's absolute need of a colony, but as he did not succeed at first in gaining the support either of his government or of the Belgian people as a whole for his ideas, he had to act in his private capacity and establish at his own cost a state of his own, which he conceived as a future Belgian colony.

Central Africa, when the king first turned his attention to it, was still largely unknown. The greater part of the Congo basin was still a blank on the map. The first task was exploration. For that purpose, in 1876, the king summoned a Geographical conference in Brussels which resulted in the foundation of an African International association. This was a scientific and philanthropic association, organized to promote the exploration and civilization of central Africa. As an international venture it was not a success, but it served as a very effective cover for the king's personal enterprises.

These took a decisive turn with the announcement of the results of the great journey across Africa in 1874–77 by Henry M. Stanley (*q.v.*), and his discovery of the course of the Congo. The king then decided to concentrate on the Congo, and to make Stanley his chief agent. Stanley entered the service of the king in 1878. He was officially engaged by the Comité d'Études du Haut Congo, and later (1882) by the International Association of the Congo (Association Internationale du Congo, or A.I.C.). These were only nominal affiliations as both organizations were mere tools in the hands of King Leopold.

In five years (1879–84) Stanley, helped by a few dozen young Europeans and by soldiers recruited mainly in Zanzibar, succeeded in establishing a connection between the Congo estuary and Stanley pool through the difficult cataract region. He then launched steamers on the upper river, and founded a few stations along the river up to Stanley falls. He met neither serious native resistance nor foreign opposition. On Stanley pool, however, which had been reached by the Frenchman Savorgnan de Brazza before his arrival, he had to leave the northern shore to the French, establishing his own station, Léopoldville, on the southern shore.

Stanley signed treaties with a number of African chiefs who transferred their sovereignty to the A.I.C., but to profit by these treaties and acquire a sovereign status, the A.I.C. needed the recognition of the great powers. In seeking such recognition King Leopold assured the powers that he would open the Congo basin to free trade and assure equal treatment to all nationalities.

This led first the United States (April 1884), then Germany (Nov. 1884) and afterward all the great European countries to recognize the A.I.C. as an independent power. The free-trade engagements regarding the Congo were at the same time emphasized in the Berlin act concluded at the end of the Berlin West African conference (Feb. 1885). This international conference had met, under the presidency of the German chancellor, Bismarck, not to deal with the partition of Africa, but specifically to define a free-trade zone in central Africa. On the day when the final act was signed, the A.I.C., having been recognized by all the major powers, was in a position to adhere to the act as an independent state.

Leopold's next step was to assume his place as the sovereign of the new state. The Belgian chambers in April 1885 authorized the king to act as the chief of the state, with the proviso that its union with Belgium should be "exclusively personal." Strictly speaking, Belgium bore no responsibility whatever in Africa, and this remained the case until its annexation of the Congo in 1908.

The Congo Free State.—From July 1, 1885, the new state took the name of Congo Free State (État Indépendant du Congo). Its sovereign and its central administration were in Brussels. The seat of the local government was at Boma, on the lower Congo. The frontiers which were defined by the king in 1885 enclosed a territory approximately coinciding with that of the Congo republic. These frontiers bore no relation to the real extent of territorial occupation, which was still limited to a few districts on the lower Congo and along the upper river. Nevertheless, they were accepted by all the powers, which could not disapprove of King Leopold's plan to open up central Africa to all traders at his own cost.

The occupation of the territory was a slow process, especially because of the financial difficulties of the state. It was mostly peaceful. The only serious clashes were with the Arabs, who, like the notorious Tipoo-Tib, had entered the eastern parts of the country as slave and ivory traders and had established political control over these regions. Most of the Arab chiefs were defeated in campaigns between 1892 and 1894. Many Belgian officers distinguished themselves in these campaigns. The Katanga region, with its great mineral wealth, had been secured during 1891–92 by expeditions which had to race with those of Cecil Rhodes' agents. King Leopold also tried to extend the territory of the state beyond its original limits. These efforts met with little success except for the temporary occupation of the Lado enclave on the Nile. This was leased from England during 1894–1909.

For years the personal subsidies of the king formed the major part of the state's resources. When the financial burden became intolerable for the sovereign, he appealed to Belgium. In 1890, and once more in 1895, he was granted considerable loans. Belgium in exchange received the right to annex the Congo state, if it wished to do so, in 1901. Financial salvation, however, was achieved mainly by the economic device known as the *régime domanial*, by which all the vacant land was declared state property. The products of this land were also considered to be state property. This applied to most of the ivory and rubber of the country. Traders, from 1891 on, were forbidden in most parts of the state to buy these products, which were thenceforth collected by state agents. This killed all private trade in many areas. In a few years, however, the rubber revenue became enormous and the basis of the prosperous state finances.

It was soon alleged that in many cases the compulsory collection of rubber involved oppressive treatment of the population. These charges appeared conspicuously in the report of the British consul at Boma, Roger Casement, which was published in 1904 by the British government. They led in England to a strong anti-Congolese campaign, led by E. D. Morel, who founded the Congo Reform association. An independent commission of inquiry was sent to the Congo and its report, while expressing admiration for the many signs of progress, confirmed the existence of grave abuses there.

The Congo state made serious efforts to improve the situation, but it appeared that the only way to eradicate the evil completely was to transfer control to Belgium. Belgium had not exercised its right of annexation in 1901, being satisfied at that time with the Free State regime, but in 1906 the chamber of deputies passed two motions in favour of annexation. Negotiations were long and difficult, however, because the king wanted Belgium to guarantee the continuance of the Fondation de la Couronne, a corporation which owned vast rubber estates covering more than one-tenth of the area of the state, the revenue from which was used at the king's discretion for various purposes of public interest. A first treaty of transfer, maintaining the Fondation, was signed in Nov. 1907, but this encountered strong opposition both in parliament and from public opinion and it was amended in March 1908 by a second act which suppressed the Fondation.

Annexation by Belgium.—Long debates took place in the Belgian parliament on annexation, which was opposed by the Socialists and some Liberals, and on the law setting forth the principles upon which the new colony should be governed. This law, called the Charte coloniale, established a colonial office (*ministère des colonies*) and a strict parliamentary control over colonial government. Annexation was effected on Nov. 15, 1908.

Under the new Belgian administration, with Jules Renkin as first colonial secretary (1908–18), the *régime domanial* was abolished and free trade completely restored. This led to the end of the campaign of the Congo reformers in England. Official recognition of the annexation was nevertheless withheld by the British government until 1913.

During World War I, the Congo defense force took part in several campaigns against the Germans: in the Cameroons, Rhodesia and especially in East Africa. A considerable part of German

East Africa was conquered by Congolese troops, which entered Tabora in Sept. 1916. After the war Belgium received a mandate over only a portion of these territories, viz., over Ruanda-Urundi (*q.v.*). From the economic point of view, private enterprise, and more specifically great capitalistic enterprises, were mainly responsible for the development of the country after 1908. Some of the big concerns dated from the Congo Free State era. One, the Compagnie du chemin de fer, had achieved a brilliant success by building the first Congo railway, from Matadi to Léopoldville, which was put into service in 1898. But the great era, especially for the mining companies, began after 1908. The Union Minière du Haut Katanga (established in 1906) produced its first ton of copper in 1911; in 1928 its copper production had reached 7% of world production. Diamonds were discovered in 1907 in the Kasai by a prospector of the Forminière; in 1929 the Congo ranked second among the countries of the world, just after the Union of South Africa, in the production of diamonds. Mineral products took the place of rubber as the mainstay of the Congo economy. In 1901 rubber represented 87% of the total value of exports; in 1928 this proportion had dwindled to about 1%. Mineral products by the same time had reached more than two-thirds of the total. Copper alone in 1928 represented about half of all mineral exports. The main agricultural exports at that time were palm nuts, palm oil and cotton.

As a country whose economy was based on the export of raw materials, the Congo was seriously affected by the depression of the 1930s, and the fall in price of all primary products. The crisis became so severe that the country's financial stability was endangered. Belgium had to grant large subsidies to help the colony's budget and to avert catastrophe. In 1934, Belgian grants represented 47% of the Congo's budgetary receipts.

When World War II came, the economic crisis had been overcome. The main contribution of the Congo to the war was economic, and the Congo never left the side of the allies. The war effort was directed by the Belgian government, which had established itself in London in 1940 after the invasion of Belgium, and by the governor general of the colony, Pierre Ryckmans. A Congolese expeditionary force fought successfully against the Italians in Ethiopia in 1941, but this was less important than the production of raw materials, which was increased during 1940–45 to meet the demands of the allies. Congolese tin was of the first importance after the loss of southeast Asia. Uranium ore was furnished by the Union Minière to the United States for the construction of the first atomic bomb.

After the war, the rate of economic development increased still more rapidly. This is best illustrated by the growth of the white population: in 1944, 34,000; in 1958, 113,000 of whom 88,000 (78%) were Belgians. The growth of the big cities was enormous. In 1944 the population of Léopoldville was about 100,000; in 1958 it was estimated at 389,547.

Characteristic of that period was the ten-year plan for economic and social development (*plan décennal*), which was published in 1949. This aimed at the development of public works, the improvement of the living standard of the African population and the creation of a domestic market. It cost more than 50,000,000,000 fr., all furnished by the Congo exchequer or by public loans.

The Missions.—The civilizing work of the Belgians was marked from the beginning by close co-operation between the state and the missions. Protection of missionaries of all denominations was one of the provisions of the Berlin act of 1885. For a long time, however, state subsidies were reserved for Catholic missions, as they alone appeared to be "national" (Belgian). In 1946 the subsidies were extended to the Protestant organizations, which were all non-Belgian at that time.

Practically all the great Catholic orders sent missionaries to the Congo. The first to arrive were the White Fathers of Cardinal Lavigerie who, coming from the east, were already at work along the shores of Lake Tanganyika in 1880. Then came the Fathers of Scheut (1888), the Jesuit Fathers (1893), and others. The first important Protestant station was that of Léopoldville, established in 1882 by the Baptist Missionary society. Protestant missionaries came mainly from Great Britain, the United States and Sweden. In the 20th century the numerical relation between the two groups of missionaries was about four or five to one.

The work of the missionaries was never restricted to evangelization. It also made an important contribution to the medical services and to education. Up to 1954, when the first nondenominational state schools for Africans were opened, the state relied completely on the missionaries for the education of the Africans. The two main educational efforts of the missionaries were directed at primary education and the training of an African clergy. Because of these efforts the level of literacy in the Congo became one of the best in Africa, while the number of African priests grew steadily. But the development of college and university education was much slower. The first Congolese to graduate from a university received his degree at Louvain (Belg.) in 1956. An important step forward was the foundation of two universities in the Congo, the Catholic university of Lovanium, near Léopoldville (1954), and the state university of Elisabethville (1956).

The medical work of the missions supplemented the efforts of the state, the great industrial societies and specialized bodies like the FOREAMI (Fonds Reine Elisabeth pour l'assistance médicale aux indigènes). The hardest fights were against sleeping sickness and malaria. The general mortality rate, which was still 30–40 per thousand in the interwar period, had come down to about 20 per thousand in 1957.

The Belgian System.—The Belgian system of colonial government had two main characteristics which distinguished it from the British and French systems: a high degree of centralization, and paternalism. Brussels remained up to 1960 the nerve centre of colonial government. Colonial law was made there by the king acting through his responsible minister, with the help of a colonial council (Conseil colonial). There was no legislative council in the Congo. Control was in the hands of the Belgian parliament. No body elected in the Congo itself had any control over the administration. Up to 1957 no inhabitant of the country, whether European or African, had the right to vote. This was the result of a deliberate policy of postponing elections until they could be organized with the assurance of an African majority. Thus control by the minority of European settlers was deliberately excluded.

The first elections were the municipal elections of 1957 in the great towns, with universal male suffrage. It was long believed in Belgium that the process of emancipation of the Congo would be a slow and gradual one. It proved on the contrary to be the quickest in Africa. The first Congolese parties asking for greater political liberty appeared in 1956. By 1958 several of these parties had published programs demanding the independence of the Congo. The Belgian government came to the conclusion that to try to curb African nationalism would be a fruitless task; they were confirmed in that opinion by the troubles which broke out in Léopoldville on Jan. 4, 1959. On Jan. 13 an official declaration of policy was made, promising independence to the country. No time limit was given, but the nationalist parties asked for immediate independence. To withstand this demand would have meant a struggle which every section of public opinion in Belgium wished to avoid. A round-table conference with African leaders met in Brussels during Jan.–Feb. 1960. It passed resolutions approved later by the Belgian parliament, which fixed the date of independence as June 30, 1960.

See also Index references under "Belgian Congo" in the Index volume.

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BELGIAN LITERATURE. The literature of Belgium falls into two divisions, according to the language in which authors

write: Flemish and French (*see* BELGIUM: *Population*).

FLEMISH

When speaking of the linguistic and literary conditions of Flemish Belgium, it must be remembered that for centuries the Belgian territories (Flemish and Walloon) were united politically, economically and culturally with what is now the Netherlands (*q.v.*); it was only toward the end of the 16th century that religious influences made the northern (Reformed) Netherlands secede from the Catholic south. Thus, until approximately 1600 the literature of Flanders and Holland showed itself as a strongly united entity.

It was in Flemish that the literature of the medieval Netherlands flowered most profusely; for example, in the work of Henric van Veldeke (Heinrich von Veldeke, *q.v.*), in *Van den vos Reinaerde* (*Reynard the Fox, q.v.*), in *Beatrijs*, in the mystical writings of Hadewych (*q.v.*) and of Jan van Ruysbroeck (*q.v.*) and in the religious and secular drama (such as the *Abele* plays, *Mariken van Nieumeghen* and *Elckerlyc*, from which *Everyman* was translated), as well as in Jacob van Maerlant (*q.v.*) and his didactic school. It was, moreover, in Flanders that letters showed a new vigour under the influence of the Renaissance and the Reformation. In the literature inspired by the latter, the tone was set by the glowing satirical verse of the Catholic Anna Bijns and the polemical *Biencorf der H. Roomsche Kercke* of the Calvinist Philips van Marnix van Sint Aldegonde (*q.v.*), who also wrote in French. The Renaissance started with L. de Heere, C. van Mander and J. van der Noot—all three of whom, significantly enough, had to flee their country for religious reasons.

Emigrés fled in great numbers to the north because of the religious and political troubles which paved the way for the secession of the Netherlands, with the result that the impulse toward a great revival of Renaissance and baroque literature in Flanders was interrupted and a period of decline set in. Whereas Holland was approaching its golden age, partly helped by the immigrants from the south (*e.g.*, Joost van den Vondel), the Counter-Reformation in the Catholic south showed no first-class literary work. But J. de Harduyn (1582–1636), a lyrical poet after the fashion of the *Pléiade*, R. Verstegen (*c.* 1550–1640), a polemicist and a writer of "characters," A. Poirters (1605–74), a popular moralist, the dramatists Willem Ogier (1618–89) and C. de Bie (1627–*c.* 1711) and, especially, M. de Swaen (1654–1707), the last important baroque poet and playwright who was deeply inspired by religion, may be compared to their advantage with the majority of didactic, moralizing and popular writers of the period. The decline was most noticeable in the first half of the 18th century, the popular character of Flemish letters becoming more marked as the elite came increasingly under French influences.

Before the end of the 18th century, however, W. Verhoeven and J. B. C. Verlooy had started a reaction against the French influence. Like the contemporary historical and scientific writers, they reverted to the work of the 16th-century humanists; but they neglected the medieval masterpieces. The literary revival, though still very halting, was helped by the "Rederijkers" ("rhetoricians") who, despite the submission of the upper class to French influence, continued more or less successfully to use their own language. Karel Broeckaert (1767–1826) wrote dialogues modeled on Addison's *Spectator* essays in a spirit of rational liberalism, creating a literary figure, "Gysken," the ironical representative of the old regime; he also wrote the first Flemish prose story, *Jellen en Mietje* (1811). The poet P. J. de Borchgrave (1758–1819) embodied the transition from classicism to romanticism, and J. B. Hofman (1758–1835), a prolific playwright, introduced the middle-class tragedy or *drame bourgeois*.

Romanticism made its influence clearly felt in the first quarter of the 19th century and helped to revive Flemish national consciousness. Thenceforth nationalist inspiration and the glorification of the past were preferred to individual sensibility. The older generation (J. F. Willems, J. B. David, P. Blommaert, F. Snellaert), particularly active in Ghent, still gave proof of a rational spirit in vigorous philological, historical and controversial writings. It was they who rediscovered the treasures of the medieval inheritance (*Van den vos Reinaerde*, Ruysbroeck and Maerlant, as well as old songs and chronicles) and to their group belonged the first two important poets of the new epoch, K. L. Ledeganck (1805–47) and P. van Duyse (1804–59). The younger generation, active in Antwerp, was more spontaneously romantic and preferred creative to philological work. Its typical representative was the prolific Hendrik Conscience (*q.v.*), the creator of the Flemish novel, of whom it is said that "he taught his people to read." Conscience wrote ardent historical novels, for example, *De Leeuw van Vlaanderen* (1838), an epic of the battle of the Golden Spurs, which has inspired patriotic feeling for generations; he also wrote moral-social stories and masterly rustic tales (*De Loteling*, 1850). Theodoor van Rijswijck and J. A. de Laet freed poetry from classical concepts and forms. The ultraromantic stories of E. Zetternam and F. van Kerckhoven denounced social evils.

Reaction against romanticism set in about 1860 with D. Sleeckx, protagonist of a quiet realism. Writing in general was now characterized by acute observation, description of local scenery, humour and pessimism. Anton Bergmann produced a masterpiece of storytelling (*Ernest Staes*, 1874). Virginie Loveling (1836–1923) made the novel more profound and widened the field of problems treated in it (*Een dure eed*, 1890). J. M. Dautzenberg, J. van Beers and R. Loveling made poetry finer and more sober. Max Rooses, spiritually allied to H. A. Taine, proved himself the first Flemish literary critic worthy of that name. He wrote the standard work on Rubens (1903).

Parallel to this rather dull realism was a remarkable revival in West Flanders. The genius of Guido Gezelle (*q.v.*) found in God, in nature, in his country and in an easily moved and deep-rooted sensibility the fourfold inspiration for an almost perfect and entirely original lyricism. With its passion, its soul-life, its contemplation of God's glory, its noble thirst for eternity and the discovery of a metaphysical sense in its innate melancholy, this poetry was without equal in the Europe of the period. Hugo Verriest (1840–1922), a nationalist agitator as well as an excellent *causeur*, made prose natural and supple once more. Albrecht Rodenbach (1856–80), the "ideal young man" who died too young, wrote militant songs, thoughtful lyrics, monumental epic verses and a verse-tragedy (*Gudrun*, 1882).

The generation of *Van Nu en Straks* ("Today and Tomorrow," 1893–94, 1896–1901), a review which was to make Flemish literature of European importance in the 1890s, was more fruitfully influenced by Gezelle, Verriest and Rodenbach than by its immediate predecessors of the 1880s. Led by Pol de Mont (1857–1931), a versatile and often brilliant personality but above all a fresh and already complex modern poet, this generation had, however, widened the horizon and, by their emphasis (though inconclusive) on sensuousness, on individualism and on the doctrine of art for art's sake, prepared the ground for their successors.

The writers grouped around *Van Nu en Straks* helped to bring about a true revival of Flemish letters. Though they held various opinions (there were anarchists as well as conservative Catholics in their ranks), they all strove, under the banner of neo-romanticism, for an art which would comprehend all human activity and in which individual feelings would be given universal significance. In his masterly essays and in his symbolic novel *De Wandelende Jood* (1906) their leader, August Vermeylen (1872–1945), advocated rationalism infused with idealism. Prosper van Langendonck (1862–1920), on the other hand, interpreted the incurable pain of the *poète maudit*. E. de Bom wrote the first modern Flemish psychological novel (*Wrakken*, 1898) and Alfred Hegenscheidt a Wagnerian drama (*Starkadd*, 1898).

The poetry and prose of Karel van de Woestijne (1878–1929) forms the symbolic autobiography of a typical *fin de siècle* personality, the sophisticated and tired sensualist who strives to attain increasing spiritual detachment and who is constantly concerned, since he possesses a disturbingly vivid imagination as well as a sharp intellect, with two of life's chief problems—those of man's relationship with woman and God's relationship with man. These are the themes of his work (often overloaded with meanings), one of the great achievements of European symbolism and one of the most passionate confessions of human frailty in literature.

Stijn Streuvels (*q.v.*), a master of prose (*Langs de Wegen,* 1902; *De Vlaschaard,* 1907; *Werkmenschen,* 1926), made the West Flemish landscape his microcosm, a visionary world of his own in which man is at one with nature. The polished work of the versatile Herman Teirlinck (1879– ; novelist, dramatist and essayist) is characterized by imagination, sensuality and a sonorous vocabulary. In F. V. Toussaint van Boelaere's stylistically refined stories —crystallizations of intense experience—there are often tragic undertones.

Apart from the influence of *Van Nu en Straks* other tendencies of writing developed, of no less importance in many respects, which were to complete the flowering of the late 19th century. Naturalism reached its apex in the robust tales (*Het Leven van Rozeke van Dalen,* 1906) and pithy plays of Cyriel Buysse (1859–1932) and in the now flourishing regional novel, best exemplified by Maurits Sabbe's emotional evocations of Bruges and by Lode Baekelmans' vivid treatment of life in Antwerp. The pictorial verse of O. K. de Laey and the vigorous rhythms of René de Clercq have a permanent quality as living poetry. Jules Persyn, a leader of the renascent Catholic intelligentsia, showed how to apply neo-scholasticism to literature. But the man who, apart from Vermeylen, represented the strongest intellectual force of his time was the priest Cyriel Verschaeve (1874–1949), the scope of whose work, like Vermeylen's, proved that he was more than a writer of belles-lettres; his poems, plays (*Judas,* 1917; *Maria Magdalena,* 1928) and essays are passionate expressions of his intensely Augustinian outlook.

The "Boomgaard Groep" ("Orchard Group"), which included A. de Ridder and P. G. van Hecke, introduced a peculiar nuance, striving to be more cosmopolitan than *Van Nu en Straks* and taking up the cudgels for a dilettante culture. The elegiac poet Jan van Nijlen, an amiable stoic, had certain affinities with it.

During and immediately after World War I there was a sudden new flowering of the picturesque regional or rustic tale; a few original books such as the exuberant *Pallieter* (1916), by Felix Timmermans (*q.v.*) and Ernest Claes' roguish *De Witte* (1920) became known far beyond the frontiers of Flanders. In the poetry of A. van Cauwelaert and the prose of F. de Backer (*Longinus,* 1934) it can be seen that the generation that fought on the front stressed life rather than literature. But the new trend that had revealed itself under the German occupation in World War I found its clearest outlet in a revolutionary expressionism. The review *Ruimte* ("Space," 1920–21), its most important rallying point, published this generation's manifesto: ethics must have priority over aesthetics and the art of the community over individualism. Expressionism was most apparent in lyrical production and on the stage.

The outstanding personality of this movement was Paul van Ostaijen (*q.v.*), who expressed his faith in humanity with moving lyricism (*Het Sienjaal,* 1918), but later turned to nihilistic Dadaism and, not long before his early death, to "pure poetry." In the meantime W. Moens, K. van den Oever, M. Gijsen and A. Mussche, in excessively metaphorical language and in revolutionary free verse, expounded a religious kind of humanitarianism, whereas V. J. Brunclair and G. Burssens practised Van Ostaijen's "pure poetry."

Against this expressionism the poets of *'t Fonteintje* ("The Little Fountain," 1921–24), the harsh and wanton Richard Minne (1891–) and his friends M. Roelants, R. Herreman and K. Leroux, reacted. They confessed their love of life in conservative forms, while the uncompromising traditional poet and essayist U. van de Voorde took up the defense of "eternal lyricism."

In the favourable atmosphere of expressionism the stage suddenly found a new life. Between 1923 and 1929 the "Vlaamse Volkstoneel," under the direction of J. O. de Gruyter and later Johan de Meester, was among the foremost avant-garde theatres in Europe. This revival also inspired native Flemish drama, the standard of which was raised by the playwright H. Teirlinck (*De Man zonder lijf,* 1925), Anton van de Velde (*Tijl,* 1925), Paul de Mont, Gaston Martens and Willem Putman. In 1930 H. van Overbeke staged for St. Bavo's cathedral in Ghent the first important open-air play in Belgium, *Het Lam Godsspel,* inaugurating a genre that became very popular after World War II.

By about 1930, however, the tide of expressionism had completely run out. The novel then took its revenge. As opposed to the more pictorial, anecdotal and provincial stories of their predecessors, Maurice Roelants (1895–) in his psychological *Komen en gaan* (1927), Gerard Walschap (1898–) in his dynamic novels and Lode Zielens in his stories of social interest sought to describe the inner man's conflicts and his moral, religious and social problems. Walschap, seeking to exert a direct influence on his contemporaries, broke with his predecessors in content and form (*Houtekiet,* 1940). Among the psychologists and stylists were F. de Pillecijn, M. Gilliams and A. van Hoogenbemt. The *Nieuwe Zakelijkheid* ("New Realism") writers included M. Matthijs, N. E. Fonteyne and A. Demedts. Three acute observers of human weakness, the corrosive Willem Elsschot (1882–1960; *Kaas,* 1933; *Het Dwaallicht,* 1946), the sceptical Raymond Brulez (1895– ; *Sheherezade,* 1932; *Mijn Woningen,* 4 vol., 1950–54) and the intellectual Marnix Gijsen (1899– ; *Het boek van Joachim van Babylon,* 1947), all clear stylists but perverse moralists, came to be recognized as important modern Flemish novelists. Poetry after 1930 turned its back on explosive humanitarianism and expressionist experiments. The tone was set by "personalistic" poets of the *Vormen* group—the hermetic dreamer P. G. Buckinx, the "vitalist" R. Verbeeck—and by such independents as the religious poet Albe, the dynamic B. Decorte and the noble pagans K. Jonckheere and H. Hensen.

The best writers of the generation which came to the fore during and after World War II were novelists. Poetry took second place: A. van Wilderode, H. van Herreweghen, Reninca, C. d'Haen and—to a certain extent—J. de Haes were traditionalists, whereas the experimental poets used new techniques and by exploiting the potentialities of the word, the image and the subconscious created confused worlds of their own which contain elements of both the real and the unreal. The most important members of this experimental school, inspired mainly by the French post-surrealists and by Van Ostaijen and Dylan Thomas, were Hugo Claus (1929– ; *De Oostakkerse gedichten,* 1955), R. van de Kerckhove, A. Bontridder, B. Cami and A. de Roover. In the field of drama, three developments should be noted: the staging of the literary plays of J. Daisne and H. Hensen, which were only moderately successful in spite of their real literary qualities; massive productions such as *Het Heilig-Bloedspel* (written by Jozef Boon, directed by A. van de Velde, music composed by A. Meulemans, with a cast of 2,000), which drew thousands of spectators, many from abroad; and the success of small avantgarde theatres and of new experimental plays by Claus (*Een bruid in de morgen,* 1955), P. Sterckx, T. Brulin and J. van Hoeck. The novel was notable for its wide range of subjects and styles: magic-realistic (Daisne), psychological (H. Lampo), social (P. van Aken), Catholic problematic (G. Duribreux, P. Lebeau and V. van Kerkhove), populist (L. P. Boon), existentialist (J. Walravens) and experimental (Claus). The last three belonged to the *Tijd en Mens* group (1949–55) which was superseded by the new avantgarde groups, *De Tafelronde* (1953–), *Taptoe* (1953–55) and *Gard-Sivik* (1955–). (R. F. Ls.)

FRENCH

Belgium, situated on the farthest continental frontier of the Roman empire, possesses a literature in French the history of which seems to some to form merely a chapter in the great history of French literature. It is distinguished, however, by certain characteristics which have indeed become more apparent since the gradual development of a national consciousness after the achievement of independence in 1830.

In the middle ages an abundant literature was produced in the Belgian provinces: *chansons de geste, romans d'aventure,* lyrical and didactic poetry, fabliaux, plays and histories. The principal authors of this period, which stretches from the 11th century to 1530, are Jean Froissart, Georges Chastellain, Philippe de Commynes and Jean Le Maire de Belges (*qq.v.*). The last, in love with fine language, is considered a forerunner of the French poets Clément Marot and Ronsard.

This brilliant period was followed by one of great literary sterility (1530–1800). Economic decline and the indifference of those in power to intellectual activity largely explain the poverty of literary output. Two names, however, deserve mention—those of the bold, biting and exuberant pamphleteer who attacked the pope and defended the ideas of the Reformation, Philips van Marnix van Sint Aldegonde, and of Prince Charles Joseph de Ligne (*q.v.*), a talented dilettante-poet, essayist, moralist, biographer and letter writer—cosmopolitan in outlook and with a great sense of style.

With the 19th century began a period of transition. The conditions favourable to a literary renaissance slowly took shape, thanks, in particular, to the efforts of the song writer Antoine Clesse (1816–88), the poets Théodore Weustenraad and André van Hasselt (*q.v.*), the novelist Charles de Coster (*q.v.*) and the philosopher Octave Pirmez (*q.v.*). The most vigorous and original writer of this group was undoubtedly Charles de Coster, whose masterpiece, *La Légende et les aventures héroïques, joyeuses et glorieuses d'Ulenspiegel et de Lamme Goedzak au pays de Flanders et ailleurs* (1867), although it had little success during its author's lifetime, later attracted numerous readers, particularly in eastern Europe.

By about 1880, Belgium had at last become conscious of its own literary potentialities and had achieved, in every sphere, a remarkable degree of success. A young writer, Max Waller, was responsible for the bringing together of its scattered energies. In 1881 he founded a review, *La Jeune Belgique*, organized several noisy demonstrations and shook public apathy. Numerous important works were to appear soon after.

Several novelists attracted attention. Camille Lemonnier (*q.v.*) wrote naturalistic, idealistic and imaginative novels. He was a painter of nature, an admirer of instinctive behaviour, a disciple of Zola. His *Un Mâle* (1881), and *Happe-Chair* (1886) are written in a highly distinctive style and make use of an obscure vocabulary. Eugène Demolder (1862–1919) drew his inspiration from the Bible, from legend and from folklore. He had a gift for the picturesque and the colourful. Georges Eekhoud (1854–1927) was a painter of social life, full of affection for the poor and the victims of misfortune and social injustice. Georges Rodenbach (1855–98), as well as being a poet of the old Flemish cities and the theme of melancholy, celebrated *Bruges-la-Morte* in a novel translated into English by Thomas Duncan in 1903. While Georges Virrès (1869–1946) praised the rough life of the Campine, Louis Delattre (1870–1938) and Maurice des Ombiaux (1868–1941) wrote stories that were sentimental and vivacious, ironical and truculent, about Wallonia. Henry Carton de Wiart (1869–1951) published historical novels. Other novelists studied the working people or the lower middle classes: Hubert Krains, Georges Garnir, Hubert Stiernet, Edmond Glesener. Henri Davignon, on the other hand, made a study of leisured society.

In poetry, the generation which was brought to light by *La Jeune Belgique* includes at least two world-famous names: Émile Verhaeren and Maurice Maeterlinck (*qq.v.*).

Émile Verhaeren wrote of the Scheldt and of his native Flanders, of the spreading towns, of physical effort and married love. This tense, stormy, torrential poet arouses lasting responses and creates powerful symbols. Among his collections of poems, these deserve special mention: *Les Campagnes hallucinées* (1893), *Les Forces tumultueuses* (1902), *Toute la Flandre* in five parts (1904–11) and *La Multiple Splendeur* (1906). Before making his name as a dramatist and essayist, Maurice Maeterlinck brought out a slim volume of poems, *Serres chaudes* (1889), followed, in 1897, by *Douze Chansons*. These works, abounding in contrasts between a real and a fairy world, influenced many French symbolist poets.

Verhaeren and Maeterlinck were closely followed by other poets, of whom the chief are Charles Van Lerberghe, Grégoire Le Roy, Albert Mockel, Iwan Gilkin, Albert Giraud, Émile Van Arenbergh, Valère Gille, Fernand Séverin, Max Elskamp and Adolphe Hardy. Some were symbolist in feeling, others followed the Parnassian ideal and others set out alone for uncharted territory. Of these solitary explorers the one most worthy of note is Max Elskamp (1862–1931), a colourful poet, at once learned and ingenuous, archaic and modern, who composed his work of the simplest materials, drawn from folklore and the daily life of the people.

At the same period, the theatre was also producing very varied works. The most interesting belong to the poetic theatre and the theatre of ideas. The dramatic work of Maurice Maeterlinck, which belongs to the poetic theatre, is centred on the idea of fatality. Everything about it is designed to arouse and maintain an oppressive atmosphere, a climate of mystery and uneasiness: a barely defined plot, hidden meanings and symbols. Although almost impossible to perform, these plays have exercised a profound influence upon the evolution of the drama. The most memorable are: *La Princesse Maleine* (1889), *Pelléas et Mélisande* (1892), *Monna Vanna* (1902) and *L'Oiseau bleu* (1909).

The best representative of the theatre of ideas is Gustave Vanzype (1869–1955). His plays are full of lofty idealism and are very clear in outline, but they have earned more esteem than success. Some which deserve special mention are: *Les Étapes* (1907), *Les Liens* (1912) and *Les Sémailles* (1919).

During this period inaugurated by *La Jeune Belgique* the corpus of Belgian drama was further augmented by the contributions of Charles Van Lerberghe, Edmond Picard, Émile Verhaeren, Paul Spaak, Iwan Gilkin, Georges Rency, Henri Liebrecht and several others.

History, criticism, the art of rhetoric and the essay were also well represented. The man principally responsible for the revival of historical studies, Godefroid Kurth (1847–1916) was succeeded and eventually surpassed by his pupil, Henri Pirenne (1862–1935), whose monumental and soberly written *Histoire de Belgique* (1899–1932) was a powerful work of synthesis.

One of the most notable literary critics was Firmin van den Bosch (1865–1949) who wrote *Impressions de littérature contemporaine* (1905), and the ablest art critics included Camille Lemonnier, Arnold Goffin (1863–1934), Jules Destrée (1863–1936) and a few others.

The essay was, at the same period, enriched by many important works, including those of Maurice Maeterlinck, and many talented writers produced subtle, precise and biting rhetoric. At the outbreak of World War I Belgium had good reason to be proud of her contribution to French letters. The years following the war were no less brilliant than those which preceded it, and the place which literature had now assumed in the country's life was confirmed in 1920 when the Académie Royale de Langue et de Littérature Françaises was founded in Brussels.

After the armistice, new novelists and short-story writers appeared. Their leaders were André Baillon (1875–1932), author of the *Histoire d'une Marie* (1921) and of *Neveu de Mlle Autorité* (1930); Jean Tousseul (1890–1944), whose books describe the work of the quarrymen of the Meuse; Charles Plisnier (1896–1952), who, after being awarded the celebrated Prix Goncourt in 1937 for his short stories *Faux Passeports* and his novel *Mariages*, turned to writing long and detailed psychological novels; Franz Hellens (1881–), a novelist concerned with unlikely facts; Marie Gevers (1883–), whose every work is a great lesson in style, and Pierre Nothomb (1887–) a novelist of great power and abounding imagination. After these novelists mention must be made of Georges Simenon (the creator of Inspector Maigret), Jean de Bosschère, Oscar-Paul Gilbert, Constant Burniaux, Robert Vivier, France Adine, Georges Linze, Lucien Marchal and others.

Poetry was also widely written and the influence of several reviews, among them the *Journal des Poètes*, founded in 1930 by Pierre-Louis Flouquet, stimulated the writing of lyric poetry. Among the finest of the poets is Marcel Thiry (1897–), who writes of speed, departure and absence; Henri Michaux (1899–), a fanatical individualist who bends the language to his will, and Géo Norge (1898–) a personality as singular as it is endearing. To these names should be added those of Roger Bodart, Robert Vivier, Lucien Christophe, Géo Libbrecht, Robert Goffin, Edmond Vandercammen, Armand Bernier, Maurice Carême, Mélot du Dy and Noël Ruet.

The theatre was dominated by Fernand Crommelynck (1885–), whose verbal facility lends itself to outrageous outbursts; of Herman Closson (1901–), for whom introspection is a function of action; and of Michel de Ghelderode (1898–1962),

an expressionistic and experimental dramatist whose works possess astonishing vigour and plastic sense. A new form of dramatic writing, the play for radio, has found in Théo Fleischman a particularly gifted pioneer.

Literature of other kinds has been well served by a number of authors. Historical research has claimed Charles Terlinden, Louis de Lichtervelde, Jacques Pirenne and others including Luc Hommel, permanent secretary to the Académie Royale, who is chiefly interested in the Burgundian period and Margaret of York. Criticism and the essay are represented by Gustave Charlier, Fernand Desonay, Carlo Bronne, Paul Fierens, etc. The statesman Paul-Henri Spaak should be remembered as an outstanding orator.

Since the end of World War II numerous new talents have appeared: the novelists Alexis Curvers, Stanislas Dotremont, Daniel Gillès, François Mallet-Joris, Francis Walder (Prix Goncourt, 1958), Albert Ayguesparse, Paul Dresse, Arthur Nisin, Maud Frère; the poets Charles Bertin, Liliane Wouters, Gérard Prévot, Jean Tordeur, Arthur Haulot; the dramatists Jean Mogin, José-André Lacour and Georges Sion; the essayists Adrien Jans, Marcel Lobet, Maurice Fraigneux; the critic Albert Kies; the historians Georges-Henri Dumont and Jean-Didier Chastelain; and many others. In 1960 literary life in Belgium enjoyed an unparalleled vitality and several international juries had acknowledged the exceptional quality of its output. (J.-E.-M.-G. D.)

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BELGIUM (French BELGIQUE; Flemish BELGIË), a country in the northwest of Europe, lies between lat. 49° 30′ and 51° 30′ N. and long. 2° 32′ and 6° 24′ E. One of the smallest countries of the European continent, covering an area of 11,781 sq.mi. (30,513 sq.km.), it is bounded by the Netherlands on the north and northeast, by Germany and Luxembourg on the east and southeast, by France on the south and west and to the northwest has a 42-mi. coastline on the North sea.

Part of the area formerly known as the Low Countries, Belgium derives its name from Gallia Belgica, the Roman designation of the southern part of that region, which was chiefly settled by Belgic tribes of Celtic origin. These tribes were later infused with Germanic elements, chiefly Salian Franks, whose migratory movement was largely broken by the forests of Flanders and Brabant or by the defensive frontier of the Roman empire. These Franks settled more especially in the northern part of the Low Countries and are now roughly represented in Belgium itself by the Flemish element, while the Walloons of the southern area are in general of a purer Celtic stock.

The Low Countries were incorporated in the empire of Charlemagne, but after his death (814) possession of the area became debatable. Belgium's medieval history is related largely to that of feudal duchies such as Brabant, Luxembourg, Flanders, Hainaut, Limburg and Liège. Its political division into Holland and Belgium was accomplished when the northern provinces of the Low Countries won, under Maurice of Nassau, their independence from Spain in 1609; this division has continued ever since except for an interim between 1815 and 1831. The line of division was dictated rather by geographical, strategical and political reasons than by racial, religious or linguistic ones. In the nine provinces constituting modern Belgium there is thus a Flemish-speaking element (using a variety of dialects or Standard Dutch), which predominates in the northern provinces of East and West Flanders, Antwerp and Limburg and in the northern half of Brabant (roughly the area settled by the Franks in the 4th century A.D.). In the rest of Belgium French-speaking Walloons largely people the original Gallia Belgica. This article contains the following sections and subsections.

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I. PHYSICAL GEOGRAPHY

The country is generally low-lying and in Flanders dikes are necessary to prevent flooding. However, there are some wooded hilly districts, notably the Ardennes (*q.v.*) in the southeast. Main drainage is provided by the Scheldt and Meuse (*qq.v.*) rivers and their tributaries.

1. Geology.—Within Belgium's small area there is a consider-

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able variety of geology. Paleozoic rocks (Cambrian-Silurian) of slate and quartzite, which are part of the Hercynian chain running from western Ireland into Germany, outcrop in the higher Ardennes and the valleys of the Dender (Dendre), Senne and Dyle rivers. Most of the Ardennes region of this chain belongs, however, to the Devonian system which rests unconformably upon the Cambrian. Along its northern margin Ordovician and Silurian rocks appear, and Carboniferous beds constitute the narrow band of the Sambre-Meuse coal field. Zinc, lead and copper are worked in the Paleozoic rocks themselves. In the extreme south occur outcrops of Triassic and Jurassic sands, clays and limestone.

Northwest of the Ardennes the greater part of Belgium is covered by Tertiary and Cretaceous deposits. The latter are not extensive, for the chalk of the Artois ridge plunges northward beneath the Flanders plain to re-emerge first around Mons and then later in the Hesbaye and Herve regions around Liège. Tertiary deposits occupy most of the northern plain. The older Tertiary of Eocene and Oligocene is found in the western and central areas but narrows to the east, where it is flanked to the north by later Tertiary. Of the older Tertiary, the Eocene, chiefly of sand and marls, is found in the west, and the Oligocene stretches from Antwerp to Maastricht. The newer Tertiary comprises a discontinuous strip of Miocene and a fairly extensive area of Pliocene.

Quaternary deposits are of some importance in Belgium. Large areas of the country are covered with the *limon* (a fine, wind-carried dust), which is chiefly found on the Hesbaye plateau and in the Herve region and through Hainaut, Brabant and East Flanders. In the northeast of the country, large sheets of coarse sand and gravel, laid down in postglacial times by the Meuse, cover the Kempenland plateau. Another series of recent deposits are the marine muds and flats of the polders in northwestern Flanders.

2. Climate.—The climate of Belgium is distinctly maritime. Winters are damp and mild with frequent fogs; the summers are cool. The Ardennes plateau, because of its position and altitude, has a climate akin to continental conditions. The annual mean temperature for the country is about 50° F.; rainfall averages 30–40 in. (F. J. M.)

3. Animal Life.—The mammals in the mountains to the east include wildcat, pine marten, roe and red deer. On the low ground where the land is cultivated, they are mainly small and medium sized. The latter include the usual species, badger, otter stoat, weasel, stone marten, polecat and fox. The small mammals include the usual shrews, mice, rats and voles, red squirrels as well as rabbits and hares. There are, however, several more typical of central Europe that extend into southeastern Belgium mainly, and these include the garden dormouse, common hamster, vole rat and pine vole. The water vole lives around the canals and dikes. The bird fauna is similar to that of western Europe including the British Isles. Notable exceptions are the black-tailed godwit, ruff, stone curlew and avocet as breeding birds in the western half of the country, and black grouse and capercaillie in the mountains to the east. A few central European species, including black woodpecker, great gray shrike and bluethroat, occur, and the woodchat shrike and Bonelli's warbler extend in from southwestern Europe. (MA. BU.)

II. GEOGRAPHICAL REGIONS

Belgium can be divided into six distinct regions. Behind the North sea coast lies a lowland known by its historic name of Flanders. Farther inland the land rises gently to the east and southeast, forming the central low plateaus, bounded on the south by the well-defined valley of the Sambre-Meuse. Beyond this valley rises the plateau of the Ardennes, succeeded in the extreme south by a part of the hill-and-vale country of Lorraine. In the northeast is an area of heathland, the Kempenland (in French, Campine).

1. Flanders.—The lowland bordering the North sea coast from the French frontier to the Scheldt—the plain of Flanders—can be further divided into two parts: maritime Flanders, extending inland from the coast for 5 to 10 mi., and interior Flanders. Maritime Flanders is bordered by a straight coastline, 42 mi. in length, with broad, sandy beaches, lines of sand dunes and numerous seaside resorts. Inland of the dune belt an almost flat plain is seamed with drainage channels; more than half is under permanent pasture. Farms stand on low sandy ridges or hillocks above the damp lands. Interior Flanders, crossed by the Lys, Scheldt and Dender rivers, which flow northeast to the Scheldt estuary, rises inland to about 150 ft. In the west low hills of Pliocene sands extend southwest from near Passchendaele, culminating in Mont Kemmel or Kemmelberg (531 ft.). Farming is intensive, and textiles have been manufactured since the middle ages.

2. The Central Plateaus.—The land rises gently inland to about 700 ft. in the south, forming the central low plateaus of Hainaut, Brabant and Hesbaye, crossed by the Senne, Dyle, Geete

and Demer rivers, flowing via the Rupel to a common outlet in the lower Scheldt. The surface is covered with sand, clay and *limon*. Agriculture flourishes (wheat, sugar beet, dairy products), and market gardening and horticulture are carried on near the towns. The population density is high, many people living in prosperous villages and large towns, including the capital, Brussels. Textile, food-processing and metallurgical industries are widespread.

3. Sambre-Meuse Valley.—The narrow valleys of the Meuse and of its western tributary the Sambre extend along the southern edge of the central plateaus. In this area, 100 mi. in length but only from 3 to 10 mi. in width, is located approximately a quarter of the population and the greater part of the nation's heavy industry. The basis of industry is the coal field (see *The Economy*, below).

4. Ardennes.—These consist mainly of an undulating plateau, mostly above 1,000 ft., from which rise gently rounded summits; the highest are in the northeast: Signal de Botrange (2,277 ft.) and Baraque Michel (2,211 ft.). The rocks are mainly hard sandstones, slate and limestone, across which rivers flowing westward to the Meuse have cut deep winding valleys. On the surface of the plateau shallow depressions contain peat bogs, while the drier eminences are heath covered. Woodland, mostly plantations of spruce and Scots pine, occupies half the area. The thin, infertile soils, the poor drainage, the heavy precipitation (40–50 in.) and the bleak exposed plateau are not favourable for agriculture. Only a small part is farmland, mostly under permanent grass for beef cattle, with dairy farming in the valleys.

5. Belgian Lorraine.—Lines of sandstone and limestone hills, with north-facing scarps, can be traced across the country, rising in places to more than 1,300 ft. Between them lie areas of clay and marl, upon whose less resistant outcrops the rivers, flowing westward to the Meuse, have developed their courses. The whole area was once under woodland and half is still wooded. Two-thirds of the farmland is under permanent pasture, supporting dairy cattle and pigs, while the arable mostly grows fodder crops. In the extreme south is a tiny portion of the Lorraine iron-ore field, which was responsible for the initial development of blast furnaces and steelworks.

6. Kempenland Plateau.—This lies mostly between 150 and 250 ft. above sea level, forming an indeterminate watershed between the Scheldt and the Meuse. Much is covered with heathlands developed on sheets of sand and gravel, though reclamation of parts has taken place. Some areas are now under permanent pasture and about a seventh is planted with coniferous trees. The Kempen forms one of Belgium's industrial districts, for concealed beneath the newer rocks is a coal basin. Numerous large factories were built, taking advantage of cheap land for spacious sites: zinc and other refineries, chemical works and glassworks. The southern part of the Kempen is crossed by the Albert canal. (F. J. M.)

III. THE PEOPLE

The common way of life, internal migration and the various ethnic strains have combined to mix and weaken the ancestral types (Paleolithic dolichocephali, Neolithic brachycephali, Celtic and German invaders). At most it could be said that the Nordic type is found more frequently in the northern provinces.

1. Languages.—By reason of its situation on the confines of the Roman and Germanic worlds, three linguistic groups are found in Belgium: Dutch and the Flemish dialects are spoken north of a line running more or less regularly from Mouscron (Moeskroen) to Aubel, approximately along the parallel on which Waterloo stands; French and the Walloon dialects south of this line; German and its dialects in the frontier communes of the east. In the Flemish towns, however, there are French-speaking minorities of varying importance. The Brussels agglomeration has been gradually transformed into a veritable enclave of French speech, and it tends to encroach outward more and more.

According to the 1947 census, 52.8% of the population spoke solely or mostly Dutch, 41.92% French and 0.92% German, the balance consisting principally of young children. A fairly large proportion (19.37%) were bilingual.

At the time of the constitution of the Belgian state in 1830, considerations of unity caused French to be the language of public life. But in 1898, when Dutch was also recognized as an official language, bilingualism became the rule. In 1932 this gave way, in principle, to a regional unilingualism, the use of two languages being maintained only in communes where a sufficiently important minority spoke a second national language. Since the number of these communes has to be reviewed at each census and tends to increase, the Flemish population has endeavoured to obtain the permanent definition of the linguistic frontier. (*See* also FRENCH LANGUAGE; FLEMISH LANGUAGE.)

2. Religion.—The Belgian state recognizes and assists the Roman Catholic, Evangelical, Anglican and Jewish faiths. About 95% to 97% of the people are baptized into the Roman Catholic Church; but it is estimated that in industrial and urban areas only 80% are fully practising Catholics, and that the percentage of regular attendance at Sunday Mass is 60% in Flanders, 40% in the Walloon area and 35% in the *arrondissement* of Brussels. The Roman Catholic territorial organization comprises six dioceses and 3,803 parishes.

Belgium was very quickly affected by the Reformation, but only a few islands of Protestantism survived the political events, though during the last hundred years it has seen a certain revival. The number of its adherents is estimated at about 75,000, of whom from 40,000 to 45,000 are effectively reached by the ministry. They are grouped in 284 communities, principally in the provinces of Hainaut (96) and Brabant (51), and belong to 15 denominations. The most important are the Union of Protestant Churches of Belgium and the Belgian Christian Missionary Church.

3. Customs and Culture.—If, on the one hand, there are certain more or less marked differences between Flemings and Walloons, the former being in general calmer and the latter more lively, there are also strong resemblances: a zest for work, common sense, love of the soil, a spirit of independence and friendliness. Both Flemings and Walloons have given during the centuries many proofs of their artistic disposition, in painting, music and literature. The Flemish primitives and their emulators of the Renaissance are justly famous. *See* BELGIAN LITERATURE; WALLOON LITERATURE; PAINTING; MUSIC. (L. G. Po.)

IV. HISTORY

It is sometimes suggested that Belgian nationality dates from 1830. It is true that after the Burgundian regime in the Netherlands (*q.v.*) and the abdication of the emperor Charles V the country was subject first to Spain, then to the Austrian Habsburgs, then to France and finally to the kingdom of the Netherlands, union with which ended with the 1830 revolution. But the Belgian provinces in fact preserved their ancient institutions and traditions (*see* BRABANT, DUCHY OF; FLANDERS, COUNTY OF) throughout modern history, and it was only for a short period, under the first French republic and Napoleon, that integration with an alien system could be enforced.

The Burgundian period, from Philip the Bold to Charles the Bold, was one of political prestige and economic and artistic splendour. The finest monuments of the country and its most famous paintings date from the 15th century, and the "Great Dukes of the West," as the Burgundian princes were called, were rightly considered as national sovereigns, their domains extending from the Zuider Zee to the Somme. The death of Charles the Bold (1477) and the marriage of his daughter Mary to the archduke Maximilian of Austria proved fatal to the independence of the Low Countries by bringing them more and more under the sway of the Habsburg dynasty. After the death of Maximilian's son the archduke Philip the Handsome (1506), the provinces were wisely governed by Margaret of Austria, Philip's sister, the aunt of the young prince Charles who was to become king of Spain as Charles I and Holy Roman emperor as Charles V (*q.v.*).

A. Spanish Rule

Charles V, toward the end of his reign, issued a series of edicts which violated the liberties of the Netherlands. Then, in Brussels on Oct. 25, 1555, he abdicated the Netherlands to his son, who in Jan. 1556 became king of Spain as Philip II. Under Spanish rule

discontent increased in the Netherlands, and revolution broke out in 1567, but the union between Catholics in the south and Protestants in the north could not be maintained after the first years of conflict. The formation of the League of Arras (Jan. 6, 1579) by the Catholic provinces of Artois and Hainaut enabled Alessandro Farnese (*q.v.*) to resume the war against the Protestants of the Netherlands. William of Orange, who was supported by the Union of Utrecht (Jan. 29, 1579), at first tried to set up François, duc d'Anjou and brother of the king of France, in opposition to the king of Spain; but the assistance of the ambitious French prince proved to be useless. He arrived in Antwerp early in 1582 and attempted in the following year to gain possession of the city by force (Jan. 17, 1583). This act of treachery put an end to his pretensions and promoted the success of Farnese. On Nov. 30, 1581, the latter had captured Tournai. After a series of sieges he made himself master of Ypres, Dunkerque, Bruges, Ghent, Brussels and finally Antwerp, which capitulated on Aug. 17, 1585. From this time onward the whole of the southern part of the Netherlands once more recognized Philip II as its sovereign.

The system set up by the treaty between Spain and the League of Arras (May 19, 1579) in all the reconquered provinces was not one of Spanish domination, but simply of dynastic union with Spain. The country recognized Philip II as its legitimate sovereign but retained its autonomy. The king was represented by a governor general at Brussels. The council of state, the privy council and the council of finance which acted with him were, however, composed entirely of Belgian notables. All the provinces were confirmed in their constitutions and privileges. The only departments in which the king had sole control were the command of the army and foreign policy. Taxes could not be levied without the consent of the provinces. This was the principal safeguard of national autonomy; Philip II and his successors dared not withdraw it for fear of causing a fresh revolution.

Although the treaty of Arras represented the capitulation of the king of Spain in the political sphere, it gave him complete victory on the religious question. In all the provinces which Farnese reconquered the Protestants were obliged either to become reconciled to the Catholic Church or to emigrate, and the Spanish Netherlands, as the country was then called to distinguish it from the United Provinces, henceforth became exclusively Catholic.

The reconquest of Belgium by Farnese was intended to be merely the prelude to that of the 17 provinces of the Netherlands. The United Provinces were supported, however, by France and England, and under Maurice and Frederick Henry, the sons of William of Orange, they successfully repelled all the efforts of Philip II's generals. The destruction of the Spanish Armada in Aug. 1588 and the fact that Farnese was obliged to go to France to make war on Henry IV gave them opportunities of which they were not slow to take advantage.

1. Albert and Isabella.—The able Farnese died, worn out, on Dec. 3, 1592, and was succeeded as governor by Philip's nephew, the Austrian archduke Ernest, after whose death (Feb. 1595) Philip decided to try a new method: the government was entrusted to Ernest's brother, the archduke Albert (Feb. 1596), and he was instructed to conclude peace with France (peace of Vervins, May 2, 1598) in order to have his hands free for the reconquest of the United Provinces. Hoping that the provinces would be less recalcitrant to an independent sovereign than to the Spanish crown, the king on May 6, 1598, handed over the whole of the Netherlands as a sovereign state to his daughter Isabella, who was to marry Albert (she did so in November, after Philip II's death). The new state's independence was, however, more apparent than real, and the stipulation that Catholicism was to be the only religion tolerated destroyed any prospect of winning over the United Provinces.

The war therefore continued. Albert was defeated at Nieuwpoort by Maurice of Nassau. Ambrogio di Spinola then took charge and obtained possession of Ostend in 1604. In 1609 Albert had to conclude a 12 years' truce with the United Provinces.

The archdukes made use of the 12 years' truce to consolidate their position in the Spanish Netherlands and to reorganize Catholicism in the country on a firm basis with the aid of the Jesuits, who from that time onward exercised a predominant influence over the religious and intellectual life of the country. They impressed themselves upon it so strongly that the results may be traced even down to the present day. The reign of Albert and Isabella was the last period of brilliance which Belgian civilization enjoyed until the 19th century. It was at this time that the school of Rubens and Van Dyck flourished at Antwerp, Justus Lipsius (*q.v.*) enhanced the reputation of the University of Louvain and the Jesuits, who produced in Belgium the brilliant group of scholars known as the Bollandists (*q.v.*), began the monumental work of the *Acta Sanctorum*.

2. The Thirty Years' War.—As Albert and Isabella had no children, it was clear that after their death Belgium would revert to the king of Spain. Albert died in 1621, and Isabella thenceforth acted merely as governor for Philip IV. On the expiry of the 12 years' truce, war was resumed—with unfortunate results for Spain, now to be involved in the long struggle that had opened in Germany in 1618. Frederick Henry, Prince of Orange, captured 's-Hertogenbosch (Bois-le-Duc; Sept. 1629) and Maastricht (Aug. 1632). The situation became more critical after the death of Isabella (Dec. 1, 1633). France concluded an alliance with the United Provinces and, in May 1635, declared war on Spain. In Oct. 1637, Frederick Henry entered Breda. Arras surrendered to the king of France in Aug. 1640. In 1644 the Dutch obtained possession of Dalhem, Rolduc and Faulquemont, and in 1645 the capture of Hulst put them in complete possession of the left bank of the estuary of the Scheldt.

It was now clear that Spain could not continue to fight on two fronts. In order to have his hands free for the war with France, Philip IV resigned himself to concluding peace finally with the United Provinces at Münster on Jan. 30, 1648. The independence of the United Provinces was at last recognized, and all the districts which they had conquered in Flanders, Brabant and Limburg were ceded to them. Philip IV also granted their request for the perpetual closing of the Scheldt, thus sacrificing Antwerp to Amsterdam and the prosperity of Belgium to that of Holland.

3. Louis XIV.—Even this surrender to the rebel republic did not enable the king of Spain to wage war successfully on France. He suffered a series of defeats, alternating with treaties, each one of which represented a further cession of territory to the French. After the defeats of Lens (1648) and the Dunes (1658), the peace of the Pyrenees in 1659 gave Louis XIV the greater part of Artois and a number of fortresses along the southern frontier of Belgium. Under the peace of Aix-la-Chapelle (1668) he also received Charleroi, Binche, Courtrai and other border towns. After further vicissitudes, some of the annexed districts were restored to Spain under the treaty of Rijswijk (1697), when Louis was for the first time compelled to give way before the general European coalition against him.

Three years later, on Nov. 1, 1700, Charles II, the last remaining descendant of Philip II, died at Madrid without issue. In his will he left the whole of the Spanish monarchy, including the Catholic Netherlands, to Philip of Anjou, Louis XIV's grandson, who took the title of Philip V. From the beginning of his reign Louis had been endeavouring to make Belgium an outpost of France. England and the republic of the United Provinces were equally determined to prevent him from acquiring a position so likely to be dangerous to them. In Feb. 1701 Louis caused his grandson to hand over to him the government of the Netherlands. Thenceforward war was inevitable. William III, in his dual capacity as stadholder of Holland and king of England, had a double reason to fear French expansion and was at once the initiator of the war and the one who carried it on most actively (*see* SPANISH SUCCESSION, WAR OF THE).

The duke of Marlborough's victory at Ramillies (May 23, 1706) compelled the French to evacuate Belgium, and all their efforts to return were unsuccessful. The country was provisionally administered by a "conference" composed of English and Dutch until such time as Europe should have decided on its future. This was done by the treaty of Utrecht (April 11, 1713), when Belgium received as its sovereign the emperor Charles VI, head of the Aus-

trian branch of the house of Habsburg. (*See* also Barrier Treaty for Anglo-Dutch measures affecting the Belgian provinces.)

B. Austrian Rule

The change of dynasty did not involve any change in the political system established in 1579 by the peace of Arras. Just as there had been no Spanish domination, there was now no Austrian domination. National autonomy was maintained; the traditional institutions were preserved; the provinces continued to vote their own taxes. The only connection between Belgium and Austria was that they had the same sovereign. The emperors were represented by a governor at Brussels, just as the kings of Spain had been. The emperor also appointed a "minister plenipotentiary" at Brussels, with whom his chancellery corresponded directly, to keep watch over the conduct of the governor.

In order to prevent any further attempt at annexation on the part of France, England and the United Provinces required the emperor to sign the third Barrier treaty (Nov. 15, 1715). This treaty gave the United Provinces the right to maintain garrisons at Namur, Tournai, Menin, Veurne, Warneton, Ypres and Termonde. Belgium was thus for a second time sacrificed to its northern neighbour, for whose safety it was made a bulwark. The frontier between Belgium and France, now that Louis XIV had made restitution of the last towns he had taken (Tournai, Ypres, Dixmude, etc.), was drawn almost exactly at it was to remain in the 20th century.

The country, which had been the cockpit of Europe since the middle of the 17th century, was now exhausted. The population was profoundly discontented. Disturbances broke out at Brussels under the administration of the marquis de Prié (H. J. L. Turinetti), who, as representative of the governor Prince Eugène of Savoy, earned the detestation of the people by ordering the execution of François Anneessens for daring to oppose the vote of fresh taxes by the Brussels municipality (1719).

Peace having been restored, an attempt was made to improve the economic situation of the country. There was no hope of reviving the prosperity of the port of Antwerp, since the closing of the Scheldt had been ratified by the treaty of Utrecht, but it was proposed to develop the maritime trade of Ostend and to connect it by means of canals with the Scheldt, the Meuse and the Rhine. On Dec. 19, 1722, the emperor Charles VI founded an India company in Ostend with a capital of 6,000,000 guldens. England and the United Provinces, however, opposed the scheme, and on May 31, 1727, in the preliminaries to the second treaty of Vienna, the Ostend company (*q.v.*) was sacrificed to "the welfare of Europe."

1. Maria Theresa.—On the death of Charles VI, on Oct. 20, 1740, the provinces recognized Maria Theresa without opposition. The War of the Austrian Succession, however, soon spread to Belgium, which in 1744 was invaded by the French under Maurice de Saxe. The Dutch garrisons of the barrier capitulated without attempting any resistance. The defeat of the English at Fontenoy on May 11, 1745, gave Louis XV the possession of Belgium, for which Louis XIV had striven in vain. He occupied it only as a pledge, however, and it was restored to Maria Theresa by the peace of Aix-la-Chapelle (Oct. 18, 1748).

Maria Theresa was the only foreign ruler of Belgium whose memory was to remain in the affections of the nation. The Franco-Austrian alliances of 1756 and 1757 secured a period of peace for Belgium which lasted 35 years. The time of rest thus provided after a century of almost incessant war was utilized to the best advantage. Private individuals and the authorities of the provinces worked together in restoring the prosperity of the country and developing communications, industry and agriculture. In Hainaut, coal mining and the glass industry were actively developed. The population increased with the national wealth.

Maria Theresa entrusted the administration in 1744 to her brother-in-law Charles of Lorraine, who became extremely popular in the country. She provided him with able ministers who adjusted customs tariffs in such a way as to protect national industries. Other reforms were introduced in order to rouse the country from the intellectual apathy into which it had fallen since the middle of the 17th century. An academy was founded at Brussels in 1772. When the Society of Jesus was suppressed in 1773, the government set up "royal colleges" in several of the towns. These were the first lay educational establishments to be created in Belgium.

Maria Theresa's innovations were inspired by the doctrine of enlightened despotism. She obtained acceptance for them because of the skill with which she managed to avoid offending the conservatism of her Belgian subjects. Her successor, Joseph II (1780–90), acted in an entirely different manner.

2. Joseph II.—Joseph was sincerely anxious to promote the public welfare, but he firmly believed that progress must be imposed from above. Before he succeeded his mother he had made a hurried tour through the country and had come back full of contempt for the antiquated state of affairs that he found there. His first object was to obtain the abolition of the stipulations imposed on Belgium by the Münster and the Barrier treaties, which he regarded as incompatible with his sovereign rights. Maria Theresa had already refused to pay the sums due for the upkeep of the Dutch garrisons. In 1781 Joseph informed the states-general of the United Provinces that he had decided to dismantle the Belgian fortresses and that they should therefore recall their troops. They accepted the situation so readily that he thought he would also be able to reopen the Scheldt. Much to his surprise, the Dutch fired on the vessels which he had ordered to sail up and down the river. The outbreak of war was prevented by French intervention, and the treaty of Fontainebleau (Nov. 8, 1785) confirmed the *status quo*.

Joseph might have won popularity by this foreign policy, but the internal reforms which he introduced aroused both religious and political opposition. His first measures were aimed at the church. The Edict of Tolerance (Nov. 1781), which recognized religious freedom in Belgium for the first time since the peace of Arras, deeply offended the clergy and the Catholic sentiments of the population. The suppression of the "unnecessary" convents (1783), of the religious confraternities and of pilgrimages and the closing of the episcopal seminaries and their replacement by two seminaries founded by the state at Louvain and Luxembourg (1786) aroused bitter feeling.

Still greater hostility was aroused by Joseph's attempt to modify the traditional institutions of the country. In 1787 the whole administration was remodeled. The country was divided into nine districts (*cercles*) with intendants at their head, attached to a council of government meeting at Brussels. Justice was to be administered by two councils of appeal and a supreme council of revision and by 64 courts of first instance. Thus, by nothing less than a *coup d'état*, the traditional autonomy of the Belgian provinces, which had been respected by all their rulers from Philip II onward, was destroyed and replaced by a centralized system working by the emperor's orders. A formidable movement of opposition broke out in all the provinces. Joseph's sister, Maria Christina, duchess of Saxe-Teschen, who was governor, dared not enforce the edicts. The emperor, however, persisted. He sent a new minister plenipotentiary, Ferdinand von Trauttmansdorff, to Brussels and entrusted the command of the troops to Gen. Richard Alton, count d'Alton, who had orders to enforce the reforms and repress disturbances.

3. The Revolution of 1789.—If the emperor was obstinate, the country was equally so. In Nov. 1788 the estates of Hainaut and Brabant refused to pay taxes. The events of the following year in France and especially the news of the taking of the Bastille encouraged the Belgians in their resistance. The conservatives, whose leader was the lawyer Henri van der Noot, combined with the partisans of reform the chief of whom was another lawyer, Jean François Vonck. They fled to Holland, where they formed a corps of volunteers. On Oct. 24, 1789, under the leadership of Col. J. A. van der Meersch, they invaded the Kempenland and contrary to all expectation defeated the Austrian troops at Turnhout. This was the signal for a general rising. On Dec. 12 the government and the troops hurriedly evacuated Brussels. All Belgium, with the exception of Luxembourg, where the army was concentrated, was in a state of revolt.

The various parties were, however, very far from unanimity in their political views. Two opposing parties at once appeared in the congress. The Vonckists wished to adopt a constitution based on the principles laid down by the French national assembly; the Nootists simply desired to restore the position which had previously existed. The latter were supported by the clergy and by the majority of the people. Riots broke out; Vonck's partisans were terrorized and left the field clear for their opponents. Van der Noot was quite unable to control events. The Belgian republic, torn by internal disputes, soon fell into a state of anarchy and was unable to prepare for resistance.

4. Leopold II and Francis.—Joseph II died on Feb. 20, 1790, and was succeeded by his brother Leopold II. Leopold first attempted to win over the Belgians by conciliatory means, but his proposals were rejected. After his reconciliation with the king of Prussia at the convention of Dzierzoniow (July 27, 1790) he had recourse to arms. The Belgian army was driven back without difficulty, and on Dec. 3 the Austrian troops under J. B. Bender entered Brussels. A few days later the subjection of the country was complete.

Leopold, who did not wish to provoke further disturbances, made no attempt to reintroduce Joseph's reforms. Government was restored in the form in which it had existed under Maria Theresa. In spite of this, the restoration continued to be exceedingly unpopular, both under Leopold and under his son Francis II, who succeeded him as emperor on March 1, 1792. The course which the French Revolution was taking revived the hope of Belgian independence. Thus, when war broke out between France and Austria and Gen. C. F. Dumouriez won the battle of Jemappes (Nov. 6, 1792) and occupied Belgium, his victory was at first welcomed by the population. Dumouriez would have liked to make Belgium into a republic and to make use of it to further his plans for a restoration of the monarchy in France. The French convention, however, thwarted his plans. When the Austrians resumed the offensive and defeated Dumouriez at Neerwinden (March 18, 1793), thus once more taking possession of Belgium, the Belgians resigned themselves without difficulty.

The restored regime was of short duration. Jean Jourdan's victory at Fleurus (June 26, 1794) resulted in a fresh conquest of the Netherlands by France. The rule of the Austrian sovereigns was abolished in fact, and the position received legal sanction by the treaties of Campo Formio (1797) and Lunéville (1801), under which Francis II recognized the annexation of Belgium by the French republic.

C. Annexation by France

The battle of Fleurus enabled France to accomplish what Louis XIV had planned. After a period of occupation and military rule, the national convention on Oct. 1, 1795, voted the annexation of Belgium and the principality of Liège, which was thenceforth amalgamated with it.

France accomplished, but in a far more radical manner, what had been attempted by Joseph II. All branches of the administration were centralized and systematized. All privileges were abolished. The church, which had formerly been so powerful and so deeply respected, was persecuted. It is not surprising that the Belgians detested the new regime. Their hostility was the greater for the terrible economic crisis which accompanied the change of rule. The introduction of military conscription led in Oct. 1798 to a revolt of the peasants in the Flemish districts of the country, which was repressed without mercy.

Napoleon's *coup d'état* in Nov. 1799 was the starting point of a new era. Under the consulate and the empire, Belgium became accustomed to the system which still constitutes the basis of its administration. The country was divided into nine departments, each under a prefect. Courts of first instance and courts of appeal were created and had to administer the French code of laws. A metric system of weights and measures and currency was introduced. The clergy were reconciled with the government by the concordat. With the vast markets of the empire now open to Belgian industry a period of unprecedented activity succeeded. The manufacture of cotton and beet sugar made rapid progress.

The Napoleonic regime nevertheless remained unpopular. The complete lack of political liberty, the exigencies of conscription and the abuses of the Continental system led to a spirit of disaffection which, by the time of the fall of the empire, had become general. The occupation of Belgium by the allies in 1814 was hailed with relief.

D. Kingdom of the Netherlands

The powers were determined not to leave France in possession of Belgium. It could not be given back to the Austrian emperor, who in any case did not desire it. Under the influence of Great Britain it was decided to unite it in a single state with the old republic of the United Provinces and thus to constitute a new barrier better capable of resisting future French expansion than that of 1715. The kingdom of the Netherlands, the existence of which was confirmed by the treaty of Vienna (June 1815), was thus established for the convenience of Europe, regardless of the wishes of the Belgians and the Dutch who would have to live side by side in one country. Prince William of Orange ascended the throne on March 16, 1815, under the title of William I; he was crowned Sept. 27.

1. William I.—The new ruler was faced with the task of assimilating two peoples which for the last 200 years had had strikingly contrasted customs, economic interests, ideas and, above all, religions, the one being Catholic and the other Protestant. The fundamental law (*grondwet*) of the new kingdom gave the Belgians and Dutch an equal number of representatives in the states-general, although the population of Belgium was 3,500,000 and that of the Dutch provinces only 2,000,000. It also recognized religious liberty, and this was obnoxious to the Catholic Church. Finally, it gave extremely wide powers to the king, who was Dutch and Protestant. The king laid the constitution before the "notables" for adoption; they rejected it, but it was nevertheless promulgated. During the first few years, however, the situation did not appear unsatisfactory. Belgium began to assume the industrial character that has distinguished it ever since. Antwerp once more became a major port. The cotton-spinning industry at Ghent, the manufacture of linen at Verviers and the coal-mining industry in the Liège and Hainaut districts attained even greater prosperity than during the French occupation. The Dutch colonies provided new markets for export.

The king also endeavoured to promote education, with the support of the opponents of the old regime, who were apprehensive of the influence of the church. The three universities (Ghent, Louvain and Liège) were placed under state control; *athénées*, or state secondary schools, were created; the independent (*i.e.*, ecclesiastical) schools were subjected to inspection. In 1825 a "philosophical college" was set up at Louvain, and seminarists were required to attend it. These measures revived the hostility of the clergy. The substitution of Dutch for French as the official language irritated the middle classes, which had been affected by French influence.

William persisted in his plans. The opposition journals were prosecuted, but this only increased the strength of the movement. It became irresistible when, in 1828, the Liberals and the Catholics, who up till then had opposed one another, concluded the "union of parties." A general petition for the redress of grievances was organized and by Nov. 1829 had obtained more than 300,000 signatures. The revolution in Paris in July 1830 was not the direct cause of that which broke out in Brussels a few weeks later, but it fired the train.

2. The Revolution of 1830.—The disturbances broke out on Aug. 25, after a performance of Auber's opera *La Muette de Portici* (on the subject of Masaniello's revolution in Naples). The authorities were taken by surprise and lost their heads; the troops retired, without resistance, on the royal palace. On the following day a citizens' guard was organized under the command of Baron Emmanuel d'Hoogvorst and took over the duties of the lawful authorities. Disturbances at once broke out in the provinces and the red, yellow and black flag which had been the flag of the revolt of 1789–90 began to be shown. No one, however, yet contemplated the overthrow of the dynasty. All that was demanded at the

time was the administrative separation of Belgium and the Dutch provinces.

The king failed to realize the importance of the movement and still thought that it could be suppressed. He hurriedly sent his sons to Brussels at the head of a small body of troops. They found the town prepared for resistance, and as they did not dare to risk a fight the prince of Orange (later William II of the Netherlands) consented to parley with the rebels. He was unsuccessful, and on Sept. 3 he left Brussels, taking the garrison with him.

While the king was summoning the states-general at The Hague, volunteers were flocking into Brussels. Charles Rogier (*q.v.*) arrived at the head of a troop of Liégeois. French republicans came to foment the revolt. All regularly constituted authority was abolished. William, who hoped to obtain the support of the moderates, sent his second son, Prince Frederick, to occupy the town. His troops entered Brussels on Sept. 23, but were received by the population with a fusillade which checked their advance. After four days' fighting they retreated, and the volunteers and the citizens' guard, whose numbers were swollen by contingents from all parts of the country, victoriously pursued them to Antwerp.

On the evening of Sept. 25 there had been constituted an administrative committee which took the title of provisional government. It included Rogier, D'Hoogvorst, A. Jolly, Félix de Mérode, Alexandre Gendebien, Sylvain van de Weyer and Louis de Potter. This revolutionary government proclaimed national independence on Oct. 4, paying no attention either to the king or to the powers which had set up the kingdom of the Netherlands. On the same day it summoned a congress to draw up the constitution of the country. The congress met on Nov. 10.

In the meantime the Belgians had captured Antwerp, which Frederick had occupied on Oct. 2. The Dutch general David Hendrik Chassé maintained his position in the citadel and bombarded the town from there. On Nov. 24 the congress voted the perpetual exclusion of the house of Orange from the throne of Belgium.

William had already appealed to the powers to intervene, and in November, at the proposal of Great Britain, a conference of ambassadors was called in London. The main object was to avert a European war, which would have been the inevitable consequence if France had intervened in Belgium. Under French and British influence, Russia (which was paralyzed by the Polish rising), Prussia and Austria consented to give up the principle of legitimacy. On Dec. 20 the conference imposed an armistice on William and the Belgians, invited the provisional government to send a deputation and declared the dissolution of the unitary kingdom of the Netherlands. A month later, on Jan. 20, 1831, it decided that Belgium should be an independent and perpetually neutral state under the guarantee of the powers.

E. Independence

1. Leopold I.—The powers had first wished the Belgian congress to give the crown to the prince of Orange, but instead it elected Louis, duc de Nemours, a son of the new king of the French, Louis Philippe (Feb. 3, 1831). For the sake of preserving peace, Louis Philippe withdrew his consent. The congress then set up a regency. There ensued a period of anarchy, and France tried to take advantage of it to bring about the partition of Belgium. Great Britain, however, took a firm stand in favour of the decisions which had been adopted. The election of Prince Leopold of Saxe-Coburg as king (*see* Leopold I, king of the Belgians) put an end to the crisis. The conference drew up the treaty of Eighteen Articles (June 26, 1831) which regulated the separation between Belgium and the kingdom of the Netherlands. It was accepted by the congress, and on July 21 Leopold, who had made his consent conditional on the acceptance of the treaty, arrived in Brussels and took the oath of allegiance to the constitution. A few days later, William invaded Belgium (Aug. 2, 1831). His troops easily defeated the Belgians, who had not been able to organize an army. Leopold appealed to France, and with the consent of the conference Louis Philippe sent Marshal Étienne Gérard to restore the position. The Dutch retreated before him without an action.

The conference then replaced the treaty of Eighteen Articles by the treaty of Twenty-four Articles, which was much less favourable to Belgium (Nov. 15, 1831). Leopold accepted it reluctantly, but William protested against the forcible measures used against him and refused to sign. His resistance was not broken down even when France and Great Britain blockaded the Dutch ports and when the citadel of Antwerp was bombarded by the French, who captured it from Chassé on Dec. 23, 1832. On May 21, 1833, however, William agreed to conclude a provisional convention with Great Britain and France for the maintenance of the *status quo*. This was all in favour of the Belgians, who continued to occupy Limburg and Luxembourg, which they would have had to give up under the Twenty-four Articles.

William was finally obliged to accept the Twenty-four Articles on March 14, 1838. Belgium attempted to obtain their revision, but only received certain financial concessions. The definitive treaties were signed in April 1839. The Walloon part of Luxembourg was allotted to Belgium, and the rest became a grand duchy which was a member of the German confederation under the sovereignty of William. Limburg east of the Meuse and Maastricht remained in the possession of the Dutch. In return, Belgium was recognized as an "independent and perpetually neutral state" under the guarantee of the powers.

During the first years of Leopold I's reign, the general impression was that the new kingdom could not last. The revolution had resulted in a terrible economic crisis, and the discontented manufacturers formed a small but energetic Orangist party. It was thought that, because of its liberal character, the constitution would make it impossible for the king to govern. Thanks, however, to Leopold's wisdom and devotion and also to the energy of the nation, all the difficulties were overcome. In order to give the country new markets, an act was passed in 1834 for the construction of railways. These were some of the first railways to be built on the continent. Laws regulating the administration of the provinces and the municipalities were passed in 1836. The army was established on a sound basis. After 1839 the Orangist agitation declined and soon died away altogether.

Up to this point the Catholic and Liberal parties, whose joint action had made the success of the revolution possible, had worked together in parliament. They began to diverge soon after the existence of the state had been guaranteed by the treaties of 1839. The system of coalition cabinets was gradually replaced by that of ministries representing the party which had a majority in the chambers. After the disturbances of 1857 which led to the resignation of the Catholic Pierre de Decker and brought the Liberal Rogier into power, the new system was regularly applied.

The king guided Belgian foreign policy of the country firmly in the spirit of neutrality required by the country's international undertakings. He gave proof of this in the crisis of 1848. Thanks to the liberal character of its institutions and to the electoral-reform measure unanimously adopted by the chambers, the country escaped the disturbances which then prevailed throughout Europe. From that time onward its political system was regarded as a model. The Belgian constitution was imitated more or less exactly by a series of European countries which adopted the parliamentary regime in the 19th century.

The fall of Louis Philippe (whose daughter, Louise, had been married to Leopold in 1832) and subsequently the *coup d'état* of 1852 by which Napoleon III became emperor of the French, placed Belgium in a difficult position. The freedom of the press which prevailed in Belgium made it possible for French refugees in that country to carry on republican propaganda against Napoleon, and this gave rise to unpleasant incidents. As early as 1853 the king induced parliament to grant funds by means of which Antwerp was surrounded with a ring of forts to serve as a stronghold for the army in case of war.

Efficient measures were taken to assist the economic development of the country. After 1849 a policy of free trade was gradually substituted for protectionism. A national bank was founded in 1850; the local octrois (dues on foodstuffs brought into towns) were abolished in 1860; in 1863 the dues imposed by the Netherlands on ships sailing up the Scheldt to Antwerp were redeemed. Thus, after two and a half centuries, the port was definitely freed

from Dutch control. (*See* also LEOPOLD I.)

2. Leopold II.—The grief displayed by the nation at the death of Leopold I (Dec. 10, 1865) and the loyalty with which the accession of Leopold II was welcomed proved that the new regime was firmly established. The international situation was critical. The French were anxious to seek compensation for the triumph of Prussia in the Seven Weeks' War against Austria. The tone of the Paris press toward Belgium was threatening. The attempts which Napoleon III made in 1867 to acquire the grand duchy of Luxembourg were a disquieting symptom, in spite of their failure. In the following year the French railway company of the Est negotiated for the purchase of the railways of the province of Luxembourg. The chambers on Feb. 23, 1869, adopted emergency legislation prohibiting the sale of the railways, and a rupture was averted only by the energy and skill with which negotiations were conducted by the minister Walther Frère-Orban, who was supported by the British cabinet.

The Franco-German War of 1870 provided fresh proof of the government's determination to preserve neutrality. The army was mobilized and sent to the frontier with orders to repulse any troops which attempted to cross it. The victory of Prussia completely altered the position of Belgium. The increased strength of Germany, on the one hand, and the possibility of a French *revanche*, on the other, greatly complicated its duties as a neutral state. In order to provide for future eventualities, the king persuaded parliament in 1887 to grant credits for the fortification of the positions of Liège and Namur on the Meuse.

In the meantime the conflict of parties was growing more acute. The Education act adopted in 1879 under the Frère-Orban cabinet met with strong resistance from the Catholics. The government broke off diplomatic relations with the pope. The Liberal party, however, was weakened by the dissension in its ranks between the conservative or doctrinaire elements and the progressives, and it was defeated at the 1884 elections. From that time until 1914 there was always a Catholic ministry in power.

At this time the working classes did not have the right to vote, and the long-standing discontent to which this gave rise facilitated the spread of socialist opinion among them. In March 1886 there was a riot at Liège which was followed by very serious outbreaks in all the industrial districts. They were repressed with much bloodshed. Auguste Beernaert's ministry ordered an inquiry into the position of the workers, and it was found that social reforms must be undertaken without delay. From 1889 onward a series of laws was adopted on workers' housing, the employment of women and children, factory inspection, workmen's compensation for accidents, etc.

The constitution restricted the suffrage to a minority of the nation, and its extension was demanded with increasing vigour by the progressives and socialists. In 1890 the chambers voted in favour of the principle of the revision of the constitution. Universal manhood suffrage was established three years later, but the system was tempered by plural voting, which gave more than one vote to electors fulfilling certain conditions regarding income, age, education and family. The reform of the electoral system was completed by the adoption of proportional representation in 1899.

The progress of democracy gave increasing scope to the Flemish movement. Although freedom to use either language is one of the principles of the Belgian constitution, French alone was used for legislative and administrative purposes in the years which followed the revolution. French was, as a matter of fact, the language of the enfranchised middle classes both in the Flemish and the Walloon provinces. Between 1840 and 1850, however, protests arose against a state of affairs which placed the Flemish language in a position of inferiority and was injurious to the rights of those who used it. In 1856 the government set up a commission to study the question of linguistic grievances. It was, however, some time before parliament began to adopt a series of laws intended to redress those grievances. The government set up a Flemish academy in 1886. In 1898 an act was adopted establishing the equality of the two national languages.

From the beginning of his reign, Leopold endeavoured to develop the colonial policy of Belgium. His personal interest in the exploration and commercial development of the equatorial regions of Africa led, in the creation of the Congo Free State, to results which had originally not been anticipated. The Comité d'Études du Haut Congo, formed in 1878 at the instance of the king and mainly financed by him, had developed into the International Association of the Congo, of which a Belgian officer, Col. M. Strauch, was president. As a result of H. M. Stanley's explorations in Africa and through the efforts of King Leopold in Europe, the International association was recognized during 1884–85 by the powers as an independent state. Declarations to this effect were exchanged between the Belgian government and the association in Feb. 1885. In April of the same year, the Belgian chambers authorized the king to be the chief of the state founded by the association, which had already taken the name of État Indépendant du Congo. The union between Belgium and the new state was declared to be purely personal, but its European headquarters were in Brussels, its officials, in the course of time, became almost exclusively Belgian, and financially and commercially the connection between the two countries became increasingly close. In 1889 King Leopold announced that he had by his will bequeathed the Congo state to Belgium, and in 1890 the Belgian government, in return for financial help, acquired the right of annexing the country under certain conditions. Reports of misgovernment created a strong agitation for reform in Great Britain, the United States and other countries responsible for having recognized the state, and public opinion in Belgium became seriously concerned. The bill for annexation was finally passed in Sept. 1908, and annexation was effected on Nov. 15. (For the full story of the Congo enterprise *see* BELGIAN CONGO.)

The system of military service based on selection by lot, with the possibility of providing a substitute, meant that in practice the well-to-do classes in Belgium were exempt. This constituted a social injustice and a danger to which the king for a long time drew attention without success. The revision of the constitution strengthened the position of the partisans of personal service, and that system was adopted in Dec. 1909. A few days later, on Dec. 17, Leopold II died at Laeken after a reign of 44 years. (*See* also LEOPOLD II.)

3. Accession of Albert I.—As Leopold II had no son, the crown passed to his nephew who took the oath of allegiance to the constitution as Albert I on Dec. 23, 1909.

The early days of his reign were marked by a violent agitation by the Socialist party in favour of universal suffrage without qualification. There was a general strike in 1913, but no disturbances took place. In the same year the anxiety to which the international situation gave rise led Charles de Broqueville's ministry to pass a measure for the general reorganization of the army, the reform to be completed in five years. (*See* ALBERT I.)

4. World War I.—The international crisis which came to a head in July 1914 found Belgium unprepared for war, in spite of its recent military laws. The neutrality of Belgium and Luxembourg had been guaranteed by the five great powers (Great Britain, France, Prussia, Russia and Austria) in the treaties of 1839, which bound the guaranteeing powers to intervene if either party to a war violated that neutrality. On July 30, following the precedent in 1870, the British foreign secretary Sir Edward Grey addressed a message to the French and German governments, drawing their attention to this point and asking for an assurance that Belgian neutrality would be respected. The German government declared itself unable to answer, and on Aug. 2 German forces invaded Luxembourg. At the same time Belgium received an ultimatum demanding free passage of German troops across Belgian territory. If the request was refused, Germany would treat Belgium as an adversary. To this note Belgium, which had mobilized 15 classes of militia on July 31, replied by a formal refusal on Aug. 3. Parliament accepted war unanimously, and the Socialist party assured the government of its unreserved support. The leaders of the opposition joined the government as ministers without portfolio.

At 8 A.M. on Aug. 4 the German army invaded the country. Liège fell on Aug. 16 and Namur on Aug. 23. In the province of Namur 1,949 civilians were killed and 3,000 houses destroyed.

After their entry into Louvain, the Germans set fire to the centre of the city; the cathedral of St. Peter, the famous library and 1,120 houses were destroyed. Seventy-nine of the inhabitants were shot. The town of Aarschot was almost destroyed. The Germans entered Brussels on Aug. 20. In the course of the occupation of Brabant, 594 inhabitants were shot and in the Antwerp and Hainaut provinces 665 persons. Antwerp was evacuated on Oct. 6, and with the withdrawal of the Belgian army to the Yser river under the command of King Albert, the whole country, with the exception of the southwestern districts of Flanders, was under German occupation. (*See* WORLD WAR I.)

Germany sent Colmar von der Goltz, Moritz Ferdinand von Bissing and Ludwig von Falkenhausen as successive governors general. The governor general, assisted by a central staff, exercised executive power. He legislated by promulgation of orders, except in east and west Flanders, Hainaut and south Luxembourg, where all power rested with the highest local military authorities. The powers of the Belgian provincial councils were finally suppressed on July 6, 1918. Many Belgian burgomasters were deported. The occupied territories paid a tribute, amounting finally to 60,000,000 fr. per month, for the maintenance of the German army in Belgium. The legislative measures instituted by the German military tribunals were numerous and repressive. On April 3, 1917, the governors were empowered to pronounce total or partial confiscation of property. The Belgian judicial powers were suppressed by a decree of April 7, 1918. A sentence pronounced on an absentee could be served by another person; general confiscation of all property forbidden by the Hague convention and the Belgian constitution, was introduced, as was deportation. The Belgian magistrates, bench of judges and court of appeal made frequent protests. Three presidents of the last-named were deported in 1918.

In order to disorganize the country, Germany sought to exploit the linguistic differences between Belgium's northern and southern provinces with the help of the so-called activists. The activists consisted of a small minority of persons who expected Germany to be victorious. The Flemish people energetically disavowed them; and to the last the nation maintained its anti-German attitude, encouraged by the exhortations of Désiré Mercier, the cardinal archbishop of Mechelen. On March 21, 1917, a decree was issued dividing Belgium into two distinct linguistic regions, with administrative centres at Brussels and Namur. All ministries were doubled, the Flemish remaining in Brussels, the Walloon moving to Namur. French became the only official language in the Walloon district, Flemish in the north. The activists attempted to organize a new independent Flemish state under German protection. On Feb. 11, 1918, an enormous demonstration was held in Brussels against separation. German troops dispersed the crowds, but, in face of the unanimous protests of the Belgian authorities, Germany did not dare recognize a legislative authority for the so-called *Raad van Vlaanderen*. With ceaseless energy, however, Germany continued the efforts to foster linguistic differences, notably by making Ghent university Flemish (1916).

The stoppage of overseas exports ruined Belgian industry. Unemployment increased enormously. Germany desired to recruit these workmen for its own use, but met with obstinate refusals. On Aug. 14 and 15, 1915, the first decrees appeared ordering severe penalties for persons who refused to work for Germany. At the same time, commissions were sent from Germany to take out of the Belgian workshops everything that could be used beyond the Rhine and to destroy systematically all machinery which could not be transported to Germany. By June 30, 1918, 167 factories had been completely destroyed, and 161 were on a list of the governor general for immediate destruction. Of the 57 blast furnaces, 26 had been razed to the ground, 20 put completely out of action. Only the mines necessary for Germany were spared.

On Feb. 18 and July 21, 1917, work was forbidden in all factories and workshops except by special permission. At this moment Germany ordered the stoppage of all public works undertaken by the provinces and communes for the relief of unemployment. These steps were preliminary to the plan of deporting the Belgian working population. In November the military authorities requisitioned able-bodied men between the ages of 17 and 60 throughout the whole country. Inhabitants on the lines of communication were mostly sent to the Yser or northern French fronts, to construct railways, prepare routes and dig trenches, often within the range of artillery. The other workmen were concentrated in great camps in Germany, whence they were dispatched to German factories or labour battalions; 57,718 were transported to Germany, 57,541 to the front; 2,531 died in consequence of ill treatment.

There was a serious food shortage. Immediately on occupation, the German government had repealed all measures taken by the Belgian government to ensure rationing. Public authority had now no further power to intervene, and private initiative stepped in. Committees sprang up everywhere. At Brussels the Comité Central de Secours et d'Alimentation was founded, under Ernest Solvay. The committee desired to import foodstuffs from England, but the British government refused. Finally, Gen. von der Goltz having promised to exempt all imported foodstuffs from requisitioning, the British government consented to allow their import under supervision of the embassies of Spain and the United States. The Commission for Relief in Belgium was set up to organize transport under supervision. The Comité Central, under its new name of Comité National de Secours et d'Alimentation, had, by Dec. 1918, distributed foodstuffs to provincial committees to the value of more than 3,500,000,000 fr. (2,500,000,000 fr. for Belgium, 1,000,000,000 fr. for France). The profit made on the sale of foodstuffs was used to organize charitable works at an expenditure of 1,300,000 fr. After the United States entered the war, Herbert Hoover resigned his post as chairman of the Commission for Relief, and a Spanish-Dutch committee took over the work.

The German occupation forced the Belgian government to retire, first to Antwerp, then to Le Havre, France. At the same time, more than 1,000,000 Belgians left the country, 200,000 fleeing to France, 100,000 to England and 700,000 to the Netherlands. The government in Le Havre immediately set about reorganizing the army, which had never left the front. On March 1, 1915, it had called to the colours all Belgians from 18 to 25; numerous volunteers joined the forces, and the government was able to maintain an army in the field with an average effective strength of 150,000.

5. International Treaties.—Belgium was represented by Paul Hymans, Émile Vandervelde and J. van den Heuvel at the peace conference, but was not admitted to the deliberations of the Council of Ten. Hymans played an important part in drafting the covenant of the League of Nations and Vandervelde in framing the constitution of the International Labour office. By the treaty of Versailles, Belgian neutrality was abolished. Germany renounced its rights over Moresnet and the Walloon cantons of Eupen and Malmedy in Belgium's favour. Belgium was confirmed in the possession of these two cantons and joined the French in their occupation of the Ruhr. The grand duchy of Luxembourg, on July 25, 1921, entered into a customs, railway and consular union with Belgium. In Africa, Belgium received the mandate for Ruanda-Urundi, representing part of the territories conquered by the Belgian army, which was operating with the forces of the British empire during the war. The treaty of Versailles guaranteed Belgium priority for the sum of 2,000,000 gold marks on reparations account. In addition, the Allies declared themselves ready to transfer Belgium's war debt (5,600,000,000 fr.) to the German reparations account.

After the war the problem of Belgium's international status took on a new form. Belgium was anxious to become free of the restrictions on its right as a sovereign state to form defensive alliances, especially as the guarantee of neutrality had proved ineffectual. The treaties of Versailles, St. Germain and Trianon accordingly contained the provision that Germany, Austria and Hungary recognized that the treaties of 1839 no longer conformed to the requirements of the situation, consented to their abrogation and accepted in advance whatever arrangements might be made to replace these treaties by the principal Allied and associated powers, or by any of them, in concert with the governments of Belgium and the Netherlands.

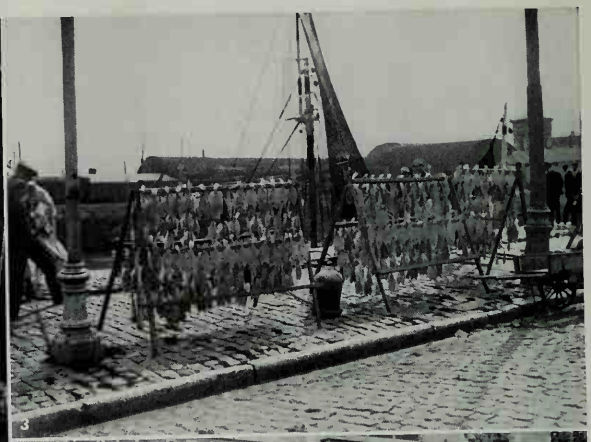
The consequence of the new position was a military convention concluded in Aug. 1920 between Belgium and France, after full consultation between the respective general staffs. In Nov. 1920

PHOTOGRAPHS, (TOP LEFT, CENTRE RIGHT) CAMERA PRESS LTD., (TOP RIGHT, BOTTOM LEFT) REECE WINSTONE, (BOTTOM RIGHT) LESLIE H. BAKER FROM PAUL POPPER (LONDON)

VIEWS OF BELGIUM

Top left: Tower of the town hall, Brussels, at night
Top right: Narrow, cobbled street of Lierre
Centre right: Scene along the Meuse river near Anseremme
Bottom left: North sea fishing boats along the quay at Blankenberge
Bottom right: Place de Brouckère, Brussels, busy intersection of the boulevards Adolphe-Max and Emile-Jacqmain

BELGIUM



PHOTOGRAPHS, (1, 2) SCHALL-PIX FROM PUBLIX, (3, 5) PAUL'S PHOTOS, (4) POMMERANZ-LIEDTKE-PIX FROM PUBLIX

SCENES IN THE LIFE OF THE BELGIAN PEOPLE

1. Horse-cab driver in Brussels with the typical high hat of his trade
2. Workers on the Quai aux Herbes at Ghent
3. The fish market at Ostend
4. Sidewalk cafés in Bruges
5. Masked penitents in the religious procession of Calvary and the Crucifixion, held annually in July by the Flemish citizens of Furnes

the two governments informed the League of Nations that the military alliance had been concluded and that it was of purely defensive character. Belgium offered to conclude a similar agreement with Great Britain; indeed, Belgium wanted to see a Belgian-French-British entente established. This could not be achieved, but the Belgian foreign policy endeavoured to maintain the traditions of the entente and to reconcile the British and French points of view. In the Locarno pact initialed Oct. 16, 1925, Germany, Belgium, France, Great Britain and Italy took note of the abrogation of the treaties for the neutralization of Belgium. A treaty signed in Paris on May 22, 1926, by Great Britain, France and Belgium confirmed the abrogation of these treaties.

The question of the Scheldt was not solved by the treaty of Versailles. Belgium attempted to reach a modus vivendi on this subject with the Netherlands. On April 3, 1925, a new treaty was signed settling the relationship between the two countries. In 1927 a general treaty was drafted by the Belgian and Dutch governments, which was accepted by the Belgian parliament but rejected by the parliament of the Netherlands.

6. Internal Affairs.—After the conclusion of peace the government was chiefly occupied with the problem of feeding the country, which necessitated various measures prohibiting export and authorizing the requisitioning of home-grown foodstuffs. In consequence of the destruction of industry there were 800,000 unemployed in the country, and 2,400,000 persons, or one-third the population, were dependent on public assistance. The state was obliged to create relief works immediately. The number of persons organized in trade unions rose from 250,000 in 1914 to 875,000 in 1920. By the end of 1919 the 2,200 mi. of railway which had been destroyed were reconstructed. As a result of the recovery of the 24,000 Belgian machines brought back from Germany and of the huge orders for material placed in England and the United States (which were made possible by the credits granted to industry by the banks, these having enlarged their capital considerably for this purpose), industry recovered rapidly.

The reconstruction of the devastated regions, valued at more than 35,000,000,000 fr., called for very great sums; military pensions, indemnities for damage caused by war and unemployment doles swelled the budget disproportionately. The public debt had risen from 4,000,000,000 fr. before the war to 22,000,000,000 in 1919 and passed 30,000,000,000 in 1921. At the same time the fall of the exchange continually increased the cost of living, necessitating a great increase of salaries and readjustment of wages. The demand for social legislation increased greatly. On June 14, 1921, the working day was reduced to eight hours. To prevent or diminish conflicts, national councils, formed by delegates of the employers and the workmen in equal numbers, with an official as president, were set up. The action, although devoid of any legislative backing, was often successful. The financial measures of the government were also democratic in tendency, including income tax, supertax and an increase in death duties.

The fall of the exchange impoverished the middle classes and the *rentiers*. This was further accentuated by the housing law, permitting tenants to continue to occupy their dwellings and limiting the rent to a sum not exceeding 125% of the prewar rents. On the other hand, the quick recovery of industry contributed to enrich the industrial and commercial classes. The high price of living also improved the conditions of the peasants. Thus the middle classes were in a difficult situation between the rich capitalists on one side and the workmen and peasants on the other.

The considerable improvement in the condition of the working classes increased the power of the trade unions. The Socialist party formed the Banque Belge du Travail, while the wealth of the peasants gave the Bank der Boerenbonden great financial and political power. The political result was the weakening of the Liberal party, which was recruited from the middle classes, and a strengthening of the Socialist and Catholic parties.

The intellectual life of Belgium revived. The Association Internationale des Académies chose Brussels for its centre, and on Aug. 19, 1920, an Académie Royale de Langue et de Littérature Françaises was formed there. The status of legal personality benefited the universities. The profits realized by the Commission for Relief in Belgium went to constitute a university fund. Each university was further endowed with a capital of 20,000,000 fr.

The period of restoration was blessed with a truce in the political struggle; universal male suffrage from the age of 21 was introduced at the demand of the Socialist party; female suffrage, which was claimed by the Catholic party, was granted for communal elections. The elections of Nov. 16, 1919, under the new franchise, had resulted in the Catholic party's losing the majority which it had held since 1884. At first the country was ruled by a "concentration" government, under Léon Delacroix and later (Nov. 9, 1920) under Henry Carton de Wiart; afterward it was ruled by a coalition between Catholics and Liberals under Georges Theunis (Dec. 16, 1921) and then, after the elections of April 1925, by a democratic Catholic-Socialist coalition under P. Poullet and Vandervelde. An act of 1921 made Flemish the administrative language of the Flemish-speaking districts.

In May 1926 Henri Jaspar formed a coalition ministry consisting of representatives of the three great parties of Belgium. He made a vigorous effort toward financial stabilization, with the help of E. Francqui, who was principally responsible for the currency reform. He obtained from parliament special powers, under the king, to carry out the necessary measures. On June 7 parliament agreed to impose fresh taxation yielding 1,500,000,000 fr. On July 23 the state handed over the management of its railways to a national railway company. A royal decree was issued on July 31 converting the internal debt; the creditors of the state were given bonds, the rate of which was guaranteed. Under these measures, the franc rose to an exchange rate of 175 to the pound, and it was stabilized at this rate by law.

The Jaspar ministry, which had resigned in Nov. 1927 only to return in reconstituted form, was followed, after a period with Delacroix as premier (Nov. 1929), by Catholic-Liberal coalitions under Jules Renkin (June 1931) and Broqueville (Oct. 1932).

(H. Pr.; J. Pr.; C. Ve.)

7. Leopold III.—Deep national mourning followed the accidental death of King Albert I on Feb. 17, 1934, near Namur. He was succeeded by his son Leopold III. The successive cabinets of the first years of the new reign—formed by Theunis (Nov. 1934), by Paul van Zeeland (March 1935), by Paul Émile Janson (Nov. 1937), by Paul Henri Spaak (May 1938) and by Hubert Pierlot (Feb. 1939)—had to face financial problems, internal unrest and a new danger to national security. The pro-Fascist party—the Rexists—under Léon Degrelle, had made considerable headway by denouncing the alleged corruption of national parties and by making a pact with the Flemish Nationalists. This movement, however, was to be arrested by severance of the Flemish pact and by defeat in the municipal elections of Oct. 1938.

In March 1936 Germany occupied the Rhineland, and on Oct. 14 King Leopold, in order to obtain from parliament the measures necessary for strengthening the defense of the country, announced that Belgium would pursue a policy of independent neutrality. There was a general assent from all political parties at this decision. While asking to be released from its obligations under the Locarno treaty, Belgium reaffirmed its decision to withstand any act of aggression, with the support of Great Britain and France. These powers accepted the new situation. In fulfillment of these promises, a fortified line from Antwerp to Namur (the K-W or Dyle line) was constructed, and the Belgian army was placed in 1939 on a wartime footing of 2 cavalry and 20 infantry divisions. In addition, 8% of the country's manpower was mobilized, and more than 20% of the total budget was allotted for defense.

8. World War II.—On May 10, 1940, eight months after the outbreak of World War II but within a few days of the German ambassador's assurance that Germany would respect Belgian neutrality, Belgium was invaded. Spaak, foreign minister in Pierlot's cabinet, immediately called on Great Britain and France to fulfill their pledge, and the Allied armies moved into Belgium.

After 18 days of bitter fighting, the Belgian and Allied forces were overwhelmed by the massive armour of the German army and by German air supremacy. After the enemy's breakthrough at Sedan, the Belgians held the coast and helped cover the evacuation of the British expeditionary force through Dunkerque. With tens of

thousands of refugees blocking the roads and no ports available, further fighting would have been useless, and Leopold, as commander in chief of his army, was compelled to surrender on May 28. In order to strengthen his troops, he had three days previously pledged himself to remain with them, and when his ministers urged him to escape, he refused to leave the country. This action was severely criticized at the time, but five months later, when Pierlot and Spaak eventually reached England and reformed the government there, the "misunderstanding" between king and government seemed to have been cleared up.

Four years of German occupation followed, with the king interned at the castle of Laeken. The spirit of the people, which had been weakened by the collapse of France (where many Belgians had sought refuge), was raised when, toward the end of 1940, the result of the battle of Britain began to be known. After Hitler's invasion of the U.S.S.R. in June 1941, the German administration became more exacting, and Belgian firms were forced to undertake work for the Nazis. The effort to recruit labour and to encourage anti-Soviet contingents to fight on the eastern front met with little response. It was estimated that only 2% of the population actively supported the German policy. The calculated release of Flemish prisoners of war while Walloons, in spite of Leopold's protests, were retained in captivity had only the effect of uniting the country. Confidence in Germany's defeat was furthered by the entry of the United States into the war and the resistance of a cross section of the population, of every religious and political colour, grew every month. Allied airmen were sheltered and an escape route was organized for young Belgians wishing to join the nucleus of a Belgian army that was being formed in England. The morale of the country was sustained by the circulation of Allied radio news bulletins and clandestine papers. This opposition brought harsh reprisals from the Germans, including the shooting of hostages, the imprisonment of 18,000 persons in concentration camps and the deportation of workers estimated at 140,000.

By the time the Allied troops reached Belgium, on Sept. 3, 1944, the resistance movement had been secretly trained and armed and was in radio communication with the army of liberation. The plans of the Germans to destroy the port of Antwerp were foiled, and the docks could be used to land ammunition and reinforcements during the eight months that ended with victory in May 1945.

9. The Regency.—With the liberation came a period of comparative prosperity. This was partly attributed to the fact that Belgium was left at the end of the war with a dollar surplus from U.S. lend-lease. Increased trade flowed through the port of Antwerp as the Allied armies advanced to the Rhine and military communications were re-established. But with the end of hostilities, successive governments were faced with the postwar problems of a rising cost of living and workers' demands for higher wages and pensions. Moreover, the life of the nation for the next five years was deeply disturbed by the *question royale*, which was to be inextricably woven into the pattern of all postwar politics.

In 1940 Pierlot and his government had sought refuge in London, with the governments of the other invaded western countries. Returning on Sept. 7, 1944, to find that Leopold and his family were in Germany, where they had been deported in June 1944, he summoned parliament and, on Sept. 20, saw a regent elected in the person of Leopold's brother Prince Charles, comte de Flandre, who undertook to assume Leopold's responsibilities until his liberation.

The first act of the finance minister, Camille Gutt, was to block all banking accounts. This drastic measure allowed him to levy a tax on fortunes made by war profiteers and collaborators. There followed a period of unrest when many people returned from concentration camps to denounce rivals, both political and personal. The Communists who, from the entry of the U.S.S.R. into the war in 1941, had taken an increasing share in the resistance, were with difficulty restrained when the government ordered the disarming of all civilians.

A new coalition government was formed on Feb. 11, 1945, under the trade-union leader Achille Van Acker. On May 8, 1945, the king was liberated by the U.S. army in Austria, where he remained. A month later Van Acker was charged with a mission to him. As early as Sept. 1944 an active campaign had been launched against Leopold by the Communists. They were soon joined by the majority of the Socialists and even by Liberals who wished to avoid disturbances at a time when the economic position was critical. Agreement could not be reached between the Socialist premier and the sovereign, and a bill prolonging the regency was introduced in July 1945, the Social Christians (Catholics) immediately resigning. In October the king issued a proclamation answering certain criticisms made against him, but he emphasized at the same time that the Belgian monarchy was founded on the will of the people and that he would accept their verdict.

Since Aug. 1945 a steady policy of reconstruction had been pursued. Loans from the United States and Canada had resulted in an improvement in economic conditions.

In the general election of Feb. 17, 1946, the Communists and Liberals lost seats to the advantage of the two main parties, Social Christian and Socialist. This showed a majority in favour of the king's return but not a clear majority over his opponents. Various efforts were made to solve the political crisis, and on Aug. 2 Camille Huysmans, the Socialist leader, came into office. His government was to last until March 19, 1947, when Spaak, who throughout the various coalitions had remained foreign minister, became prime minister, with a cabinet consisting of nine Social Christians, eight Socialists and two independents. Further attempts were made to solve the royal question, and there were interviews in Switzerland, where the king and his family were residing. During 1947 unemployment had become a major problem, rising to the peak of 220,000.

On July 3, 1947, the Benelux (*q.v.*) Union bill was ratified, in pursuance of an idea of economic union between Belgium, the Netherlands and Luxembourg, affecting 18,000,000 people, that had been outlined while the three governments concerned were in London. A collective agreement for mutual aid in military, economic and social matters, including Great Britain, France and the Benelux countries, known as the Brussels treaty, was signed on March 17, 1948. On April 4, 1949, Belgium was one of the 12 signatories of the North Atlantic treaty.

In May 1949 Prince Charles dissolved parliament. A general election was held on June 26, at which Belgian women exercised the franchise for the first time. In accordance with the census of 1947, the distribution of seats in the parliament was modified. There were 212 seats in the chamber of representatives instead of 202. A compromise left unaltered the number of Walloon seats, and allowed eight more seats to the Flemish region and two more to the bilingual greater Brussels area, so that the proportion was 104 Flemish, 76 Walloon and 32 Brussels representatives. The result of the election was that the Social Christian party gained seats, but not enough to avoid a coalition. Gaston Eyskens, as leader of that party, formed the new government with the Liberals. A bill for a referendum on the royal question was drafted and adopted by the senate. The king agreed to accept 55% of the votes cast as the minimum necessary for his return. The Socialists, led by Spaak, urged 66% or abdication.

In Feb. 1950, after a stormy passage through the lower house, the referendum bill was adopted by 117 votes to 92. On March 12 the referendum was made: 57.68% voted for the return of the king, who stated that it was now for parliament to make the final decision. Eyskens resigned on March 18, and after six weeks of uncertainty and strikes a general election was held (June 4, 1950). The Social Christian party, by gaining three seats, obtained an absolute majority over the left and was able to form a single-party government. Jean Duvieusart, the new premier, announced as one of the first points in his program the ending of the regency and the return of the king. After protracted debates lasting nearly a month, the bill was passed, and the prime minister flew to Switzerland to acquaint the king with parliament's decision. On July 22, accompanied by his sons Prince Baudouin and Prince Albert, Leopold flew to Brussels and went to the castle at Laeken. Loyalist demonstrations were opposed by counterdemonstrations, and unrest grew. The Socialists now ordered renewed resistance, and a march of protest to Brussels was timed for Aug. 1. In order to restore peace, Leopold announced, on Aug. 1, 1950, that he

had decided to transfer his royal powers to Baudouin as a step toward enabling the prince to accede to the throne when he came of age (Sept. 7, 1951).

10. Baudouin.—On Aug. 11, 1950, Baudouin, then known as the prince royal, took the constitutional oath. Duvieusart resigned and was succeeded on Aug. 15 by Joseph Pholien, a former minister of justice. Paul van Zeeland was appointed foreign minister and associated Belgium with the United Nations on the Korean question. On Jan. 10, 1951, the prince royal signed a decree empowering the minister for defense to send Belgian units to serve in the army of the North Atlantic Treaty organization (NATO). The prime minister declared that Belgium would contribute 10% of the western union defenses. On March 21 parliament passed the bill extending military service from one to two years. On July 16, Leopold abdicated definitively, and on the next day the prince royal ascended the throne as Baudouin I.

In Jan. 1952 Pholien resigned as prime minister and was succeeded by Jean van Houtte. After the election of April 1954 Van Acker formed a Socialist-Liberal government, with Spaak as minister of foreign affairs until he became secretary general of NATO and was replaced by another Socialist, Victor Larock.

The elections of June 1958 resulted in a short-lived one-party Social Christian government, which gave way to a Social Christian-Liberal coalition under Eyskens. The dispute with the Netherlands regarding the enclaves of Baarle Nassau and Baarle Hertog dating from the middle ages was finally resolved in Belgium's favour by the International Court of Justice in June 1959. The main difficulties of this government arose from the increasing political problems in the Belgian Congo (*q.v.*), which caused it to grant independence to the former colony on June 30, 1960. On Dec. 20, 1960, the government submitted to parliament a bill, popularly known as the *loi unique*, outlining an austerity program including higher taxes, aimed at financial stabilization which was in part to offset the economic losses suffered in the Congo. This immediately resulted in a wave of crippling strikes and antigovernment demonstrations by Socialist-dominated trade unions largely in the Walloon areas. From 1961 Belgian politics were dominated by the thorny problem of relations between Flemings and Walloons.

(E. Ca.; C. Ve.)

V. POPULATION

Belgium is one of the most densely populated countries of Europe. There was in 1961 a total population of 9,189,741. This was equivalent to a density of 780 persons per square mile. The distribution among the nine provinces is shown in Table I.

The estimated numbers inhabiting the Flemish area in 1963 were 5,160,595, the Walloon area 3,068,228, and the Brussels area (which may be regarded as too mixed to be classed as either Flemish or Walloon) 1,040,523. German-speaking were estimated at 58,780. The total estimated population in 1963 was 9,328,126.

Brussels (*q.v.*) is the main financial centre, the seat of a great number of the industrial companies linked with three bank groups. Complaints about a too-large centralization of economic life in Brussels were often voiced by Walloons and Flemings. However, the concentration was partly due to the central position and easy access of the capital while various branches of industry were shifting to the region between the port of Antwerp and the Brabant province. In 1961 Brussels and its suburbs had 1,439,536 inhabitants. Other large cities are: Antwerp (Anvers) with 253,295 inhabitants, Liège 153,240; Ghent (Gand) 157,811 (*qq.v.*).

TABLE I.—*Population*

Province and capital	Area		Population	
	Sq.mi.	Sq.km.	1947 census	1961 census
Antwerp (Antwerp)	1,105	2,861	1,281,333	1,443,355
Brabant (Brussels)	1,301	3,369	1,798,468	1,992,139
East Flanders (Ghent)	1,149	2,977	1,217,280	1,272,005
West Flanders (Bruges)	1,209	3,132	996,449	1,068,976
Hainaut (Mons)	1,466	3,798	1,224,800	1,248,854
Liège (Liège)	1,497	3,876	963,851	1,003,526
Limburg (Hasselt)	935	2,422	460,446	574,606
Luxembourg (Arlon)	1,706	4,418	213,478	216,818
Namur (Namur)	1,413	3,660	356,090	369,432
Total	11,781	30,513	8,512,195	9,189,741

The mining industry is concentrated in the following basins: Borinage (around Mons), Centre (around La Louvière), Charleroi, Liège and Kempen (in Limburg province). The textile industry is located at Courtrai (Kortrijk) and Roeselare (Roulers) in West Flanders, Ronse (Renaix), Ghent and Sint-Niklaas (St. Nicolas) in East Flanders and Verviers in the province of Liège, while the steel industry is mainly established in the provinces of Liège and Hainaut. Most of the other branches of industry are spread over the country, the province of Luxembourg being the poorest.

Development of electricity distribution after World War I encouraged the establishment of factories in places where building sites and labour were available, and small suburbs were rapidly outgrowing ancient cities. The coast is almost a continuous line of sand dunes and holiday resorts but industry was also expanding at Ostend and Zeebrugge. Metal-working factories exist at Ghent and Mechelen (Malines). Shoe manufactures made Izegem (in West Flanders) famous, but Diest (in Brabant) was becoming a shoe-making centre as well. Binche (in Hainaut) has a flourishing ready-made clothing industry.

Nurseries are concentrated in the Ghent and Bruges (Brugge) areas and market gardens in the region of Mechelen. The main glasshouses are around Brussels. The sugar industry is located at Moerbeke in East Flanders and Tienen (Tirlemont) in Brabant and the diamond industry at Antwerp. The main shipyards are at Hoboken and Temse (Tamise) on the Scheldt river. Fishing is organized from the ports of Ostend, Zeebrugge, Nieuwpoort (Nieuport) and Blankenberge. *See* also *The Economy* below.

VI. ADMINISTRATION AND SOCIAL CONDITIONS

1. Constitution and Government.—The Constitution was promulgated on Feb. 7, 1831, and revised in 1893 and 1920–21. The 1893 revision provided for the administration of colonies or protectorates under the condition that overseas territories should be defended by Belgian volunteers only. In 1920–21 the composition of the senate and the franchise were altered.

Belgium (officially Royaume de Belgique or Koninkrijk België) is a constitutional, representative and hereditary monarchy. All powers derive from the nation. The king is the head of the state and his person is inviolable. He shares the legislative power with the chamber of representatives and the senate, which are elected for four years. He sanctions and promulgates the laws and exercises the executive power in conjunction with his ministers who are responsible to parliament.

The king cannot act alone; his actions in the political sphere must be sanctioned by a minister. In the case of disagreement a minister can be dismissed by the king, or the minister (or the entire government) can resign. Ministers are appointed by the king generally from members of parliament. Since World War I the government has been headed by a prime minister who coordinates government policy. The number of ministers varies; they have equal rights. The government must rely on a majority in parliament. If it has not a majority, it ordinarily resigns and, if no other government is acceptable, parliament is dissolved and general elections must follow within 40 days.

The king is commander in chief of the armed forces, declares war, makes peace and concludes trade treaties. Treaties that may entail burdens for the state or for Belgians individually take effect only after they have been ratified by parliament, signed by the king and published in the *Moniteur Belge*. On the death of the king and until the heir to the throne has taken the oath before parliament, the royal prerogatives are exercised by the cabinet council under the responsibility of the ministers. If the king becomes unable to reign the cabinet council exercises his prerogative pending the election of a tutor or a regent by the assembled chambers.

The succession to the throne goes by primogeniture to the descendants of Leopold of Saxe-Coburg (King Leopold I). Females are debarred from succession. In the absence of a male heir the king may nominate his successor with the approval of parliament. The king comes of age on his 18th birthday. Sons of the king become by right members of the senate at 18, but cannot take part in votes until they are 25. A member of the royal family cannot

be a minister. The king can appoint ministers of state who have no special function but may be consulted in critical times.

Since 1949 the chamber has been composed of 212 members; the constitutional maximum is one deputy to every 40,000 inhabitants. Deputies are elected by universal direct suffrage, which extends to all male Belgians over 21 and (after 1949) also to women. All candidates must have the appropriate residence qualifications and be at least 25 years old. Voting is compulsory and secret. The distribution of seats among the lists of candidates is decided by the D'Hondt system of proportional representation (*q.v.*).

The organization of the senate is complex. The number of members elected directly equals half the number of members of the chamber of representatives who are elected by the same electorate. The candidates must be at least 40 years of age. A number of senators, one to every 200,000 inhabitants, are elected by the provincial councils by proportional representation. The directly elected and the provincial senators co-opt further members, their number being half that of the provincial senators. Since 1949 the senate has been composed of 106 directly elected members, 46 provincial members and 23 co-opted members, making a total of 175. In March 1960 a new electoral law was passed which in forthcoming elections would permit the Belgian people to elect 226 deputies instead of 212 and 183 senators instead of 175.

The chamber of representatives and the senate have equal powers. Bills may be introduced in both. Before being signed by the king they must have been passed in the chamber and the senate. Speeches can be delivered in French or Dutch (Flemish in its broader sense), this being facilitated by an interpreter system with earphones.

A court of accounts (*cour des comptes*), the members of which are appointed by the chamber of representatives, has authority to control all the operations of the treasury as well as the revenue and expenditure of the provinces. It sees that the budget is not exceeded, and that funds are not transferred from one authorized purpose to another.

The council of state (*conseil d'état*), created by the act of Dec. 23, 1946, consists of two sections, one of which deals with legislative matters and the other with administrative affairs. The legislative section is responsible for improving the drafting and editing of legal texts. The administrative section has the task of ensuring protection of the citizen's rights and interests in relation to the public powers.

2. Local Government.—The constitution recognizes the existence of nine provinces: Antwerp, Brabant, West Flanders, East Flanders, Hainaut, Liège, Limburg, Namur and Luxembourg (*qq.v.*). These provinces and their communes are the principal units of local government. Local authorities administer affairs under the control of the central government through the minister of the interior but possess a considerable amount of autonomy. The executive head of each province is the governor, who is selected by the king on the advice of the minister of the interior. The governor transmits instructions from the minister of the interior to the communal councils and in general holds a watching brief for the central authority. He is also responsible for the execution of the provincial council's decisions on the public services coming within his competence.

The legislative power of the province resides in the provincial council, which is elected by parliamentary voters for a term of four years. The main duties of the provincial council are voting the budget and looking after such services as highways, drainage and education. The working administrative body within the province is the *députation permanente*, a core of the council elected by its own members. The body meets frequently under the presidency of the governor, whom it also advises; it cannot be suspended or dismissed by the central government.

The province is divided administratively into districts (*arrondissements*), of which there are 41. In every district there is a district commissioner who supervises communes of fewer than 5,000 inhabitants. The municipality (commune), of which there are 2,663, is the basic unit of local government, and there is a uniformity throughout the country in the details of its administration. The administrative power is vested in the burgomaster, the college of the burgomaster and aldermen, and the communal council. The burgomaster is nominated by the council and appointed by the king, and is usually a member of the council. He holds office for a period of six years, which may be renewed. The communal council also serves for six years and has the duties of voting the budget, of organizing police, public institutions and services (including primary education) and of administering public property. It is not responsible to any superior authority, but any decrees which overstep its powers can be annulled and its budget must be approved by the governors and by the king. The executive power of this council is delegated to the burgomaster and the college of salaried aldermen, of which the burgomaster is president.

3. Political Parties.—The Social Christian, Liberal and Socialist parties were often called the constitutional parties. The first two existed when Belgium became independent, although they were not organized. The Liberal party was founded in 1846 in Brussels. The Catholic party took shape at a congress at Mechelen in 1863. The Belgian Workers party was created in 1885. The present denominations Social Christian party and Belgian Socialist party were introduced after World War II.

The Social Christian party is an amalgam of landowners, industrialists, middle classes, peasants and workers linked by their devotion to the Roman Catholic Church. The farmers, through the *Boerenbond* with about 300,000 members, exercise a great influence and are responsible for the protectionist agricultural policy. Since World War II the influence of the Roman Catholic trade unions has been predominant in the party, which is stronger in the Flemish than in the Walloon area.

The Socialist party recruited its first adherents among the textile workers in the Ghent region and the miners and metalworkers in the Walloon industrial centres. After World War II the party gained some support among intellectuals and even among the farm workers, and aimed at overtaking the Social Christian party. The Socialists in the 1950s did not press for nationalization of industries and preferred forms of co-operation between private management and local or provincial authorities.

The Liberals exercise a policy of holding the balance between the Social Christian and the Socialist parties. After World War II they lost ground at general elections to the benefit of the Social Christian or Socialist parties, but their influence in government coalitions was often greater than their electoral strength. For instance, in the Socialist-Liberal cabinet after the April 1954 election they secured 7 portfolios out of 16.

The Communists obtained 12.7% of votes in the first postwar election (Feb. 1946), but later lost their influence over the workers. In June 1958 they obtained only 1.9% of the total votes cast.

The Christian Flemish People's union was an attempt to restore pre-1939 Flemish nationalism.

The trade unions are divided into Socialist (more than 630,000 members) and Social Christian (530,000 members) as well as some Liberal neutral unions. The Socialists are dominant in heavy industry and the Social Christians in the Flemish textile centres and in smaller industries. The total number of union members (1951) was more than 1,200,000.

4. Taxation.—Income tax is levied at a rate of up to 35% of earned income with separate taxes on unearned income, on real property and a personal complementary tax. In addition there are customs (except within the Benelux territories) and excise duties, transfer tax, stamp duties and estate taxes. Local governments also are authorized to levy taxes.

5. Welfare Services.—Social welfare in Belgium is operated under a law passed in Dec. 1944, amplified and extended by subsequent bills and decrees. The services are administered by the Central National Office of Social Security, which collects contributions from both employers and employees, and distributes sums to various national institutions dealing with family allowances, health, old age and holidays with pay. The state contributes only to old-age pension schemes. Contributions are compulsory for all wage earners in industry (except for miners, who have their own scheme), trade and agriculture, but not for self-employed persons. Participation by all employees in mutual insurance so-

cieties is compulsory; these conduct schemes of compensation for industrial injury. Public assistance is controlled by committees in each commune appointed by the communal council, under the ministry of health. Various public-health activities (dealing with maternity and child welfare, the prevention and treatment of tuberculosis and venereal diseases, etc.) are carried out by semi-official or unofficial organizations, subsidized by the state.

6. Justice.—The Belgian constitution provides that the judicial power can be exercised by courts and tribunals in the name of the king. The legal system itself is to a large degree patterned upon that of France. The administration of justice is centralized under the control of a minister of justice; there is a codified body of law.

The lowest court in each of the 229 judicial cantons (whose boundaries rarely coincide with those of the electoral cantons) is that of the justice of the peace, who deals with breaches of police regulations and can pass judgment in civil cases where the amount in litigation is small. Within each of 26 judicial districts there is a tribunal of first instance presided over by one or three judges sitting without a jury. It acts as a court of appeal to the justice of the peace. One or more chambers of the tribunal deal with misdemeanours involving a sentence of not more than five years' imprisonment. Each tribunal of first instance includes a children's court composed of a single judge.

There is a court of assize which is located in the provincial capitals to try crimes, as well as political and press offenses. Trial is by jury. The bench is composed of a judge of the court of appeal and two judges of the tribunal of first instance who sit with the jury. Courts of appeal are established in Brussels, Ghent and Liège. There are also various special tribunals.

At the top of the legal system there is the court of cassation in Brussels which provides for unity of jurisdiction. On appeal, the court does not deliver a fresh judgment but may suspend the sentence and send the case back to another court or tribunal. A minister can be accused by the chamber of representatives and brought before the court of cassation, which in this event is entitled to judge the ground of the case. A minister condemned can obtain mercy from the king only at the request of the chamber of representatives or of the senate. Judges are appointed for life and are irremovable except by court sentence. Justices of the peace and of tribunals are appointed by the king.

There are two types of police in Belgium, state and communal, each with the twofold function of preventing crime and investigating it. The burgomaster is the chief of the communal police. He can request the assistance of the state police.

7. Education.—Freedom of education is a constitutional liberty. After the separation of the Netherlands in 1831 many municipalities suppressed primary schools to alleviate expenses. Other schools were rudimentarily organized and many teachers were unqualified. A bill introduced in 1842 by a Catholic-Liberal coalition government compelled the municipalities to organize public primary schools or to adopt confessional (Roman Catholic) schools. Roman Catholic religious teaching was compulsory except for children belonging to another faith.

In 1879, under pressure of an anti-Catholic wing, a Liberal government ordered each municipality to organize at least one public school where religion was taught out of school hours. The state had the monopoly of teachers' training, and teachers appointed by local authorities needed state certificates. Violent opposition to these measures developed, and the political repercussions of what was called a "school war" were still felt at mid-20th century. Enrollment fell at many public schools and hastily organized confessional schools had, within two years, about 190,000 children or 66% of the total schoolgoing population.

In the 1884 election the Catholics gained the majority which they kept until World War I. They withdrew the state monopoly and allowed the local authorities either to have public schools or to replace them by the so-called "free" (independent) schools. After World War I, Jules Destrée, a Socialist minister, decided that teachers of both public and free primary schools would be paid by the state. Free secondary schools, however, were not subsidized.

A new "school war" started in 1954–55 when the Socialist-Liberal government undertook educational reform. Concessions were made to Catholic opinion but the 1955 bill, which proposed reduced subsidies to free schools, was declared unacceptable by the Social Christian party and the Roman Catholic Church. After the 1955 act (passed without the support of the Social Christian deputies) the framework of education was as follows:

1. Primary schools were to be built and maintained by the local authorities. Free primary schools, mostly Roman Catholic but including some Protestant and private schools, were to be organized by private bodies. Some municipalities subsidized free primary schools with heating, school meals and transportation.
2. Secondary and vocational schools were to be built and maintained by the state, the provinces and municipalities, or by independent (mostly Roman Catholic) organizations. Free and vocational schools were subsidized to a limited amount (3,000,000,000 fr. in 1955–56).
3. The teachers must possess the appropriate certificates and would be paid by the state.
4. Free schools must observe the language regulations so that teaching could be in French or Dutch (Flemish) according to region.
5. Both in the state primary and secondary schools, parents could choose the type of religious instruction (Roman Catholic, Protestant or Jewish) for their children. In 80% of cases the Roman Catholic faith, taught by priests, was preferred.

Friction between Roman Catholics and Socialists over education continued until Nov. 1958 when a joint national committee drew up a final agreement (ratified May 1959) under which the school-leaving age was raised to 15 and tuition fees in all primary and secondary schools were abolished. The state ceased to subsidize the building of free primary schools but agreed to compensate them for losses incurred by the abolition of fees, also to increase the subsidy for teachers' salaries. The principle was restated that parents could choose between state and free schools.

By the early 1960s there were four universities and several institutions of higher education, such as mining schools, the University Institute for Oversea Territories, industrial and commercial schools and agricultural schools, which were organized by the state, the provinces or by Roman Catholic associations. The Louvain Roman Catholic university (founded in 1425) is bilingual, and the non-confessional Brussels university (1834) was becoming bilingual. The Liège university (1817) teaches in French, and Ghent (1817) taught in Dutch after 1930.

Nuclear research was divided among the four universities, the college of engineering at Mons and the Royal Military schools under the guidance of an Interuniversity Institute of Nuclear Sciences. An experimental reactor was established at Mol, in Antwerp province.

School attendance was made compulsory by the 1914 act for children between 6 and 14 (inclusive). Infant schools existed for children below the age of entry into the primary school. The secondary schools were divided into a lower degree category where education was by teachers trained in normal schools and a royal *athénées* category (free Roman Catholic colleges) divided into classical (Latin and Greek) and modern where lessons were given by university-trained teachers.

8. Defense.—According to the constitution the king commands the armed forces, declares war and makes peace. When the North Atlantic Treaty organization came into operation a way out was found from a complex situation. Baudouin, who then was prince royal, signed in Jan. 1951 a decree placing the Belgian fighting forces at the disposal of NATO.

In March 1951 compulsory military service was extended from one to two years; in Aug. 1952 it was reduced to 21 months, in May 1954 to 18 months and later to 12 months. The effectives in the early 1960s numbered more than 120,000, including about 50,000 conscripts. In addition, about 30,000 men were available for the territorial antiaircraft units.

The fighting forces included one infantry and one armoured division with more than 40,000 regular soldiers and the rest conscripts.

The air force, with about 21,000 personnel, comprised 400 aircraft and had three wings for interception, two fighter-bomber wings, and one transport squadron.

The navy, with 4,800 officers and men, was composed of one

frigate, a number of high-sea mine sweepers and coastal mine sweepers based on Ostend and Zeebrugge; one transport ship and several speedboats based in the neighbourhood of Cologne on the Rhine. A few mine sweepers for keeping open navigation on the Scheldt river were under commission.

VII. THE ECONOMY

Belgian is essentially a manufacturing country but a fair proportion of the population is engaged in agriculture. The economy suffered severely during the German occupations of both world wars, chiefly from the deportation of workers and the dismantling or deterioration of plants. But recovery in both cases was remarkably rapid.

1. Agriculture.—In the early 1960s more than 1,000,000 Belgians, about one-eighth of the total population, depended on agriculture for their livelihood and almost half worked on farms or market gardens. Three-fifths of the national territory was under cultivation, a rather high proportion considering that the region of the Ardennes consists of bleak uplands with thin soils. Agricultural income exceeded 22,000,000 fr. annually or approximately 6% of the national income. About 18% of the total value of agricultural production derived from crops, 65% from animal husbandry and 17% from market gardening. Four-fifths of the national requirements were in the 1960s covered by home agricultural production.

Wheat is the principal cereal crop, though oats, barley and rye are also grown. The latter is decreasing in importance. Potatoes and sugar beet occupy a considerable acreage and sugar extraction and refining have become important industries since World War II. Small quantities of tobacco and flax are also grown.

Beginning in the late 19th century, the area under pasture increased substantially at the expense of arable land. Permanent meadowland increased threefold by mid-20th century. The number of dairy cattle greatly increased, accompanied by an increase in pigs, kept particularly by small holders. Sheep declined steadily, with the growth of wool imports. A famous heavy (Belgian) breed of horses is still produced for draft and farm work, especially in Hainaut and Brabant.

Exports of agricultural products represented 18% of the total. Agriculture was not sufficiently profitable, and protection and subsidies were required. Import duties varied between 3% and 15%, but the main protection was derived from import prohibition and quotas. Subsidies were granted for the production of cheese, condensed milk and tobacco.

Effects of mechanization in agriculture and of the increased use of improved seeds and fertilizers were noticeable. Higher wages demanded by farm workers encouraged the conversion of fields to pastureland. The emphasis was on the production of fodder for the increasing stock of cattle and of poultry. Improvement in quality of meadows and of fodder resulted in a decrease of forage imports and in the development of the dairy industry, but cost prices remained high so that further rationalization and greater productivity were needed.

Between the mid-1950s and 1960s the number of horses used in agriculture decreased by more than 30,000 and the number of tractors increased by nearly 20,000. The most important obstacle to mechanization was the small farm—four-fifths of the 250,000 farms covered a surface of less than 49 ac., the average being between 14 and 17 ac. Only about 400 farms exceeded 247 ac.

2. Industry.—Belgium is one of the most industrialized countries of the world. The country's economic prosperity is mainly dependent on the large-scale import of raw materials for the production and subsequent export of manufactured articles. To assist industrial production Belgium has several advantages—a dense population which has acquired a great technical skill, a good system of communications (rail, road and water) and domestic supplies of coal.

During the middle ages the prosperity of the area was chiefly centred in the towns of Flanders, where the chief industry was textiles. The Meuse valley, especially around Liège, has been an industrial area since the 12th century, using local iron ore, charcoal from the Ardennes forests, and water power. In the 16th century coal mines were opened in the Meuse valley and an allied industry of iron smelting developed. There was also a variety of other occupations such as printing, diamond cutting and glassmaking. Under the Spanish Habsburgs the provinces forming Belgium experienced a period of wars and persecution, which caused the migration of many skilled workers.

In the 18th century, however, when rule passed to the Austrian crown, some recovery took place in the provinces' economic position; the clothing and lace trades revived, and mining technique was improved. Under the French occupation (1792–1814) industrial prosperity increased. After union with the Netherlands, the raw materials and the markets of the Dutch colonies were open to Belgium.

With the granting of independence from the Netherlands in 1831, a certain temporary distress resulted from the loss of overseas markets. By mid-19th century about 7% of the population was engaged in industry compared with about 25% in agriculture. The period of free trade contributed to the rapid advance of Belgium as an industrial region, and the country became the chief rival of Great Britain. Foreign capital was invested particularly in its iron and and steel trade. By the end of the century the number of industrial workers was nearly twice what it had been in 1840.

During World War I much of the country's plant was dismantled and removed to Germany, and many workers were deported. Various reparations, the rapid reconstruction of ports, factories and communications and the establishment of new industries and modern plants soon set the country on the path of economic recovery.

After its liberation in World War II, Belgian industry was handicapped by damaged or obsolete plants, a depletion of skilled labour and the loss of contact with overseas markets. After a period of initial hesitancy, some of the country's industries, particularly metallurgy and chemicals, assisted particularly by the wealth of basic resources in the former Belgian Congo, by the re-establishment of the economic union with Luxembourg (later widened to include the Netherlands as the Benelux union) and by the demands of western European rearmament, recovered their former prosperity despite temporary labour unrest.

Handicraft industries declined considerably in Belgium in the 20th century; about 200,000 workers were engaged at home in such occupations as clothmaking, tailoring, dressmaking, lacemaking and leatherwork in 1910; about 52,000 (33,000 women) in 1930, and still fewer in the early 1960s. More than 1,000,000 persons were engaged in manufacturing industries in the early 1960s, mainly in metallurgical, textile and food industries.

Coal Industry.—The coal industry dates from the 16th century, by which time mines were being worked in the Ardennes and Meuse valleys, and in the first half of the 19th century it became Belgium's most important industry.

By mid-20th century Belgium, in common with other western European countries, suffered from overproduction of coal. A rationalization policy under the European Coal and Steel Community (*q.v.*) closed uneconomic mines, and modernized others. Output was reduced to 22,600,000 tons in 1959, and was reduced still further in 1960.

Workable coal exists in two main fields. One, the Sambre-Meuse (*Bassin du Sud*), runs in a narrow band through the centre of the country from the French frontier on a general line through Mons, Charleroi, Namur and Liège. A second field (the *Bassin du Nord* or *Noorderbekken*) was developed after World War I; beginning in the vicinity of Aachen, Ger., and crossing Dutch Limburg, it extends west-northwest into the Kempen area. The southern field is structurally complex, seams are thin and broken, firedamp is prevalent and mechanization is difficult. The field is now "old," and many parts have been worked out (*e.g.*, around Namur), or abandoned as uneconomic. Output in 1959 totaled 13,970,000 metric tons, but with the ending of the subsidy system in 1963 declined rapidly. The Kempen field produced 8,800,000 tons in 1959 (more than one-third of the Belgian total) but has since cut back this production level.

For many years Belgium was unable to produce enough coking coal and long-flame coal for its industrial needs. The development of the Kempen field supplied types previously lacking, and the

country became less dependent upon imports.

In the mid-19th century there were about 44,000 workers engaged in the coal industry, of whom 26% were women and children. There were 148,000 miners (123,000 Belgians and 25,000 foreigners) in 1938. By the early 1960s the number of miners was reduced to only 80,000, of whom about a quarter were foreigners.

Metallurgical Industry.—Production of iron, like that of coal, dates back many centuries; it was initially based on the local ore and abundant forests of the Sambre-Meuse belt. In 1827 coke-burning blast furnaces were erected near Liège and Charleroi. There was a decline of the domestic ores (which had reached about 850,000 tons yearly in the 1860s) toward the end of the 19th century. Supplies had thus to be drawn from the conveniently placed sources of Luxembourg and Lorraine. After World War I the Belgian iron and steel industry rapidly erected new plants and was soon established as one of the world's chief exporters of iron and steel. There was a temporary period of difficulty after 1945 following the German occupation of World War II, but production soon exceeded prewar output, and the industry benefited considerably from the demands created by the North Atlantic Treaty organization. By the early 1960s pig-iron production exceeded 5,000,000 tons annually, raw steel 6,000,000 tons and finished steel 4,000,000. More than half the steel was produced by two large combines formed by a merger in 1955.

Belgium has only small deposits of nonferrous ores. Consequently there is a large import of these metals. Nonferrous industries expanded considerably during the 20th century. The chief of these was that of zinc, which was first based on local ores but came later to rely on imports, principally from the Congo. Refineries are situated mainly in the Liège area and in the Kempenland. Copper and lead were also refined on a large scale. A considerable percentage of the output was exported.

Engineering and Chemical Industries.—The Belgian heavy and light engineering industries are chiefly situated along the coal fields, but light engineering spread into the larger towns and communes. Both types are well organized and flourishing. The manufacture of rolling stock constituted at mid-20th century an important branch of heavy engineering; shipbuilding was of lesser but increasing significance, while aircraft and motor production remained relatively small. An electrical plant industry produced a large quantity of heavier equipment, while in addition a widespread light electrical and machine tool industry was to be found throughout the industrial area, mainly concentrated in Brussels, Liège, Antwerp and Charleroi.

By the early 20th century the chemical industry in Belgium began to develop, with an emphasis initially on primary products such as sulfuric acid and ammonium sulfate, the by-products of the coke furnaces. After 1918 the industry was expanded to produce more secondary chemicals, in particular fertilizers. The heavy production, including that from coal distillation and that of by-products of iron, zinc and other metals, as well as the large-scale manufacture of acids and salts (especially copper sulfate), was situated in the towns of the Sambre-Meuse area and in the Kempen area. The light production (*e.g.*, drugs, soaps, paints) infiltrated from these areas into the larger centres. Fertilizers constituted an important item of Belgian export.

Textiles.—Since the middle ages textiles have formed the chief occupation of Flanders. In addition to the earliest production of wool, linen and cotton, considerable manufacture of artificial silks and other fabrics was developed. The Flanders district began to concentrate during the 19th century on the making of cotton and linen; the cotton industry was centred chiefly in East Flanders, particularly around Ghent, and the linen in the Lys valley and the Courtrai area. Jute fabrics, silk, rayon and nylon were also produced there to a smaller degree. An important woolen industry sprang up in the Vesdre valley in eastern Belgium, its chief centre being Verviers.

Other Industries.—Miscellaneous industries include the production of leather and paper goods, furniture making and diamond cutting. Sugar is refined in many parts of the country and is derived almost entirely from domestic beet. The old-established glass industry, founded at Charleroi and Val-St.-Lambert, spread into the Kempen area at Gompel. At mid-20th century pottery and bricks, using mostly domestic clay, were manufactured along the Sambre-Meuse valley, at the Scheldt-Rupel confluence, around Brussels and Ghent, and near Turnhout.

TABLE II.—*Trade by Principal Countries*
(values in 000,000 fr.)

Country	1938		1948		1959	
	Imports	Exports	Imports	Exports	Imports	Exports
United Kingdom	1,833	2,973	8,478	6,665	14,342	9,743
United States	2,489	1,443	15,647	4,452	16,252	21,786
France	3,310	3,324	7,577*	6,969*	21,552	14,719
Netherlands	2,075	2,610	7,189	11,444	27,171	35,008
Germany	2,599	2,648	5,196†	3,403†	28,266†	22,103†
Former Congo	1,934	410	6,508	2,793	9,745	4,385

*Including the Saar. †Federal Republic of Germany only.

3. Foreign Trade.—Except for a period between 1834 and 1849, Belgian commercial policy from 1831 was one of free trade, though in the two final decades of the 19th century attempts were made to stimulate a declining agriculture by protective tariffs. In July 1921 a customs agreement between Belgium and Luxembourg was signed, which ensured mutually advantageous policy, particularly in agriculture and metallurgy.

During the 1920s and 1930s Belgium attempted, despite the prevailing trend of other nations during the period toward protection, to cling to the policy of free trade but was progressively forced in defense to impose moderate tariffs on the agrarian products and finished industrial goods of other countries. Continued efforts were made to promote export trade by the conclusion of bilateral trading treaties.

The country weathered the effects of the German occupation in World War II partly because the German regime was relatively mild. Moreover, the Belgian possessions in the Congo provided a rich source for a world hungry for mineral products. There followed an immediate postwar period of comparative hardship, but by the end of 1948 Belgium recovered to the prewar level. Belgium became a member of the Benelux Customs union (1948). Membership of the wider European Coal and Steel Community (1952), the European Atomic Energy Community (1958) and the European Economic Community (1958) aims at progressive economic integration with France, the Federal Republic of Germany (Western Germany), Italy, Luxembourg and the Netherlands.

Between 85% and 90% of the imports consist of raw materials and foodstuffs (chiefly iron ore, crude oil, raw wool, cotton and flax, fertilizers, wheat and maize). Exports cover a wide range of manufactured goods, coal, coke, refined oil and foodstuffs.

4. Finance.—The unit of Belgian currency is the franc, which from the foundation of the national bank in 1850 until 1918 was on the gold standard with a parity of 1 fr. = .29032238 g. of fine gold. The franc declined after 1918 and was stabilized in 1926 at 175 fr. to £1 sterling (.04184 g. fine gold per franc). It was devalued in March 1935 by 28% and again (following the pound) in Sept. 1949 (with 0.01777 g. of fine gold). The exchange rate in the early 1960s was 140 fr. to £1 sterling and 50 fr. to the U.S. dollar.

The budgetary position, in spite of two periods of German occupation during the 20th century, has in general been sound. Belgian budgets are presented in two main divisions: an ordinary budget for normal current expenditure financed by direct or indirect taxation; an extraordinary budget for capital investment and armament financed chiefly by loans. The chief items of the ordinary expenditure (135,995,000,000 fr. in 1960) were public-debt interest, pensions, defense and education.

Out of an extraordinary budget of 25,089,000,000 fr. in 1960, nearly 25% was earmarked for defense and about 40% for public works and communications.

By the early 1960s the national debt had increased tenfold from the 1938 figure of 44,201,700,000 fr. The national income was estimated at 257,600,000 fr. in 1948 and was more than 400,000,000,000 fr. in the early 1960s.

5. Transport and Communications.—The Belgian railway network (Société Nationale des Chemins de Fer Belges) is a state enterprise and is denser than that of any other country, but

the waterways, especially canals, are equally developed. Both means of communication handle national and transit traffic. The total length of the railways was 3,008 mi., of which 306 mi. were electrified. Light railways (*chemins de fer vicinaux*) afford a valuable contribution to the transport system. The total length of tracks was 1,040 mi., together with 4,400 mi. of supplementary autobus routes. In addition, street cars, trolley buses and autobuses were operated by seven town services.

The main roads maintained by the state and the provincial administration had a total length of 6,983 mi. This included the motorway, completed in 1957, between Ostend and Brussels. The total number of motor vehicles in the early 1960s was in excess of 1,000,000 (more than 60% passenger cars).

Navigable waterways with a total length of 983 mi. are important. The Albert canal which links Antwerp with Liège was a success because it brought about the revival of several branches of industry in the area around Liège and led to increased exports of finished and half-finished goods.

Several stretches of rivers and canals can be used only by 300-ton barges. Under a ten-year (1956–66) program most of them were to be made navigable for 1,350 ton barges. This would apply to the Meuse (Maas) river from the Netherlands to the French frontier and to the Scheldt river, for the benefit of the ports of Antwerp and Ghent. The program coincides with the extension of the port of Antwerp (*q.v.*) which handles most of Belgium's trade.

It was felt that the status of Belgian shipping was not in proportion to the country's economic position. For that reason it was decided in 1956 to construct 20 to 30 ships to provide an additional tonnage of 250,000 to 300,000. This would extend the Belgian merchant marine up to 800,000 net registered tons. Other Belgian ports which served seagoing vessels were Ghent, Ostend and Zeebrugge.

In 1919 a Belgian syndicate organized the first civil flights between Brussels, London and Paris. In 1923 the Sabena (Société Anonyme Belge d'Exploitation de la Navigation Aérienne) was founded. The government retained 50.7% of the shares in this international airline. There is a regular helicopter service to Eindhoven, Duisburg, Dortmund, Rotterdam, Lille, Maastricht, Cologne and Bonn.

After 1930, telecommunications included a *régie* (state monopoly) of telegraphs and telephones for the exclusive use of business organizations. *See* separate articles on the provinces and major towns; *see* also Index references under "Belgium" in the Index volume. (F. J. M.)

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BELGOROD, an *oblast* (province) of the Russian Soviet Federated Socialist Republic, U.S.S.R., formed in 1954, and a town, the administrative centre of the *oblast*. The *oblast* covers 10,463 sq.mi., chiefly in the basins of the upper Vorskla, Northern Donets and Oskol. It is largely rural and of its 1,227,000 inhabitants (1959), only about 18% (224,000) are urban. Belgorod and Stary Oskol are the only sizable towns. The *oblast* lies in the forest-steppe, on rich chernozem (black earth). The forest has almost all been cleared since the 17th-century settlement of the area and now exists only as groves, predominantly oak, along the rivers. The open farm lands are mainly under grain: winter and spring wheat, barley, millet and maize (corn); with sugar beet important in the west of the *oblast* and sunflowers in the east. There are numerous orchards. Large iron-ore deposits occur around Belgorod and Stary Oskol; they are part of the Kursk magnetic anomaly (*see* KURSK). Mining is rapidly expanding.

BELGOROD town (pop. [1959] 71,000), situated on the upper Northern Donets at the foot of chalk bluffs to which it owes its name (meaning "white town"), on the Moscow-Kharkov railway, is chiefly concerned with processing agricultural products, as are the other towns. It was an old fortified town, part of the Belgorod defensive line, set up in 1636–38 to protect Russia's southern frontier. (R. A. F.)

BELGOROD-DNESTROVSKI, a town of Odessa *oblast* (province) of the Ukrainian Soviet Socialist Republic, U.S.S.R., formerly the Rumanian Cetatea Albă and earlier still the Turkish Akkerman. It stands on the southwestern shore of the broad, shallow Dniester estuary (Russ. Dnestrovski Liman) on the railway from Odessa to Izmail. It is a very ancient town: on its site stood Tyras, a colony from Miletus and, later, the Genoese factory of Mauro Castro under Moldavian princes. From 1484 to 1881 it remained Turkish, although captured several times by the Russians. The town was Rumanian from 1918 to 1940, and was occupied by the Germans in 1941–44. It was renamed Belgorod-Dnestrovski after its capture by the Soviet army in 1944. The old Genoese-Moldavian fortifications still survive. Wine producing and fish canning are its chief industries. (R. A. F.)

BELGRADE (Serbo-Croatian, BEOGRAD, "white fortress"), the capital of the Federal People's Republic of Yugoslavia as well as of the people's republic of Serbia, lies at the confluence of the Sava and Danube rivers. Its highest point is 146 m. (479 ft.) above sea level. Pop. (1961) 587,899. City area 629.1 sq.km. (242.9 sq.mi.). Situated on a ridge that extends 10 mi. S. of the old fortress (Avala hill, 511 m. [1,676 ft.]), Belgrade spreads fanwise southward and southeastward in the directions imposed by both location and history. Since World War II a new town, New Belgrade, has been developed on the plain to the north, between the left bank of the Sava and the right bank of the Danube.

Belgrade has several boulevards and avenues with names reflecting the country's recent history, such as Marshal Tito avenue, running south from Terazija, the central shopping area, and the Boulevard of the Revolution running southeast. Historic names have been retained in streets like Dusan, through the northern part of the city, Milos the Great, crossing the southern side to the west, and Karadjordj, on the western edge along the Sava. Old buildings preserved include the citadel (1725–36) with the Kalemegdan park, the Dositej museum (1780), Prince Milos cottage (1831) and the cathedral (1845). Among the more notable

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FORTRESS OF KALEMEGDAN, BELGRADE, YUGOS. (1725–36)

newer buildings are the National Assembly (1928), the tall Albanija house (1936), the Trade Union building (1957) and the Metropol hotel (1957). Public transport is by street car, bus and trolley bus, covering about 224 km. (140 mi.) of routes.

The capital has more than 260 schools, a university (founded 1863) and other institutions of higher education and research. There are also ten museums, four large archives (federal, republican, municipal and army), two public libraries, and a philharmonic orchestra. The Serbian Academy of Sciences is also located there.

Belgrade is an important communications centre. Railways and roads link it with Italy, Austria, Hungary, Rumania, Bulgaria and Greece, and roads with Albania. A 390-km. (244-mi.) road runs to Zagreb. More than 1,000,000 tons of freight is carried annually along the Sava and the Danube to its two ports. The airport at Zemun, to the northwest across the Sava, links the city with European capitals, and Yugoslav airlines provide many internal services.

The city is also a commercial and industrial centre. The extensive grounds of the Beograd fair (1957), with its monumental pavilions and unique architectural conception, are located in a park on the right bank of the Sava. In the early 1960s the city had about 150 industrial enterprises including various branches of production, predominantly consumer goods. In these enterprises and in commerce about 21% of the population found employment, while more than 20,000 persons were engaged in the handicrafts with their several thousand smaller workshops.

History.—Because of its exceptionally favourable position as a centre of land and river communications and its dominating situation overlooking the Pannonian plain to the northeast, the site where Belgrade stands has attracted various peoples since ancient times. The first fortress, on the hilly right bank of the confluence, was built by the Celts in the 3rd century B.C. and was known until the 7th century A.D. as Singidunum ("fortress on water" or "fortress of the Sings"). Within the walls of this citadel, subsequently enlarged, the town of Belgrade grew up. In the course of countless armed conflicts it was often destroyed, only to be rebuilt, and it changed masters many times. The Romans seized it from the Celts and in the 1st century A.D. it was the harbour for a considerable portion of the Roman Danubian fleet. From the 4th to the 6th century it was held by the Huns, Sarmatians, Goths and Gepids, but it was reconquered by the emperor Justinian. At the end of the 8th century the Franks captured it under Charlemagne, and the Bulgars held it from the 9th to the 11th century, when it was conquered by the emperor Basil II for Byzantium. It was later held successively by Greeks, Bulgars and Hungarians. In the 14th century it came under the rule of the Serbian kings and, under Stephen the Tall, it was proclaimed a capital for the first time. The despot, George Brankovic, surrendered the town to the Hungarians in 1427. From 1521 onward it was in the hands of the Turks, who called it Darol-i-Jehad ("home of wars of the faith"). Three times (1688–90, 1718–39 and 1789–92) it was occupied by the Austrians, who called it Griechische Weisseburg.

After the first Serbian uprising under Karageorge in 1804, Belgrade was the Serbian capital during 1807–13, but the Turks recaptured it and only in 1867 were they forced to surrender the citadel to the Serbs, whose rights were confirmed by the treaty of Berlin in 1878. From then on the town began to develop rapidly and between 1874 and 1910 its population grew from 27,605 to 89,816. During World War I the Austrians succeeded in occupying Belgrade on Dec. 2, 1914, but only for 12 days. The defense of the city against a further attack in Sept.–Oct. 1915, in which nearly the entire population took part, is legendary. It fell to the invaders on Oct. 9.

From Dec. 1, 1918, Belgrade was the capital of the kingdom of Yugoslavia. Much modern planning and building took place and the city began to lose what remained of its Turkish appearance. In 1921 it had a population of 111,740, and by 1931 it had 266,849. New residential suburbs grew on the south and southeast, while the adjacent town of Zemun, on the left bank of the Sava, was included in the city area. The old fortress of Kalemegdan is now a historical monument; its former glacis was replanned as a garden from which is seen the famous view of the plain across the Sava and the Danube.

On April 6, 1941, Belgrade was heavily bombed by the German air force, and a few days later it was occupied by the German army. It was liberated on Oct. 20, 1944, by units of the Yugoslav National Liberation army assisted by the Soviet army.

In Sept. 1961 Belgrade was the site for a meeting of more than 20 delegations from nonaligned nations of Asia, Africa and Latin America to discuss world disarmament, colonialism and the problems facing emerging nations of the world. (Jo. MA.; K. SM.)

BELGRANO, MANUEL (1770–1820), the principal military leader early in the Argentine war for independence was born on June 3, 1770, in Buenos Aires. Trained in law at Spanish universities, he was appointed secretary of the Buenos Aires official merchant's guild and became an advocate of liberal ideas. He received his first military experience at the time of the English invasion in 1806. After the viceroyalty of the Río de la Plata broke with Spain (May 1810), Belgrano became a member of the junta and in 1811 was sent as commander of a small army to bring Paraguay under the authority of that body. His forces were repulsed. Later he was successful in defeating royalist forces at Tucumán and Salta in the Argentine northwest, only to be decisively defeated in that area in 1813. Belgrano was replaced as commander of the army in 1814 by José de San Martín (*q.v.*) and soon departed with Bernardino Rivadavia (*q.v.*) on an unsuccessful diplomatic mission to Europe. Like other leaders of South American independence Belgrano favoured the establishment of a monarchical type of government, and his European mission had as its purpose the furtherance of this goal. He died in Buenos Aires on June 20, 1820. *See* ARGENTINA: *History.*

(T. F. McG.)

BELHAVEN AND STENTON, JOHN HAMILTON, 2ND BARON (1656–1708), one of the promoters of the revolution of 1689 in Scotland, was later prominent as a vigorous opponent of the union between England and Scotland. He was born on July 5, 1656, the eldest son of Robert Hamilton, Lord Presmennan (d. 1695), and succeeded to the title of Belhaven and Stenton through his wife in 1679. In 1681 he was briefly imprisoned for speaking slightingly of James, duke of York, in the Scottish parliament, and in 1689 he was among those who asked William of Orange to undertake the government of Scotland. Belhaven was at the battle of Killiecrankie (July 27, 1689) and was made a member of the Scottish privy council the same day. Passionately opposed to the Act of Union, he made, in the Scottish parliament on Nov. 2, 1706, a speech against this proposal which attracted much attention and was included by Daniel Defoe in his *History of the Union,* 2nd ed. (1786).

Shortly afterward Belhaven was imprisoned on suspicion of favouring a projected French invasion. He died in London on June 21, 1708.

BELIEF, a mental attitude of acceptance or assent toward a proposition. The different degrees of belief may be roughly indicated by the following scale: (1) surmising or suspecting; (2) opinion; and (3) conviction. Some philosophers have held that believing is an introspectable occurrence, either an intellectual act (an act of "judging") or, as Hume maintained, a special sort of feeling. Such an intellectual act does sometimes occur when we make up our mind to accept a proposition after a period of doubt, and it may recur subsequently when we again consider the proposition. Moreover, when we compare a proposition which we believe with another about which we have no belief, it does seem to be true that the two propositions "feel different," as Hume indicated. But a belief-attitude manifests itself in many other ways as well. It manifests itself by what we do in circumstances to which the proposition believed is relevant; by our decisions and the degree of confidence or of hesitation with which we take them; by the inferences which we draw; and by the surprise which we feel if the proposition turns out to be false. To mention only one example, a man shows his belief that a chair will support his weight by sitting down on it, without any belief-feeling or any act of judgment.

Belief "in" and Belief "that".—It is often said that believing "in" someone or something is quite different from belief "that," where what is believed is a proposition. The most important case

of belief "in" is belief in God. But we also speak of someone's belief in a person, in an institution, in a policy or in a method, and even of belief in oneself or one's own powers. The distinction is important, but should not be pressed too far. Believing "in" is an emotional and conative attitude and contains an element of valuation or approval. But a cognitive attitude, the acceptance of a proposition, is also an essential constituent of it. To believe in God, one must accept the proposition that God exists.

Reasonable and Unreasonable Belief.—A reasonable belief is one which is in accordance with the evidence. The evidence for a proposition is some known fact or facts which increase the probability of the proposition; the evidence against a proposition is some known fact or facts which decrease its probability. Moreover, if one believes reasonably, the degree of one's belief varies with the strength of the evidence. It would be unreasonable to be absolutely convinced that a book has been stolen, merely on the ground that it is not in its usual place on the shelf. It would be equally unreasonable if we merely surmised or suspected that it has rained in the night, when we find that the streets are wet at seven o'clock in the morning. A reasonable belief, of course, may be mistaken. It was reasonable for primitive people to believe that the sun was much smaller than the earth; the evidence which they had supported that proposition. Equally, an unreasonable belief may happen to be correct. I may believe that Jones is at home, on no evidence at all and merely because I wish to see him; my belief is unreasonable, but he may in fact be at home. It is also important to notice that the reasonableness or unreasonableness of a belief is determined by the evidence which the believer himself has. Facts, however relevant, which he does not happen to know are not evidence for him, though they may be for other people. Finally, one may have good evidence for a proposition although one cannot recall the evidence to mind. The estimates or judgments of experts are sometimes of this kind, being determined by a long series of relevant experiences which cannot be recalled in detail. The expert has reasons for his judgment but cannot *give* reasons for it, not even to himself.

Belief and Knowledge.—It is never a contradiction to say "What *A* believes is false," but it is, of course, a contradiction to say "What *A* knows is false." Even when the proposition believed is in fact true, the belief need not amount to knowledge. A belief which is correct but unreasonable (based on no evidence) cannot be counted as knowledge. Even a belief which is both reasonable and correct may still fall short of knowledge. I may believe that it will be a fine afternoon, because the barometer has risen. My belief is reasonable and may also turn out to be correct; but it does not amount to knowledge, because my evidence, though quite strong, is by no means conclusive. Thus if knowledge is to be defined in terms of belief, (1) the proposition believed must be in fact true, and (2) the believer must have conclusive evidence for it. In some cases, however, the only way to get conclusive evidence for a proposition is by direct observation of the state of affairs which makes the proposition true. This observation is knowledge, but knowledge of this kind falls outside the sphere of belief altogether.

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BELINSKI, VISSARION GRIGOREVICH (1811–1848), eminent Russian literary critic, "father" of the Russian radical intelligentsia. Born in Sveaborg, Fin., July 12 (new style; June 30, old style), 1811, son of a drunken provincial doctor who resented the boy's brilliance, Belinski was expelled from Moscow university (1832) and earned his living as a journalist. His first substantial critical articles, "Literary Dreams" (published in the newspaper *Molva*, 1834), expounded F. W. J. Schelling's view of national character, applying it to Russian culture, though Belinski later embraced Hegel's philosophy of history. He obtained a permanent post (1839) with the journal *Otechestvennye zapiski*. By 1840 he was showing signs of revolt against orthodox Hegelianism.

Belinski's judgment of literary excellence was sound and sensitive and his articles on Pushkin, Lermontov and Gogol combined enthusiasm with perspicacity. Though his excitement about reshaping the world cannot be held responsible for the later tendency to evaluate art on purely political grounds, his bombastic patriotism led his cruder disciples to introduce into Russian literature the chronic ethical itch and journalistic shoddiness which nearly destroyed it as an art.

Some Soviet critics, tearing his rare political utterances from their context, consider his almost accidental contribution to the Russian "national" type of socialism his principal achievement. In fact he devoted his life to the promotion of literature, philosophy and art, and thought the success of social education depended upon the success of literature, since education derived from the effect literature had on the ideas and conduct of society. In 1846 Belinski joined the review *Sovremennik*, for which he wrote more soberly about literature's slow task of helping the still embryonic Russian nation to develop into an adult civilized society. In 1847 he wrote his famous letter to Gogol, denouncing the latter's *Vybrannye mesta iz perepiski s druzyami* as a betrayal of the Russian people because it preached submission to church and state.

Belinski died June 7 (N.S.; May 26, O.S.), 1848, in St. Petersburg.

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BELISARIUS (*c.* 505–565), Byzantine general, one of several able military commanders who served the emperor Justinian I. He first won his military laurels at the age of 25, as commander of the east, by a victory over the Persians at Daras (530). Defeated in the following year, he was recalled to Constantinople, but with honour, and while there saved the throne for Justinian by putting down the Nika revolt in the city with a handful of mercenaries (532). In 533 Justinian sent an expedition under Belisarius against the Vandal kingdom of North Africa. In 534 Belisarius returned to Constantinople in triumph, at the peak of his career, having defeated the Vandals and taken prisoner their king. He was next sent to reconquer Italy from the Goths. In 535 he invaded Sicily, and in 536 went on to take Naples and Rome, which he held for a year against the whole strength of the Goths. Reinforcements were sent and he was able to rout the enemy and take Ravenna (540).

The Goths had wished to proclaim him emperor, and in spite of his refusal he was recalled and coldly treated by Justinian. The pretext for his recall was the renewed danger from the Persians under King Khosrau I, and from 541 to 544 he fought again on that front, but the revival of the Gothic forces caused him to be sent back to Italy. He spent five years of indecisive campaigning there with inadequate forces until his recall in 549. In 559 a vast horde of Bulgars penetrated to the walls of Constantinople and Belisarius came out of retirement to drive them off at the head of a makeshift army.

Belisarius was hampered throughout his career by the suspicion of Justinian, who never wholly trusted him, in spite of his proved loyalty. In 562 he was imprisoned and his fortune confiscated on a charge of conspiring against the emperor, but he was restored to favour (563) before his death. There is no truth in the later legend of his being blinded and reduced to beggary.

Belisarius was above all a cavalry commander, a great tactician rather than a strategist. He went into battle leading his own household cavalry, and by his personal courage and the simplicity and force of his character became the idol of his soldiers. These were of mixed race and difficult to control, but he maintained stern discipline, and applied his Christian and humane principles to the conduct of war. He was usually accompanied on campaign by his wife, Antonina, a friend of Theodora (*q.v.*), Justinian's wife. Belisarius was one of the last Roman citizens to receive the consulship (in 534, as a reward for his Vandalic victory).

See also Index references under "Belisarius" in the Index volume.

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BELIT, the Semitic name of NINLIL, wife of the Sumero-Akkadian god Enlil, or Bel (*q.v.*). She was "lady of heaven and earth" and was worshiped, especially at Nippur, throughout the recorded history of pre-Christian Mesopotamia. In the epilogue to his code of laws Hammurabi prays that she will use her influence in the place of judgment of Enlil against any who violate or use despitefully his code or stele. Like her husband, she is a deity of destiny.

On Assyrian documents she is sometimes identified with Ishtar of Nineveh and sometimes made the wife of either Ashur (*q.v.*) or Enlil. *See* also BABYLONIA AND ASSYRIA: *Religion: Sumerian Pantheon.*

For bibliography, *see* ADAD. (T. FH.)

BELIZE, the capital and principal seaport of British Honduras (*q.v.*), on the Caribbean coast of Central America, occupies both banks of the Haulover river, a delta mouth of the Belize river. Pop. (1960) 32,824. Various explanations have been given for the name Belize. It is probably derived from an ancient Maya Indian word for the Belize river, which was until the 10th century a heavily populated trade artery of the ancient Maya Indians. The first British settlement was established apparently in the 17th century. Belize is built on ground that is only a little above sea level and is surrounded by mangrove swamps. It was severely damaged by a hurricane and accompanying tidal wave on Oct. 31, 1961, and plans were made to rebuild it on an inland site not liable to flooding. The annual temperature range is from 55° to 95° F. with a mean average of 78° F. The climate is mitigated by sea breezes.

The houses are mostly built of wood, with verandas, and are raised on piles for coolness. They are roofed with corrugated iron or asbestos-cement sheets. Many of the modern buildings are of concrete. Palms and flowering trees and shrubs beautify the town. St. John's cathedral was built in 1812 and Government house in 1814. The town possesses an institute devoted to the arts and drama, technical and teachers' training colleges, and hotels. Belize is linked by motor roads with all the district towns except those in the Toledo (southernmost) district. There is a municipal airport for light airplanes at the northern end of the town, and an international airport, Stanley field, 10 mi. W. The chief exports are mahogany, cedar and other timbers (both millwood and in the round), coconuts, copra, maize and other agricultural products, furniture, boats and other wood manufactures. (A. H. AN.)

BELJAME, ALEXANDRE (1843–1906), French professor of English literature, author of the erudite and eminently readable *Le public et les hommes de lettres en Angleterre au XVIIIe siècle* (1881, 2nd ed., 1897; Eng. trans. 1948), was born at Villiers-le-Bel (Seine-et-Oise), Nov. 26, 1843. He was first on the list of *agrégés* in 1868, and later occupied with distinction a chair of English at the Sorbonne which had been specially created for him. In 1905–06 he was Clark lecturer on English literature at Trinity college, Cambridge. He died at Domont (Seine-et-Oise), Sept. 17, 1906. (J. G. CK.)

BELKNAP, WILLIAM WORTH (1829–1890), U.S. politician and Civil War general, was born at Newburgh, N.Y., on Sept. 22, 1829. He studied law and practised that profession in Iowa during the 1850s. He entered the Union army in 1861 as major of the 15th Iowa volunteers. In the Atlanta campaign under Sherman he gained distinction, rising to the rank of brigadier general in 1864 and major general in 1865. After the war he became collector of internal revenue for Iowa, leaving that post in 1869 to become secretary of war. In 1876 he was impeached by the house of representatives on charges of corruption. He resigned, was acquitted by the senate and the charges were never definitely proved. He died at Washington, D.C., on Oct. 13, 1890.

BELL, ALEXANDER GRAHAM (1847–1922), U.S. inventor and physicist, inventor of the telephone, was born in Edinburgh, Scot., on March 3, 1847. He was educated at Edinburgh university and the University of London, and, because of ill-health, moved with his father to Canada in 1870. In 1872 he opened a school in Boston for training teachers of the deaf and also gave instruction in the mechanics of speech. The following year he became professor of vocal physiology in Boston university. In 1876 he exhibited an apparatus embodying the results of his studies in the transmission of sound by electricity, and this invention, with improvements and modifications, constitutes the modern telephone (*q.v.*). He was also the inventor of the photophone, an instrument for transmitting sound by vibrations in a beam of light, and of phonographic apparatus. Later, he interested himself in the problem of mechanical flight. He gave numerous addresses and published many scientific monographs. Bell was the founder of the American Association to Promote the Teaching of Speech to the Deaf, and of the Volta bureau for the increase of knowledge relating to the deaf. He was for a time president of the National Geographic society and was appointed a regent of the Smithsonian institution by congress in 1898. He died on Aug. 2, 1922, at his summer home near Baddeck, Nova Scotia.

See C. D. Mackenzie, *Alexander Graham Bell* (1928).

BELL, ALEXANDER MELVILLE (1819–1905), British-U.S. teacher of elocution and author, was born at Edinburgh, Scot., on March 1, 1819. He was the son of Alexander Bell, an early authority on phonetics and speech therapy, and the father of Alexander Graham Bell (*q.v.*). Melville Bell lectured on elocution at Edinburgh university from 1843 to 1865 and at University college, London, from 1865 to 1870. In 1870 he moved to Canada, teaching linguistics and philology at Queen's college, Kingston, Ont. He went to Washington, D.C., in 1881, to be with his son, and lived there until his death on Aug. 7, 1905.

Striking in appearance, an excellent teacher and lecturer and a prolific writer, Bell exercised an important influence on the development of speech education. His most valuable and original scientific contribution was probably his system of "visible speech." He analyzed the positions assumed by the speech organs as they produce sounds and then invented symbols that depicted all the modes of action of throat, tongue and lips in speech formation and that could therefore represent any sound human speech organs are capable of uttering (*Visible Speech: the Science of Universal Alphabetics*, 1867). Bell's system provided a basis for subsequent international phonetic alphabets and for later graphic symbol systems for teaching the deaf. (R. L. McC.)

BELL, ANDREW (1753–1832), Scottish clergyman and pioneer of a system of education by mutual tuition, was born at St. Andrews on March 27, 1753. He graduated there and went as a tutor to Virginia, where he made a small fortune growing tobacco. After ordination in the Church of England, he went to Madras, India, where he introduced into an orphan school a "monitorial" plan which overcame the problem of the shortage of teachers by putting the better pupils to instruct the slower ones. On his return to London in 1797 he published *An Experiment in Education* which explained the advantages of his system, but his ideas had little popularity in England until they were adapted by Joseph Lancaster (*q.v.*), with whom Bell quarreled, in a school opened at Southwark in 1801 and by Robert Owen (*q.v.*) in New Lanark. Meanwhile (1801) Bell was rector of Swanage, Dorset. In 1811 he became superintendent of the National Society for Promoting the Education of the Poor in the Principles of the Established Church, a society newly formed to put his schemes into effect. He was master of Sherburn hospital, Durham (1809), canon of Hereford cathedral (1818) and prebend of Westminster (1819). He died at Cheltenham on Jan. 27, 1832, leaving a large fortune to endow educational schemes in Scotland.

See J. D. Meiklejohn, *An Old Educational Reformer* (1881).

BELL, SIR CHARLES (1774–1842), Scottish anatomist, noted for his contributions to the study of the brain and nervous system, was born at Edinburgh in Nov. 1774. Educated at the high school and the University of Edinburgh, he devoted himself chiefly to the study of anatomy, under the direction of his brother John. In 1802 he published a series of engravings showing the anatomy of the brain and nervous system taken from dissections made for the lectures or demonstrations he gave on the nervous system. In 1804 he moved to London. Before leaving Edinburgh,

he had written his work on the *Anatomy of Expression,* in which he gave a rational explanation of the muscular movements which usually accompany the various emotions and passions.

In 1811 Bell published his *New Idea of the Anatomy of the Brain,* in which he announced the discovery of the different functions of the nerves corresponding with their relations to different parts of the brain; his latest researches were described in *The Nervous System of the Human Body* (1830), a collection of papers read by him before the Royal society. He confirmed François Magendie's discovery that in the nervous trunks there are special sensory filaments, the office of which is to transmit impressions from the periphery of the body to the sensorium, and was the first to discover that the anterior roots of the spinal nerves contain special motor filaments which convey motor impressions from the brain or other nerve centre to the muscles.

Bell also showed that some nerves consist entirely of sensory filaments and are therefore sensory nerves; others are composed of motor filaments and are therefore motor nerves; while a third variety contains both kinds of filaments and is therefore to be regarded as sensory-motor. These discoveries are regarded as the greatest in physiology since that by William Harvey of the circulation of the blood.

In the year 1812 he was appointed surgeon to the Middlesex hospital, a post he retained for 24 years. He was also professor of anatomy, physiology and surgery to the College of Surgeons of London, and for many years teacher of anatomy in the school which used to exist in Great Windmill street. In 1815 he went to Brussels to treat the wounded of the battle of Waterloo. In 1836 he accepted the chair of surgery in the University of Edinburgh. He died at Hallow Park near Worcester on April 28, 1842.

Bell's chief works, other than those mentioned above, are: *System of Comparative Surgery* (1807); *Lectures Concerning the Diseases of the Urethra* (1810); *Quarterly Reports of Cases in Surgery* (1816–18); *Observations on Injuries of the Spine and of the Thigh Bone* (1824); and *Practical Essays* (1841).

(A. B. L.)

BELL, CHARLES FREDERIC MOBERLY (1847–1911), British journalist who played an outstanding part in the management of the *Times* (London) during a troubled period, was born in Alexandria, Egypt, on April 2, 1847. Educated privately in England, he returned to Alexandria in 1865 to work for a commercial firm, but soon established an informal connection with the *Times,* and in 1875 became official correspondent. In 1880 he helped to found the *Egyptian Gazette.* It was after a visit to Egypt by A. F. Walter, chief proprietor of the *Times,* that Bell was invited, in 1890, to assist in the paper's management. Its fortunes were at a low ebb after the Parnell-Pigott scandals (*see* PARNELL, CHARLES STEWART), but although Bell was somewhat out of touch with technical developments, his strong will, courage and industry enabled him to keep the paper alive. He reorganized the foreign department, writing personally to correspondents abroad, formed a publications department and founded *The Times Literary Supplement* (1902) and *The Times Educational Supplement* (1910). He was associated with H. E. Hooper in the sale of the reprint of the ninth edition of the *Encyclopædia Britannica* (1898) and of the tenth edition (1902–03). He was also an enthusiastic supporter of Hooper in the formation of the Times Book club in 1905. In 1908, despite much opposition, he brought about the sale of the paper to Lord Northcliffe. He became managing director of the newly formed publishing company, a post he retained until his death, in his office chair, on April 5, 1911.

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BELL, GEORGE KENNEDY ALLEN (1883–1958), Anglican bishop of Chichester, outstanding leader of the ecumenical movement and advocate of the arts and drama in the service of religion, was born on Feb. 4, 1883, son of the vicar of Hayling Island, and educated at Westminster school and Christ Church, Oxford. After ordination in 1907 he was curate of Leeds parish church from 1907 to 1910 and student (*i.e.,* fellow) of Christ Church from 1911 until 1914, when he became chaplain to Archbishop Randall Davidson, obtaining widespread recognition for his unusual ability, discernment and industry. In 1924 he became dean of Canterbury, where he formed the Friends of Canterbury Cathedral. In 1929 he became bishop of Chichester. After the rise of Hitler, Bell secured asylum in England for Jews and non-Aryan Christians. During the decade 1929–39 he played a prominent part in movements for reunion of the churches, and established close relations with the German Confessional Church. During World War II, he became widely known as a critic of obliteration bombing. In 1942 he paid a visit to Sweden, where suggestions for peace with a non-Nazi government in Germany were given to him to relay to the British government. After the war he resumed contact with the German church and became a tireless itinerant on behalf of the ecumenical movement (*q.v.*) and the World Council of Churches (*q.v.*), of which he was first chairman and then president. He criticized the decision of the British government to manufacture nuclear weapons, and was a prominent speaker in the house of lords on a variety of problems, including Cyprus. Meantime he was active in urging a readjustment of the relations of church and state in England. His literary works included a definitive biography of *Randall Davidson* (2 vol., 1935), *The Modern Parson* (1928), *Christian Unity* (1948) and four volumes of *Documents on Christian Unity.* As bishop he was a true pastor and father in God, beloved by clergy and laity, and was recognized far beyond the borders of the Anglican communion as an apostle of unity. He died at Canterbury on Oct. 3, 1958. (N. S.)

BELL, GERTRUDE MARGARET LOWTHIAN (1868–1926), English traveler and administrator in Arabia, was born at Washington Hall, County Durham, on July 14, 1868, the daughter of Sir Hugh Bell, bart. Her brilliant career at Oxford, where she took a first in history in 1887, was followed by some time in Teheran, where her uncle Sir Frank Lascelles was British minister. Returning to the life of political and intellectual salons in England and Europe for a decade, it was not until 1899 that she embarked on the career of Arabian activities that made her famous. Visiting Palestine and Syria in that year, she was frequently back in the middle east during the following decade, extending her travels to Asia Minor. But her heart was set on an Arabian journey, which she began in 1913, being the second woman (after Lady Anne Blunt) to visit Ha'il, where she was not very favourably received, although she ever afterward favoured Ibn Rashid as against the Ibn Sa'ud dynasty. She never wrote a full account of this journey, though her literary output during the 20 years preceding World War I had been considerable, comprising *Safar Nameh* (1894); her translation, *Poems From the Divan of Hafiz* (1897); *The Desert and the Sown* (1907); *The Thousand and One Churches* (1909); and *Amurath to Amurath* (1911). She had always been a voluminous correspondent, and her letters, severely pruned to suit the taste of a touchy generation, were published in two volumes by her stepmother in 1927. But perhaps her greatest work was a masterly official report on the administration of Mesopotamia during the difficult period between the Armistice of 1918 and the Iraq rebellion of 1920. After a short period of war work in England and France she had plunged into the rough-and-tumble of middle east politics, mainly in Mesopotamia, where she served in turn under Sir Percy Cox, Sir Arnold Wilson and again Sir Percy Cox. That she exercised great influence on Cox is undeniable, and she played a principal part in the establishment in Baghdad of the Hashemite dynasty. The last three years of her life were devoted to the creation of an archaeological museum at Baghdad, which is her monument in the land she loved and served so well. She died in Baghdad on July 12, 1926.

(H. ST. J. B. P.)

BELL, HENRY (1767–1830), Scottish engineer who first placed a steamboat on the Clyde, was born at Torphichen, Linlithgowshire, in 1767. He was apprenticed to his uncle, a millwright, and then to a shipmodeler at Borrowstounness. He then went to London, where he found employment under John Rennie. Returning to Scotland in 1790, he first settled as a carpenter at Glasgow and afterward removed to Helensburgh on the Firth of

Clyde. In 1800 he submitted proposals to the British admiralty for the steam propulsion of vessels. His own steamboat, the "Comet" of 28 tons, launched at Port Glasgow in July 1812, was the first to attain commercial success in Europe.

Henry Bell died at Helensburgh on Nov. 14, 1830. A monument to his memory stands on the banks of the Clyde, at Dunglass, near Bowling.

See E. Morris, *Life of Henry Bell* (1844); H. P. Spratt, *The Birth of the Steamboat* (1958). (H. P. St.)

BELL, JOHN (1691–1780), Scottish traveler and doctor whose vivid accounts of his journeys did much to throw light on the contemporary way of life of the peoples of Russia and the east, was born at Antermony in 1691. After qualifying as a doctor he decided to travel and in 1714 set out for St. Petersburg where he joined an embassy departing for Persia. Returning to St. Petersburg in 1718, Bell spent the next four years in an embassy to China, passing through Siberia and Mongolia. Scarcely had he rested from this last journey when he was summoned to accompany Peter the Great in his expedition (1722) to Derbent and the Caspian Gates. In 1737 he was sent by the Russian government and the British minister on a mission to Constantinople, afterward settling there as a merchant. He retired to his estate of Antermony in 1747, living there until his death on July 1, 1780. His *Travels*, published in Glasgow in 1763, went through many editions and were reprinted in J. Pinkerton's *Voyages and Travels* (vol. vii, 1811).

BELL, JOHN (1796–1869), U.S. political leader, was born on a farm near Nashville, Tenn., Feb. 18, 1796, soon after the state's admission to the union. He graduated from Cumberland college (later University of Nashville) in 1814. Two years later, before he was 21 years old, he began to practise law in Franklin, Tenn. In 1817 he was elected to the state senate, but served only one term. In 1827 he won a seat in the U.S. house of representatives, defeating the distinguished Felix Grundy, and continued to serve until 1841. From June 1834 to March 1835 he served as speaker of the house. Although Andrew Jackson, also a Tennessean, actively opposed his election in 1827, Bell entered congress as a Jackson Democrat. Largely as a result of the bank controversy, he broke with Jackson in 1834 and supported Hugh Lawson White for president in 1836. After White's defeat Bell became a Whig, and in March 1841, as a reward for party service, was made secretary of war in Pres. William Henry Harrison's cabinet. A few months later, after the death of President Harrison, he resigned this post as a result of the break between President Tyler and the Whigs led by Henry Clay. From 1841 to 1847 Bell practised law and supervised his coal and iron business. The state legislature elected Bell to the U.S. senate in 1847. Although a large slaveholder himself, he opposed efforts to expand that institution. As a senator he vigorously opposed President Polk's Mexican War policy, the Compromise of 1850, the Kansas-Nebraska bill and the attempt to admit Kansas as a slave state. After the disintegration of the Whig party Bell co-operated with (but never joined) the "Know-Nothings," yet always referred to himself as a member of the "Opposition." His conservatism and vigorous defense of the union brought him the nomination for president on the Constitutional Union ticket in 1860, but he carried only Virginia, Kentucky and Tennessee. He opposed secession and insisted that Lincoln's policy would be moderate. However, following Lincoln's call for troops, he openly advocated resistance and henceforth classed himself a rebel. He spent the war years in retirement in Georgia, returning to Tennessee in 1865. He died at his home near Dover, Sept. 11, 1869.

See J. H. Parks, *John Bell of Tennessee* (1950). (J. H. Pa.)

BELL, LAWRENCE DALE (1894–1956), U.S. aircraft designer, was one of the few aviation pioneers whose active career extended well into the era of supersonic jet aircraft. Born in Mentone, Ind., April 5, 1894, Bell saw his first airplane in 1910. Two years later he entered the aviation business as a mechanic for his brother, Grover Bell.

When his brother was killed in an airplane accident in 1913, "Larry" Bell decided to quit, but the attraction of flying was too great, and he went to work for another of the great pioneers, Glenn L. Martin. At the time of his death Bell was the still active head of one of the great manufacturing companies of America, Bell Aircraft Corp. Bell fighter airplanes, including the P-39 Airacobra, were widely used in World War II. Bell was entrusted with the design of the first jet aircraft in America, the XP-59A fighter, originally powered by two British Whittle engines, which made its first flight on Oct. 1, 1943. In 1947 Bell's experimental X-1 rocket-propelled airplane was the first to break the so-called sonic barrier in level flight. Bell was awarded the Collier trophy, the Guggenheim medal and a presidential citation. He died in Buffalo, N.Y., Oct. 20, 1956. (S. P. J.)

BELL, a percussion instrument, usually of metal, made to vibrate by the action of a clapper within the bell or by a hammer striking the bell from outside.

Bell Founding.—The identifying characteristic of the bell is the campaniform. The earliest bells were probably beaten out of flat plates, until at the advent of the metal age small bells began to be cast. Later the art of casting was either lost or failed to spread as fast as civilization did, with the result that riveted plate bells came into being. Then, about the 8th century, casting was resumed and, from that time on, all bells with worthwhile musical tones have been cast of bronze.

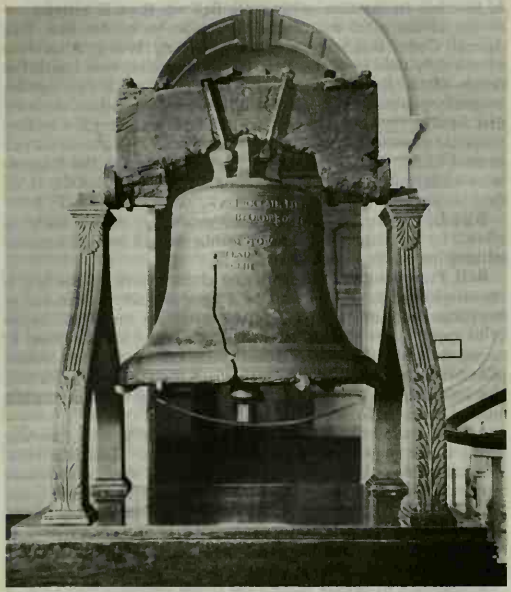
A bronze alloy of 77% copper and 23% tin is now generally used. Other alloys have been used in the past. The bells excavated at Nimrud by Sir Austen Henry Layard (*see* below) were ten parts copper to one of tin; other mixtures have been found in bells from widely different locations. While other metals such as iron, steel, gold, silver, zinc and lead have been used, in combinations and alone, none has been found that can compare in tone value with the clean bronze alloy of the early 1960s.

Resumption of bronze casting led to the primitive bell form, a type of the tintinnabulum whose height was greater than its diameter. Constant striking by the clapper caused the early bells to crack, since their walls were about the same thickness from the top ring to the edge of the lip. Later a ring of metal was added to the lip of the bell to strengthen it at the point of clapper impact. Curiously, this thickening of the lip improved the tone of the bell. It is now known that the strike tone, the main tone of the bell, is dependent upon the thickness of the lip. The primitive bell, invariably convex from top to lip, resembled a beehive in shape, and later became even more like one when rings were cast around the sides.

Early in the 13th century, the shape of the bell made a definite break with all primitive forms. The hallmark of the new form was a change in the waist from convex to concave, scarcely noticed at first as the waist became almost straight and potlike. Then, as the superior tone of the new shape was noted, the bell took on the gradually inward-sloping sides that are now used. Known as the archaic bell, this type evolved, through flattening of the crown, squaring of the shoulders, flaring of the sides down to the mouth or the sound bow and variations in its wall thickness, into the modern bell.

Originally, bells were often founded with considerable ceremony; many were beautifully inscribed, often with prayer or verse. Prayers were said while the metal was poured into the molds. The bells were then blessed by a church official, followed by thanksgiving and rejoicing.

The chief English centres of the art of bell founding in medieval times were London, York, Gloucester and Nottingham. Bells by John of York (14th century), Miles Graye (1605), Samuel Smith, father and son, of York (1680–1730), Abraham Rudhall and his descendants, of Gloucester (1684–1774), Robert Mot (16th century), Lester and Pack (1750), Christopher Hodson of London (who cast "Great Tom" of Oxford, 1681), Richard Phelps (1716) and H. Bagley (18th century) are still held in high repute. The Whitechapel Bell foundry was established by Robert Mot in the early part of the reign of Elizabeth I. It incorporated the business of the Gloucester foundry (Rudhall's), the Hertford foundry (John Briant), the Aldbourne foundry (the Wells), the Downham foundry, Norfolk (Dobson), and, as Mears and Stainbank, became one of the leading bell founders. Many of Mot's bells are still in existence, among them the fifth and seventh at



EWING GALLOWAY

THE LIBERTY BELL IN INDEPENDENCE HALL, PHILADELPHIA, PA.

Westminster abbey, cast in 1583 and 1598. Later the firm cast the original American Liberty bell, Big Ben and the famous Bow bells. The latter, which were originally cast in 1738 and 1762, were recast (with others) following their destruction during World War II. John Taylor and company, Loughborough, were the founders of "Great Paul," weighing 17 tons, for St. Paul's cathedral, London, and of "Great George," 15 tons, for the Anglican cathedral, Liverpool. The carillon in the Mountain Lake (Bok) Singing tower, Lake Wales, Fla., with its 71 bells covering a range of 4½ octaves chromatic, is a product of the Loughborough foundry. Gillett & Johnston, formerly of Croydon, built what in the early 1960s was the world's largest carillon, the 72-bell Laura Rockefeller Memorial carillon in New York city, and its companion instrument, second largest in the world, at The University of Chicago.

On the continent of Europe, famous medieval founders were Pieter van den Gheyn of Mechelen and Louvain (1554); Frans and Pieter Hemony, members of a Lorrainese family, who founded bells in Zutphen and Amsterdam (1641–77); Pieter, Matthias and Andreas Josef van den Gheyn, of Louvain and St. Trond (1717–91); Joris Dumery, of Bruges (1738–1834); four members of the Van Aerschodt family, of Louvain (1830–1926); and Ernest, Amadee and A. Jr. Bollee, of Orleans (1860–1929). Other founders include Petit & Fritsen, Aarle-Rixtel (1868) and Paccard of Annecy-le-Vieux (1895–1929).

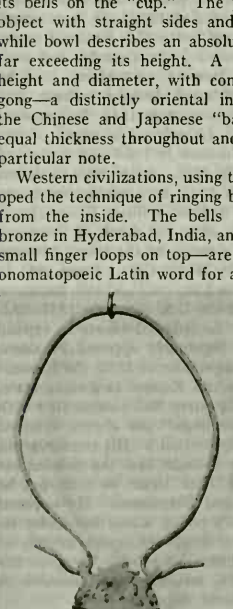
Early Bells.—The oldest bell in the world, found near Babylon, is reputed to be over 3,000 years old. China, Japan, Burma, India, Egypt and other ancient civilizations made use of bells in different forms so long ago that to trace their history is almost impossible.

Bells for horses are mentioned in Zech. xiv, 20. In Greek literature, bells are spoken of by Euripides (*c.* 484–407 B.C.) in his *Rhesus*. Aristophanes spoke of bells in his *Frogs*, and they are mentioned in the fables of Phaedrus. The Romans Ovid, Tibullus, Martial, Statius, Manilius and Strabo all speak of bells. Plutarch's *Life of Brutus*, telling of the siege of Xanthus in Lycia, in 42 B.C., states that "their bells, on nets stretched across the river, rang when people tried to escape by swimming." Decorative ceremonial bells were reported as being hung on Lars Porsena's tomb in the 6th century B.C. and on the funeral car of Alexander the Great (356–323 B.C.). The Jewish-Roman historian Flavius Josephus wrote that "King Solomon, who reigned from 974 to 937 B.C., had large gold bells on the roof of his temple to keep the birds away." It is recorded that Gaius Octavianus (63 B.C.–A.D. 14), who later became the first Emperor Augustus, hung a bell before the temple of Jupiter. Hand bells were used in religious rites in Athens by the priests of Cybele, known to the Romans as "the great mother of the gods." Herodotus (*c.* 484–425 B.C.), the Greek historian, says that in Sparta when a king died women walked in the streets striking small bells. Thucydides, in his *History of the Peloponnesian War* (431–404 B.C.), states that during the siege of Potidaea in Macedonia the Spartan general Brasidas, hearing the bell on the sentry's uniform as he passed in the dark, raised his scaling ladders and passed inside the walls. The Bayeux tapestry depicts the ringing of hand bells at the funeral of Edward the Confessor.

Research by antiquaries proves the early use of bells. Eighty bronze hand bells, buried in a copper caldron, were found by Sir Austen Henry Layard (1817–94), excavator of Nineveh, in his further excavations at Nimrud, originally destroyed with Nineveh by the Medes *c.* 612 B.C. Small bells, similar to modern sleigh bells, have been found in ancient Peruvian tombs. All were copper and undoubtedly date to the pre-Incan era, though no earlier than A.D. 500, the beginning of the metal age in that area. No known record exists of clapper-type bells traceable to native origin having been found in the western hemisphere.

Development of the bell from its most primitive forms took two distinct directions—eastern and western. The "pot" and "bowl" were favoured in the orient, while the west later developed its bells on the "cup." The pot as used here means a hollow object with straight sides and a height exceeding its diameter; while bowl describes an absolutely convex object, with diameter far exceeding its height. A cup is an object of nearly equal height and diameter, with convex sides. The bowl became the gong—a distinctly oriental instrument. The pot evolved into the Chinese and Japanese "barrel-formed" bells, with walls of equal thickness throughout and of impressive tone, though of no particular note.

Western civilizations, using the cup as their general form, developed the technique of ringing bells by means of a clapper striking from the inside. The bells found in Nimrud, others of cast bronze in Hyderabad, India, and still later ones in Rome—all with small finger loops on top—are those to which tintinnabulum, the onomatopoeic Latin word for anything tinkling, was first applied.



ERNEST MORRIS

ANCIENT BELL FOUND NEAR BABYLON; ABOUT 1000 B.C.

The first Christian writer to speak frequently of bells is Gregory of Tours, *c.* 585. He states that they were either struck or shaken, and even speaks of a cord used for this purpose. Credit has been given to Paulinus, bishop of Nola in Campania, Italy, for the creation of the bell resembling its modern form (*c.* 400), one writer stating that Paulinus caused a larger copper or bronze kettle to be mounted upside down at the top of the church, to "ring as a bell." On the other hand, Pope Stephen III, in 752, erected a belfry with three bells (*campanae*) at St. Peter's in Rome. It is possible that the name *campanae* led Walafrid Strabo to assert that bells were of Italian origin and from Campania.

Small bells were probably used in many places because there was no metal native to the section suitable for casting larger ones.

There was ample copper but no tin to make bronze in Ireland. An example of substitutes is the cowbell type, brought to Ireland by St. Patrick and Palladius, the first missionaries from Rome, about A.D. 450. Their bells were made from a flat plate with the corners cut out, then bent and riveted in a square or oblong shape. These bells were used in Europe for nearly four centuries. Many specimens of these small bells still exist, such as the bell of St. Gallen in Switzerland, believed to date from 612; the "Saufang" of Cologne dating from the 9th century, hammered round and riveted on two sides; and the "Bell of St. Patrick's Will" (in Irish, Clog Edachta Pátraic), preserved in the National Museum of Ireland.

Further references to the early history of bells are found in *De Tintinnabulis* by Hieronymous Magius. Gulielmus Durandus refers to *squilla* for the refectory, *nola* for the choir, *campana* for the steeple and *cymbalum* for the cloister. Joannes Belethus writes of *tintinnabulum* for dormitory and refectory, *campana* for the tower and *campanella* for the cloister. Early Latin writers speak of *signum* in the tower—from which the Portuguese derive their words *sino* for "a bell." David is shown playing nine bells in a 14th-century psalter (Lambeth palace library Manuscript 233). The secular curfew bell was introduced in England by William the Conqueror. Bells play an important part in the rites of the Mass.

Bell Ringing and Change Ringing.—The evolution of the bell, from its archaic form to the forms in use in the 20th century, split in two directions in the west because of differences in bell-music tastes between the English and the people of the Low Countries.

In England, bell music has always been most appreciated when the bells are "clocked"; *i.e.*, rung in single note sequences as chimes and in mathematically precise "change ringing," or ringing "rounds." The people of the Low Countries found that bell music was most satisfying to them when full harmony was played from their towers. The "chiming" bell thus developed in England while on the continent of Europe the Flemish carillon-type bell was favoured. (*See* CARILLON.)

"Clocking" the bell consists of causing it to sound by letting it hang motionless and by pulling the clapper against the side of the bell with a rope. An alternate method was to place a striking hammer outside the bell, causing the strike to be made against the sound bow. This practice was disliked because it cracked and destroyed many of the early bells. "Chiming" the bell is achieved by swinging the bell just enough to permit the clapper to strike the sound bow, a method that provides little sound volume but permits one ringer to cause as many as three bells to ring gently. For "ringing," the bell is swung through slightly more than a complete circle, the clapper striking with its full weight against the sound bow at each change of direction or turn. The sound is thus louder and more far-reaching.

The art of scientific change ringing originated in England and is used there and in Scotland, Canada, South Africa, Australia and the United States. Change ringing is a method for producing changes in the note sequences in sets of bells numbering from 4 to 12, all tuned to notes of a major scale, with the tenor bell (largest in size and smallest in number) being the tonic or key-note while the smallest in size (largest in number) is the treble. With one ringer assigned to the rope on each bell, the rules governing change ringing are: (1) alter the sequence of the bells at each successive blow of the clappers; (2) each bell must move up or down ("hunt") in sequence only one place at a time (*see* Table I); (3) the first sequence is "rounds," *i.e.*, ringing down the sequence of the bell group from the treble to the tenor bell; and (4) the full composition of the changes, the "peal," is not completed until the sequence of rounds is reached again. Proper change ringing is not possible on less than 4 or more than 12 bells (*see* Table II). Changes are rung on 7, 9 and 11 bells, but, in each case, 8, 10 and 12 bells are used—the tenor bell remaining the last note of each sequence throughout the composition. The principal methods of change ringing, each of which has its special rules and advocates, are "Grandshire" (*see* Table I); "Plain Bob"; and "Stedman," named for its inventor Fabian Stedman of Cambridge, *c.* 1670.

TABLE I.—*The First 20 Changes of a "Plain Course" of "Grandsire Triples" (Changes on 7 Bells)*

Rounds	Rounds
1 2 3 4 5 6 7	7 5 6 1 4 2 3 (10th change)
2 1 3 5 4 7 6 (1st change)	5 7 1 6 2 4 3
2 3 1 4 5 6 7	5 1 7 2 6 3 4
3 2 4 1 6 5 7	1 5 2 7 3 6 4
3 4 2 6 1 7 5	1 2 5 3 7 4 6
4 3 6 2 7 1 5 (5th change)	2 1 5 7 3 6 4 (15th change)
4 6 3 7 2 5 1	2 5 1 3 7 4 6
6 4 7 3 5 2 1	5 2 3 1 4 7 6
6 7 4 5 3 1 2	5 3 2 4 1 6 7
7 6 5 4 1 3 2	3 5 4 2 6 1 7
	3 4 5 6 2 7 1 (20th change)

TABLE II.—*The Number of Changes Possible on Various Numbers of Bells**

No. of bells	Name	No. of changes	Time needed			
			Years	Days	Hr.	Min.
4	Singles	24	..	...	..	1
5	Doubles	120	..	...	..	5
6	Minor	720	..	...	..	30
7	Triples	5,040	..	...	3	..
8	Major	40,320	..	1	4	..
9	Caters (quaters)	362,880	..	10	12	..
10	Royal	3,628,800	..	105	..	..
11	Cinques	39,916,800	3	60	..	..
12	Maximus	479,001,600	37	355	..	..

*The number of possible changes on *any* series of bells may be determined, using the mathematical formula of permutatioos, by multiplyiog the number of the bells together. On three bells, only six changes or variations in the order 1 x 2 x 3 can be produced; on five bells, 1 x 2 x 3 x 4 x 5 = 120; and so on up to the astronomical total of 479,001,600 changes on 12 bells.

A relay of ringers rang 40,320 changes in 27 hours at Leeds in Kent, Eng., in 1761. Because a relay of ringers was used, this is not accepted as a true record, although it is not known to have been exceeded. In 1950 a single group of ringers at Winsford in Cheshire, Eng., rang 21,600 changes in 12 hr. 58 min., an accepted record.

Because ringing the bell, as the English preferred to do, demanded that it be rotated slightly more than a complete circle on each change of direction (a stay pawl, on a slider, stops the bell at the top of its inverted swing just as it passes the vertical centre line of motion), it was found necessary to make the height of the bell somewhat less than its major diameter. Mounting the bell higher between its gudgeons, the pivot points around which it rotates, permitted a nearly perfect balance of the bell and reduced the muscular effort needed to swing it the many hundreds of times required for a complete set of changes. But this shortening of the height also caused a change in the tuning pattern of the ringing bell, as compared with those designed for carillon use. The result was that English bells, up to about 1895, generally produced tones composed of a different group of partials or overtones from those found in Flemish carillon bells. After that date, the Taylors of Loughborough, using data originally compiled by Canon Simpson and published in *Pall Mall* magazine, Oct. 1895, completely revolutionized the tuning of their bells, with the result that their product compared favourably in tone structure with the bells of Flanders.

The original English tone pattern was based on five main partial tones as follows: the strike, or fundamental, tone (the pitch note of the bell); a minor third and perfect fifth above the strike tone; the nominal, heard as an octave above the strike tone; and the hum tone (now a full tone), a major sixth or seventh below the strike tone on the octave of the minor third. Above the nominal, in larger bells, a major third and perfect fifth can be heard; in smaller bells they are too weak to be noted. Actually, English founders tuned only the fundamental or strike note, depending on careful design of their casting molds to cause the other partials to fall into position.

Tuning of a cast bell is achieved by placing the rough casting of the bell, as it comes out of the mold, on a lathe suitable for shaving off metal from the inside surface of the casting. Small bells are turned on a horizontal lathe, while large ones are usually machined on a vertical lathe. Bell metal is removed by cutting tools, as the bell revolves in the lathe, at the points inside the bell surface where the various partial tones are produced. Ex-

treme care must be used in machining the bell, because the removal of even a few thousandths of an inch of metal at the wrong place can ruin the tone of a partial produced by a previously machined section. If too much metal is removed from one area, the bell will have a false tone, and the only remedy is to melt it down and recast it for tuning again. In the United States, most church bells, both singly and in peals, were cast in England or cast in the U.S. by English methods.

Bells in Carillons.—The people of Flanders have worked for several centuries on their plan to have their tower bells used as true musical instruments; and this includes playing all of the intricate trills, arpeggios, runs and full harmony that are familiar to lovers of carillon music.

To achieve this result, the evolution of the carillon bell from its archaic form followed slightly different lines than did the English bell. As early as the 13th century continental founders considered it necessary for every good bell to produce three prominent notes. Frans Hemony declared in the 17th century that each true carillon bell must be designed and finished to include, in the arrangement of its partials (harmonics), three octaves, a minor third, a major third and two fifths. An analysis of the great bell of Erfurt, Germany, proves that Hemony's theory was carried out almost two centuries before his time, inasmuch as this nearly perfect bell was cast in 1497.

Flemish carillon bells, based on the research and experiments of nearly seven centuries, possess a group of partials as follows: the strike or fundamental tone (pitch note of the bell); a minor third and perfect fifth above the strike tone of the bell; the nominal, heard as an octave above the strike tone; and the hum tone, a full octave below the strike tone (compared with the original English tuning of the hum tone, a major sixth or seventh below the strike tone). The major third and perfect fifth above the nominal can be heard in Flemish bells of large size but are too weak to be noticed in smaller bells.

English bells are not suitable for playing in harmony, whereas the Flemish bells are perfect for this purpose. This is the major difference between the two types of bells, and there is little ground for preference of one over the other when the bells are to be used for clocking or ringing. It is only when a full carillon of 25 or more notes in the chromatic scale is heard that the difference in the tones of the two kinds of bells assumes major importance.

Large Bells.—Russia can claim the largest bells in the world. The "Tsar Kolokol" (king of bells), cast in 1733, is the largest known. This bell, 19 ft. high, 22½ ft. in diameter and weighing 193 tons, has never been rung. In 1737 fire destroyed its supports and its fall broke an 11-ton piece from its side. The bell at Trotzkoi weighs 171 tons. A second Moscow bell weighing 110 tons is the largest in actual use.

Other large bells are the great bell at Peking, 53 tons; Nanking, 22 tons; Olomouc, 17 tons; Vienna (1711), 17 tons; Notre Dame (1680), 17 tons; "Great Paul," St. Paul's cathedral, 16¾ tons; "Great Tom," Oxford, 7½ tons; Independence hall bell in Philadelphia (cast by Meneely of Troy, N.Y., in 1876), 6½ tons; "Big Ben" of Westminster, 13½ tons (cracked); the original Wanamaker "Founder's bell" in Philadelphia, now owned by the Philadelphia National bank, 17½ tons; and the Bourdon bell of the Rockefeller memorial carillon at Riverside church in New York, 18½ tons, the largest tuned bell in the world and the largest cast in England, supplied by Gillett & Johnston of Croydon, who also built The University of Chicago carillon with a tenor bell of 16½ tons. The world's highest bells (700 ft.) are situated in the Metropolitan Life Insurance tower, New York city. They can be heard at the record distance of 28 miles.

SOCIETY FOR CULTURAL RELATIONS WITH THE U.S.S.R.

"TSAR KOLOKOL," SO-CALLED KING OF THE BELLS (1733), FROM THE IVANOVSKAYA BELFRY; KREMLIN, MOSCOW, U.S.S.R.

Modern Bells and Electromechanical Bells.—Since the early 1930s a revolution in bells and bell uses has come about with the introduction of electronics. Because the aim of researchers was to duplicate the tonal perfection of fine-cast bells in a modern and economical way, their efforts have been to do this without infringing on the tradition of cast bells. Several electromechanical devices have been perfected for producing similar versions or perfect duplicates of the tones of fine-cast bells. In a purely electronic bell instrument the tones are generated by electronic oscillators. All of the so-called electronic units of the early 1960s used electronic amplifiers for magnifying sound generated by mechanical vibrating-tone generators.

In these instruments, a small tuned metal bar or rod is struck by a miniature hammer or clapper, just as the clapper strikes a cast bell. The impact of the hammer blow causes the rod or bar to vibrate, though the sound produced is but a very faint ping. If the tone generators are made of a bell-metal alloy similar to that used for cast bells, an electrostatic pickup unit is mounted solidly, close to the vibrating metal. If the bars are made of iron or steel, an electromagnetic unit is used.

With the electrostatic pickup unit, the physical movements of the vibrating-tone generator bar change the capacity of the pickup unit, thus causing fluctuations in the amount of electric current that passes through the unit. This causes the physical vibrations to be converted into electrical impulses, and these tiny impulses are then passed into electronic amplification devices. There they are built up hundreds of thousands of times and passed to reproducers, which convert the electrical energy to audible sound.

With the electromagnetic pickup units, the physical vibrating movements of the iron or steel bars disturb the magnetic field of the pickup unit. This action causes fluctuation in the electrical energy created in the magnetic field, changing the physical vibrations into electrical impulses. As described above, the tiny impulses so developed are amplified and converted to audible sound.

The vibrating bars that generate the bell tones are usually straight round or flat bars, and the series of vibrations produced in them by the hammer blows contain the complete series of vibrations found in the struck-cast bell, as well as added series over those in the bell. A pure bell tone can be produced from the small bar or rod by filtering out unwanted vibrations in the bar. The wanted vibrations are isolated by both mechanical and electronic filter methods.

Tuning the tone-generator bar or rod is far simpler than tuning a cast bell. Being small (one-eighth to one-fourth inch square or in diameter), the bars are tuned to accuracies impossible to achieve in tuning large cast bells. Manufacturers claim limits of plus or minus one-half cent in tuning the Flemish-type electric bell tone generators; and three cents plus or minus on tuning English-type electric bells. (A cent is equal to $\frac{1}{100}$ of a semitone, the octave being divided into 12 semitones or 1,200 cents.)

A few manufacturers of modern electric bells have reached their goal of duplicating the tones of perfect cast bells. Both the English-type and Flemish-type tones are produced and are so nearly tonally perfect that even the keenest ear cannot detect whether cast bells or the electric bells are being played.

The cast bell originated as a single tone-generating unit and is still used alone in thousands of towers. It has never been possible for bell manufacturers to spread the use of their bells over broad markets, because the cost of the bell has always been high. Hence, until the advent of the electronic age and the invention of the electric bell, comparatively few large peals and carillons were in use.

The main deterrents to the broader use of cast bells having been the weight and cost of the bell itself, the cost of building towers to support them and raising them into the tower, and finding trained musicians to play them; it follows that modern electric bells fill a great need. One characteristic of the modern

electromechanical bells is the complete control it provides over the distribution of tones around the tower. Sound waves emitted from cast bells are omnidirectional and consequently cover the entire surrounding area with sound. By means of stentors the sound waves of electric bells can be projected in any and all directions, either horizontally or vertically, to selected areas.

The use of the single electric bell compares with that of the single cast bell, long used as a warning signal, a call to worship or a time indicator. Peals, rings, chimes and carillons are groups of individual bells, each tuned to be consonant when played with others in the same set. The building of a carillon of several octaves of fine-cast bells is an expensive project, but electric-bell units can be assembled at a fraction of the cost in as many as five full chromatic octaves. The cost of the entire electric instrument in the early 1960s was less than the cost of the tenor bell of a cast-bell carillon. Automatic playing devices for cast bells have always been expensive to purchase, cumbersome to operate and costly to maintain. Most of the moving parts of such devices must be in the open belfry since they must be close to the bells they are to play; this leads to weather damage. The modern electric bells are completely enclosed in metal cabinets for installation inside a building. The only units exposed to weather in the tower are the reproducers, which have no moving parts and are completely weatherproof.

Electronics and the modern electric bell have wrought great changes in the field of campanology. Through exact duplication of cast-bell tones, low initial cost, simplicity of installation and operation, wide range of automatic playing devices and the low maintenance costs as claimed by manufacturers, the modern instruments of the early 1960s far outnumbered the traditional cast-bell instruments. Evidence of this trend is the fact that there were about 80 cast-bell carillons on the North American continent, yet one electric-bell manufacturer alone listed over 5,000 full carillons, plus hundreds of single bells and peals, while other manufacturers reported varied numbers of instruments in daily use.

Electric bells are built in one-bell units, various multiple numbers of bells in peals and chimes and in full carillons of from 25 to 61 bells. Probably the highest achievement in the modern electric-bell field was the development of a 61-bell Flemish-type carillon that is equal in musical result to a cast-bell carillon of 61 bells weighing 275,372 lb. This instrument can be played from its one-manual electric keyboard, with foot-pedal expression control of the volume of the bells; it produces intricate carillon music passages that cannot be played on even the finest of cast-bell instruments. Just as the rope that swings the heavy cast bell is replaced by a pushbutton that rings the electric bell, so the electric keyboard replaces the clavier on the carillon.

See also Index references under "Bell" in the Index volume.

BIBLIOGRAPHY.—S. N. Coleman, *Bells, Their History, Legends, Making, and Uses* (1928); E. Morris, *Bells of all Nations* (1951), *Towers and Bells of Britain* (1955); P. Price, *Campanology, Europe 1945–47* (1948); G. S. Tyack, *A Book About Bells* (1898); A. Gillgrass, *The Book of Big Ben* (1946). (AN. B.; J. BL.)

BELL, BOOK AND CANDLE, an old ceremony of pronouncing the "major excommunication" or "anathema" (*see* EXCOMMUNICATION). Its origins are not clear, but it goes back certainly to the end of the 9th century, if not to the middle of the 8th. The bell represents the public character of the act, the book the authority of the words spoken by the presiding bishop. The candle is believed to symbolize the possibility that the ban may be lifted by the repentance and amendment of its victim. The ceremony is performed in some conspicuous place and, upon its termination, letters are written to bishops of other sees to report the fact. When the assemblage has been convoked a bishop appears with 12 priests; all of the 13 hold lighted candles. The bishop then recites the formula, ending thus: "We separate him . . . from the precious body and blood of the Lord and from the society of all Christians; we exclude him from our holy mother the Church . . . ; we declare him excommunicate and anathema; we judge him damned . . . until he shall . . . return to amendment and to penitence." Those present answer, "So be it!" Then the bishop and the 12 priests extinguish their candles by dashing them to the ground and (as a general rule) the ceremony is ended.

BELLA, STEFANO DELLA (1610–1664), known in France as ÉTIENNE DE LA BELLE, Italian engraver, whose most famous works are his engravings of military events, in the manner of Jacques Callot. He was born at Florence on May 18, 1610. He was apprenticed to a goldsmith, but turned his attention to engraving, and studied that art under Canta Gallina. By the liberality of Lorenzo de' Medici he was enabled to spend three years in study at Rome. In 1642 he went to Paris, where Cardinal Richelieu engaged him to make drawings at Arras of the siege and taking of that town by the royal army.. About 1650 he returned to Florence. His productions numbered over 1,400 separate pieces. His masterpiece is the view of the Pont Neuf in Paris. He died in Florence on July 12, 1664.

BELLABELLA, the common name (popularized from the Indian corruption of Milbank) for a tribe of Kwakiutl Indians at Milbank, B.C., including the subtribes Kokaitk, Oetlitk and Oealitk. *See* KWAKIUTL.

BELLA COOLA. At the time of European contact the Bella Coola Indians of British Columbia occupied about 30 villages in the lower Bella Coola river valley and the adjacent sea coast, with outlying settlements at Kimsquit and Tallio. They probably numbered about 5,000, but were reduced by disease in the 19th century to less than 1,000, who lived in a single village. In the mid-20th century the population is increasing.

The language is the most northerly representative of the Salish stock. Like other tribes of the central British Columbia coast, the Bella Coola lived in permanent villages of large plank-built houses occupied by a number of families. Wood was used for houses, canoes and watertight boxes which served a variety of domestic purposes; shredded cedar bark provided clothing; baskets were made of cedar and spruce; alder and cedar were carved into masks and other ceremonial objects, including the spectacular totem poles of the 19th century. Fish was the basic food supply, supplemented by hunting and by collecting berries and roots. Salmon, taken in the summer, were eaten fresh or smoked; oil extracted from eulachon (candlefish) was used as a condiment. Life was essentially on a village basis, with status dependent both on hereditary rank and on wealth, measured by ostentatious giving at potlatches. There was no formal tribal cohesion, but a strong feeling of unity based on common language, common origin and pride in respect to neighbouring tribes. Secret societies were important, with an unusually well-developed pantheon of deities and great dependence on numerous oral traditions.

See T. F. McIlwraith, *The Bella Coola Indians* (1949).

(T. F. McI.)

BELLADONNA, a name for the deadly nightshade (*Atropa belladonna*). *See* ATROPINE; NIGHTSHADE; SOLANACEAE.

BELLAIRE, a city of southeastern Texas, U.S., entirely surrounded by the city of Houston. (For comparative population figures *see* table in TEXAS: *Population.*) A council-manager form of government has been in effect since 1949. The city, then 10 mi. S.W. of Houston, was founded in 1911 when W. W. Baldwin (1845–1936) bought a tract of ranch land and laid out two communities. He named one of them, the only one to survive separately, for Bellaire, O. A prairie just south of the city was the site, in 1921, of a mammoth ceremony in which 2,051 men were inducted into the Ku Klux Klan; it was one of the largest such meetings in the 20th century. Incorporated in 1918, Bellaire grew slowly until World War II caused the sudden growth of the whole Gulf region. Bellaire is primarily a residential city, and most of its inhabitants are employed in surrounding Houston. Managerial, professional and technical workers comprise nearly half of the city's population. (G. M. F.)

BELLAMY, EDWARD (1850–1898), U.S. writer and reformer, is best known for his utopian romance, *Looking Backward.* He was born on March 26, 1850, in Chicopee Falls, Mass. Of good New England family, he was the son of an impecunious Baptist minister. At 18, while studying for a year in Germany, he first realized how harsh was the lot of the urban poor. He became a journalist and free-lance writer. Bellamy's early essays

and stories reflected the religious unrest of the post-Civil War period. Several tales, some posthumously collected in *The Blindman's World and Other Stories* (1898), indirectly criticized conventional America. *Dr. Heidenhoff's Process* (1880) used symbols in a fashion reminiscent of Nathaniel Hawthorne.

Bellamy's *Looking Backward, 2000–1887* (1888) described a coming society that featured co-operation, brotherhood and an industry geared to human need. It appealed to a public still suffering the effects of the economic depression of 1883, disturbed by such industrial clashes as the Haymarket riot in Chicago (1886) and aware that other, even more spectacular, crises could arise. Bellamy's humanity, ingenious plot and confidence in man's inventiveness stirred elements from every class and section of the population. *Looking Backward* sold over 1,000,000 copies and precipitated numerous polemical attacks on and defenses of Bellamy's ideas.

Bellamy became an active propagandist for nationalization of public services and Nationalist clubs proliferated. His magazine, the *Nationalist* (1889–91), helped crystallize principles that his followers wrote into the Populist platform of 1892, but its successor, the *New Nation* (1891–94), saw his movement in decline. *Equality* (1897), a less successful sequel to *Looking Backward*, treated in detail problems of social organization and motivation too little developed in its predecessor. Bellamy's never robust health failed him, and he died of tuberculosis in Chicopee Falls on May 22, 1898. Two later volumes of his uncollected writings, *Edward Bellamy Speaks Again!* (1937) and *Talks on Nationalism* (1938), seemed timely to admirers who felt that aspects of Bellamy's work foreshadowed the New Deal.

See Arthur E. Morgan, *Edward Bellamy* (1944), which treats him as a social engineer rather than as a utopian; Sylvia E. Bowman, *The Year 2000* (1958), a critical biography. (L. Fr.)

BELLARMINE, SAINT ROBERT (Roberto Francesco Romolo Bellarmino) (1542–1621), Italian cardinal and theologian, outstanding in his day as a controversialist, was born at Montepulciano, Tuscany, on Oct. 4, 1542. He entered the Society of Jesus in 1560 and, after studying in Rome, Mondovi (Piedmont) and Padua, was sent in 1569 to Louvain where he began the following year, after ordination, to lecture on theology. There he was forced by the strength of Protestantism and the Augustinian doctrines of grace and free will prevailing in the Low Countries to define his theological principles carefully and precisely. He returned to Rome where he lectured on controversial subjects at the new Jesuit college founded at the instigation of Gregory XIII. He was made a cardinal by Clement VIII in 1599 and was appointed archbishop of Capua in 1602. He died in Rome on Sept. 17, 1621. He was canonized in 1930 and declared a doctor of the church in the following year. His feast is kept on May 13.

The subjects on which Bellarmine wrote have remained controversial, and his name has been passed over in the heat of subsequent disputes, but during his own day he was regarded as one of the most enlightened theologians and gave impartial attention to Protestant works. His most influential writings were the series of lectures published under the title *Disputationes de controversiis Christianae fidei adversus huius temporis haereticos*, in three volumes between 1586 and 1593, which contained a scholarly statement in lucid and uncompromising terms of Catholic doctrine under the four headings Christ, the church, the sacraments and grace, and stimulated comments from both Protestants and Catholics. Bellarmine took part in the preparation of the Clementine edition (1591–92) of the Vulgate in which the inaccuracies of the previous edition produced under Sixtus V were carefully corrected. In 1610 he published another important and controversial work, his *De potestate summi pontificis in rebus temporalibus* in reply to the posthumous work of William Barclay of Aberdeen, *De potestate papae* (1609), which denied all temporal power to the pope. Sixtus V, however, had not been satisfied with Bellarmine's restrictions on the extent of papal power, while, on the other hand, many French theologians, especially J. B. Bossuet, strongly criticized him for defending ultramontanism.

As a consultor of the Holy Office, Bellarmine took a prominent part in the first examination of Galileo's writings. He had followed with interest Galileo's scientific discoveries, and a mutual respectful admiration grew up between them. When Galileo visited Rome in Dec. 1615 he was warmly received by Bellarmine, and the high regard in which he was held is clearly testified in Bellarmine's letters and in Galileo's donation to the cardinal of his discourse on "floating bodies." Bellarmine himself did not proscribe the Copernican system but suggested instead that it be presented merely as a hypothesis until it could receive unqualified scientific demonstration.

Among Bellarmine's other works, his *De scriptoribus ecclesiasticis* (1613), his autobiography (first published in 1675) and his devotional treatises are of particular importance.

Both in his life and in his writings, Bellarmine is regarded by the Roman Catholic Church as one of its most powerful defenders. He was of a very genial and lovable disposition and took a passionate, personal interest in the relief of the poor. At his death he was himself a pauper, leaving not enough to pay even the modest expenses of his funeral. All his revenues had gone to the poor.

Bibliography.—A complete edition of Bellarmine's works was published in 12 vol. (1870–74). *See* also J. Fuligatti, *Vita del cardinale Bellarmino* (1624); E. A. Ryan, *The Historical Scholarship of Saint Bellarmine* (1936); J. Brodrick, *Robert Bellarmine, Saint and Scholar* (1961). (J. P. Bk.)

BELLARY, a town and district of Mysore state, India. The town is 305 mi. N.W. of Madras by rail and has a population (1961) of 85,673. It was strong and well fortified from early times. The fort, originally built in the 16th century, stands on a huge mass of bare granite rock, 2 mi. in circumference, which rises abruptly from the surrounding plains to a height of 450 ft. Haidar Ali (*q.v.*) built the present fortifications, according to tradition, with the assistance of a French engineer whom he afterward hanged for not building the fort on a higher rock adjacent to it.

The town has a considerable trade in cotton, in connection with which there are large steam presses, and some manufacture of cotton cloth. There are also a cotton mill, distilleries and a sugar factory.

Bellary District. Before 1953 Bellary district, then in Madras, had an area of 5,881 sq.mi. and a population (1951) of 1,243,525. In 1953 the larger part of the district (3,825 sq.mi.) was transferred to Mysore and the three eastern talukas (1,956 sq.mi.) to the newly formed state of Andhra (now Andhra Pradesh). In 1961 the population was 915,261. The district consists chiefly of an extensive plateau, 800–1,000 ft. above sea level. The highest tracts are on the west and south, where it rises to the elevated tableland of Mysore. Toward the centre the almost treeless plains present a monotonous aspect, broken only by a few rocky heights that rise abruptly from the black soil.

The district is watered by the Tungabhadra, formed by the junction of the two streams, Tunga and Bhadra, and the Haggari. Neither of the rivers is navigable: both are fordable during the dry season. Bellary has a smaller rainfall than any other district in south India. Agricultural productivity will be greatly increased with the completion of the distribution canals associated with the Tungabhadra dam, inaugurated in 1953, with administrative headquarters at Hospet (37 mi. W. of Bellary).

The principal crops are millet, other food grains, pulses, peanuts and cotton. There are manufactures of cotton and woolen goods, and cotton is largely exported. Large deposits of iron ore and smaller deposits of copper are found in the Copper mountain 8 mi. S. of the city. The district is traversed from east to west by the Southern railway.

The district abounds in prehistoric sites. A settlement and factory of Neolithic Age, where stone implements were manufactured, has been excavated at Sangankal near Bellary town. Hampi (about 35 mi. N.W.) is traditionally the kingdom of Kishkindha visited by Rama in the epic *Ramayana*. Bellary was within the dominions of the Mauryan emperor Asoka (3rd century B.C.). Subsequently it was included in the territory of the Satavahanas and ruled by the Pallava, Chalukya, Rashtrakuta and Hoysala dynasties in turn. The extensive ruins at Hampi

mark the site of the capital of the empire which flourished from A.D. 1336 to 1565. Its rulers were great patrons of learning and the arts, and of Sanskrit, Kanarese and Telegu literature.

(V. V. B.)

BELLBIRD, the common name, derived from its penetrating bell-like call, for a conspicuous white forest bird, *Procnias alba*, of northern South America. The male carries a long, black, fleshy, erectile appendage ornamented with short white feathers on the forehead. The wattled bellbirds, *Procnias tricarunculata*, of Central America, are reddish with white head and throat; they carry three black wattles at the beak.

The bellbirds belong to the tropical American family Cotingidae, cotingas or chatterers (*q.v.*).

BELL COT (Bell Cote, Bell Gable or Bell Turret), a structure, not a tower, in which bells are hung. It occurs in the form of a gable rising from a main wall, a dormer in a sloping roof or a miniature tower, or turret, at the corner of a building. A favourite position is at the top of the main west gable of a church.

BY COURTESY OF (RIGHT) UNION PACIFIC RAILROAD; PHOTOGRAPH (LEFT) AUTHENTICATED NEWS

REPRESENTATIVE BELL COTS

(Left) Palazzetto della Fraternita del Laici, Arezzo, Italy, begun in the 14th century. (Right) San Diego de Alcala, first of the Spanish missions in California (1769)

Occasionally, even when a tower is present, a small bell, known as the sanctus bell, will be hung in a bell cot near the eastern end of the church. The bell cot for this bell is often at the centre of the crossing of nave and transepts and elaborated into a flèche (*q.v.*).

In Renaissance churches, particularly in Spain and the Spanish colonies, the bell cot is frequently a large section of wall, often separated from any building, and pierced with arches in each of which a bell is hung.

BELLEAU, REMY (1528–1577), French poet and member of the Pléiade, a group of poets which aimed at the enrichment of French language and literature, was born at Nogent-le-Rotrou in 1528. He was of humble birth and his first patron was Christophe de Choiseul, who protected Pierre de Ronsard, Belleau's fellow student at the Collège de Coqueret. He took part in the campaign against Naples in 1557 under René de Lorraine, marquis d'Elbeuf, brother of the duc de Guise, and, from about 1563, lived at Joinville, seat of the Guises, as tutor and later counsellor to Réné's son Charles. He enjoyed the favour of Charles IX and Henry III and was made secretary of the king's chamber. He died on March 6, 1577, while on a visit to Paris and was borne to his grave in the Grands-Augustins by Ronsard, Baïf, Desportes and Amadis Jamyn.

Belleau was an enthusiast for the new learning and an excellent classical scholar. His translation of Anacreon and his commentaries on the second book of Ronsard's *Amours* show his erudition. His *Amours et nouveaux éschanges des pierres précieuses* (1576) are Renaissance by their learning but are also in the tradition of the medieval lapidaries. *La Bergerie* (1565–72) is an idealized yet realistic account of two days spent at Joinville. It follows Jacopo Sannazaro's *Arcadia* but its pastoral atmosphere is impaired by the occasional character of certain poems. Belleau was called the painter of nature by Ronsard. He was observant of detail and shows a command of technical expression in describing buildings and works of art. The somewhat affected grace of his style was not appreciated by Malherbe and his followers and it was only in the 19th century that he was rehabilitated by Sainte-Beuve. He wrote a comedy in verse, *La Reconnue*, and a macaronic poem on the religious wars. *Dictamen metrificum de bello huguenotico et reistrorum piglamine ad sodales.*

Bibliography.—Belleau's works are published as follows: *Oeuvres complètes*, 3 vol. ed. by A. Gouverneur (1867); *Oeuvres poétiques*, 2 vol. ed. by C. Marty-Laveaux (1878); *Les amours et nouveaux éschanges des pierres précieuses*, ed. by A. Van Bever (1909); *La Bergerie*, ed. by D. Delacourcelle (1954). *See* also A. Eckhardt, *Remy Belleau, sa vie, sa "Bergerie"* (1917); D. Delacourcelle, *Le sentiment de l'art dans la "Bergerie" de Remy Belleau* (1945). (D. W. D.)

BELLEAU WOOD, BATTLE OF, the second clash between U.S. and German troops in World War I. It took its name from that of a tract of forest land, less than a square mile in area in the French *département* of Aisne, 5 mi. N.W. of Château-Thierry and 42 mi. E.N.E. of Paris. When the German offensive of May 27, 1918, was launched on the Aisne (*see* Chemin des Dames, Battle of the), the 2nd division of the U.S. expeditionary force under Maj. Gen. Omar Bundy was rushed to the assistance of the 6th French army and deployed across the Paris-Château-Thierry road west of the latter town. On its front lay Belleau wood and the villages of Torcy, Bouresches and Vaux, all occupied by the Germans. The Germans had been temporarily halted at Château-Thierry but were consolidating themselves at Vaux and in Belleau wood in preparation for a renewed advance west of Château-Thierry. The task of dislodging them was entrusted to the 2nd division.

The attack was made on June 6 by a marine brigade of the division commanded by Brig. Gen. James Harbord. The woods were penetrated but could not be held. The ground was extremely difficult, almost impenetrable underbrush covering a rugged outcrop of rock. Three days later the attack was renewed. The fighting was bitter, but after a struggle lasting over a fortnight the woods were finally taken by the division; Bouresches and Vaux were also captured. In this engagement the Germans lost 24 guns and 1,654 prisoners, but the U.S. losses were severe, amounting to 285 officers and 7,585 men killed, wounded and missing. The battle, while not of decisive effect in itself, was of marked psychological importance as demonstrating the valour of the American soldier in modern combat.

The battleground was in 1923 dedicated as a permanent memorial to the U.S. officers and men who lost their lives there, and the French government ordered the name to be changed from Bois de Belleau to Bois de la Brigade de Marine. (D. MacA.)

BELLECOUR (1725–1778), French actor, whose real name was Jean Claude Gilles Colson, was born on Jan. 16, 1725, the son of a portrait painter. After playing in the provinces he made his debut at the Comédie Française on Dec. 21, 1750, as Achilles in *Iphigénie*. He was more successful, however, in comedy parts. He wrote a successful play, *Fausses apparences* (1761), and was very useful to the Comédie Française in editing and adapting the plays of others. He died on Nov. 19, 1778.

Bellecour's wife, Rose Pétronille (or Perrine) le Roy de la Corbinaye, known on stage as Beauménard, was born at Lamballe on Dec. 20, 1730, the daughter of an artillery officer. Under the name of Beauménard she made her first Paris appearance in 1743 as Gogo in Charles Favert's *Le Coq du village*. After a year at the Opéra Comique she played in several companies, including that of Marshal Saxe. In 1749 she made her debut at the Comédie Française as Dorine in *Tartuffe*, and her success was immediate. She retired in 1756, but reappeared in 1761 as Madame Bellecour, and continued in soubrette parts in the plays of Molière and Jean Regnard. She retired at the age of 60, but the Revolution put an end to her pension, and she died in poverty on Aug. 5, 1799.

BELLEEK, a village in County Fermanagh, N.Ire., is an angling centre and a frontier customs post. Pop. (1961) 162. Glacial diversion sends the river Erne northward through Belleek between Lower Lough Erne and the sea. In 1950 an agreement

was reached between the governments of Northern Ireland and the republic to improve drainage and provide hydroelectric power. Local Pre-Cambrian rocks include Moine schists and gneisses with veins of pegmatite, providing feldspathic material in the form of kaolin used for making chinaware. Belleek ware had its great period prior to 1884 and is valued by collectors for its delicate texture. Attractive ware is still made, partly with imported materials. (Hu. S.)

BELLE-ÎLE-EN-MER, a small island off the south coast of Brittany, France, lies 8 mi. S.W. of the Quiberon peninsula. It has several fishing settlements, the largest being Le Palais. A citadel built there in 1572 was strengthened during the next three centuries when the island's position as an outpost of the mainland ports, Lorient and St. Nazaire, was highly important to France. Occupied by the British from 1761 to 1763, it was returned to France by the same treaty that yielded Great Britain the colony of Nova Scotia. (Ar. E. S.)

BELLE-ÎSLE, CHARLES LOUIS AUGUSTE FOUQUET DE, Duc de Gisors (1684–1761), marshal of France and statesman, chiefly important for his role in involving France in the War of the Austrian Succession, was born at Villefranche in Rouergue on Sept. 24, 1684, a grandson of the notorious Nicolas Fouquet. After joining the army at an early age, the comte de Belle-Isle, as he then was, fought in the War of the Spanish Succession and in the war of 1718–19 against Spain. He made a fortune by speculation in John Law's "system," but was disgraced and exiled to his estates by the duc de Bourbon. He recovered his position at court under the cardinal de Fleury and enhanced his reputation as a soldier by his command of operations in the Rhineland during the War of the Polish Succession. A man of vast ambition, he aspired to succeed Fleury as prime minister and sought to gain his ends by intrigue. Marshal of France in Feb. 1741, he was the leader of an anti-Austrian faction at the French court, which forced the aging and cautious Fleury into offensive operations against Maria Theresa in the interest of Charles Albert, elector of Bavaria (*see* Austrian Succession, War of the). France was thereby brought to repudiate Fleury's recognition of the Pragmatic Sanction and, through involvement in Europe, to forgo the chance of concentrating on naval and colonial rivalry with Great Britain. Belle-Isle's influence as French plenipotentiary at Frankfurt am Main was instrumental in securing the election of Charles Albert as emperor (Charles VII) on Jan. 24, 1742, for which service he was created duc de Gisors in March. Previously, however, he had committed France to an onerous treaty with Prussia (June 1741). As a military commander he was responsible for the skilful withdrawal of French forces from Prague in 1742 and for the successful defense of Provence against the Austrians and Sardinians in 1746–47. His duchy was made a peerage of France in 1748, and in 1749 he was elected to the Académie Française. Minister of war from 1758 to 1760, during the Seven Years' War, he carried out a number of minor administrative reforms, but was criticized for his failure to reinforce French troops at Quebec, which resulted in the loss of Canada. He died at Versailles on Jan. 26, 1761.

See Jacques Fleury, *Le Secret du maréchal de Belle-Isle* (1934); M. Sautai, *Les Préliminaires de la guerre de la succession d'Autriche* (1907). (A. Gn.)

BELLE ISLE, STRAIT OF, connects the Gulf of St. Lawrence with the Atlantic ocean and separates the island of Newfoundland from Labrador. Its length is 90 mi. and its breadth is 10 to 17 mi. The strait is in the most direct route from the St. Lawrence and Great Lakes ports to Europe, but is open only from July until late November. During the rest of the year it is blocked by sea ice. (C. N. F.)

BELLENDEN (Ballenden, Ballentyne, Ballantyne or Bannatyne), **JOHN** (fl. 1533–1587?), Scottish writer, whose translation of the *Scotorum Historiae* by Hector Boece (*q.v.*) had a profound influence upon Scottish national feeling, was educated at the universities of St. Andrews and Paris. He was in the service of James V as clerk of accounts from the king's earliest years and translated the *Historiae* which had just appeared in Paris (1526) at his request. It was published as *The History and Chronicles of Scotland* in 1536, prefaced by an original poem entitled *A Proheme to the Cosmographe* and later reprinted separately under the various titles of *Vertue and Vyce* and *An Allegory of Virtue and Delyte*. The *History*, written in a fluent and vivid style, is one of the earliest pieces of literary Scottish prose extant, and made accessible, among other stories of interest, the first account of Macbeth's meeting with the witches.

Also at the king's request Bellenden translated the first five books of Livy's Roman History, prefacing them with *The Proheme of the History*, another original poem. This was the first translation of a Latin classic in Britain, but it was not publicly printed until 1822.

In 1533 Bellenden had become archdeacon of Moray and a canon of Ross. Later, however, he appears to have lost the king's favour, and his strenuous opposition to the Reformation caused him to go into exile. Some authorities say that he died in Rome in 1550, but others that he was still alive in 1587.

The *Works* of John Bellenden were edited by W. and C. Tait (1821–22); *The First Five Books of the Roman History* were edited by W. A. Craigie for the Scottish Text society (1901).

See R. W. Chambers and W. W. Seton, "Bellenden's Translation of the History of Hector Boece," in *Scottish Historical Review*, vol. xvii, no. 65 (1919); D. Irving, *The History of Scottish Poetry* (1861).

BELLEROPHON (Bellerophontes), a hero, probably of oriental origin, although provided with a Greek pedigree as early as Homer. In the *Iliad* he is son of Glaucus, the son of Sisyphus of Ephyre (traditionally identified with Corinth). Anteia, wife of Proetus, king of Argos, loves him, and, on her overtures being rejected, falsely accuses him to her husband (theme of Potiphar's wife, fairly common in Greek). Proetus sends Bellerophon to his father-in-law, the king of Lycia (Iobates, as later authors call him), with a written message that he is to be slain. The king sends him against the Chimera (*q.v.*); then against the Solymi, a warlike tribe; then against the Amazons; and finally, when he vanquishes them all, sets chosen warriors in ambush to kill him. Bellerophon kills them, and the king, recognizing him as more than human, marries him to his daughter. He lives in prosperity a while, then falls out of favour with the gods, loses two of his children and wanders, grief-stricken and shunning mankind, over the Aleian plain—*i.e.*, the Plain of Wandering.

ALINARI

RELIEF IN THE PALAZZO SPADA, ROME, SHOWING BELLEROPHON AND PEGASUS

Later authors, from Pindar on, add that, while still at Corinth, Bellerophon tamed the winged horse Pegasus (*q.v.*) with a bridle given him by Athena; that he visited Proetus because he had slain either the Corinthian hero Bellerus or his own brother, and so went into exile; that he used Pegasus to fight the Chimera, and afterward to punish Anteia (or, as they call her, Stheneboea) by inducing her to ride with him and then dropping her from a great height; that he earned the wrath of the gods by trying to fly up to heaven, being thrown from Pegasus in consequence, and lamed.

His adventures were frequently represented in ancient art, and formed the subject of the *Iobates* of Sophocles and of the *Bellerophontes* and *Stheneboea* of Euripides. Only fragments of these survive.

BELLEVILLE, a city of southeastern Ontario, Can., the seat of Hastings county, is situated on the Bay of Quinte, an inlet of Lake Ontario, at the mouth of the Moira river, 110 mi. E. of Toronto and 230 mi. W. of Montreal. The district was visited by Samuel de Champlain in 1615 and settled by United Empire Loyalists from the United States after 1776. Originally called

Meyers' Creek after Capt. John Meyers, who erected a gristmill on the site in 1790, the village's name was changed to Belleville in 1816. It was incorporated as a town in 1850 and became a city in 1877. Growth was rapid after World War II (pop. [1941] 15,710; [1956] 20,605; [1961] 30,163).

Natural assets include fertile soil, duck marshes and excellent fishing. Major products are cheese, whisky, cement, locks, oil burners, machinery, plastics, electronic products, heat-resistant alloys and infant and dietary food products. In 1855 a line of the Grand Trunk railway (later a part of the Canadian National railways) reached Belleville, which became a division point; with nationwide dieselization of the system it became headquarters of a district in 1961.

To the north there are uranium mines at Bancroft and an iron mine at Marmora. Trenton air station, 9 mi. W., fighter command headquarters of the Royal Canadian Air Force until 1959, was then made transport command headquarters. Belleville is the site of the Ontario School for the Deaf. (R. L. Pa.)

BELLEVILLE, a city of Illinois, U.S., 14 mi. S.E. of St. Louis, Mo., adjoining East St. Louis; the seat of St. Clair county. It is located on bluffs that form the eastern rim of a flood plain bordering the Mississippi.

The immediate area was settled before 1810, but Belleville was not founded until 1814 when the site was selected as the seat of county government. German immigrants comprised a large proportion of the early population. The city has grown steadily since its founding. (For comparative population figures *see* table in Illinois: *Population.*)

Originally Belleville's economy depended on the services it rendered to the agricultural region which surrounded it. In 1852 the first bituminous coal mine was sunk nearby, and economic diversification began. The manufacture of heating and cooking equipment was the city's leading industry after mid-20th century. Other important industries include the production of beer, paper cartons, cereal foods, bricks, stencil-cutting machines, wearing apparel, tools and dies.

Toward the centre of the city are blocks of one-story brick residences built in the first half-century of Belleville's existence.

Six miles east of Belleville is Scott air force base of the military air transport service (MATS). (R. E. M.)

BELLEVILLE, a town of Essex county, N.J., U.S., on the Passaic river, adjoining Newark. (For comparative population figures *see* table in New Jersey: *Population.*) Belleville was a portion of that part of Newark which was incorporated as Bloomfield in 1812. Belleville became a separate municipality in 1839.

It was in Belleville that Nicholas Roosevelt in 1794 or 1795 completed one of the first steam engines constructed in America. In 1798, nine years before Robert Fulton built the "Clermont," one of his engines powered the 40-ft. ship "Polacca" which John Stevens, inventor and financier of Hoboken, constructed at the Roosevelt foundry. The craft was operated successfully on the Passaic river and sailed from Belleville to New York and returned to Belleville.

Belleville is a residential suburb of Newark and New York city, but also has considerable manufacturing industries, including electrical goods, radio and television equipment, fire extinguishers, water pumps, aids to marine and aerial navigation and precision instruments. Some of Belleville's earlier Dutch inhabitants engaged in the manufacture of patent leather and papermaking machinery. (E. R. D.)

BELLFLOWER, the name given to various species of *Campanula* (*q.v.*) because of the shape of their handsome flowers.

BELLI, GIUSEPPE GIOACCHINO (1791–1863), Italian poet whose satirical sonnets present a vivid picture of life in papal Rome in the early 19th century, was born in Rome, Sept. 10, 1791. After an unhappy childhood he was employed in humble posts until, in 1816, marriage with a rich widow enabled him to devote much time to poetry. As a papal civil servant he held conservative political views and was deeply perturbed by the revolution of 1848 and the formation of the Roman republic of 1849. He was also throughout his life troubled by moral and religious scruples. He died in Rome, Dec. 21, 1863.

His sonnets in Roman dialect—more than 2,000—contrast with the conformity of his life. Composed mainly during 1830–39, they seem to have provided an outlet for his repressed feelings. Although he also wrote conventional poems in Italian, his originality lies in the sonnets, which express his revolt against literary tradition, the academic mentality and the social injustice of the papal system. The ritualism of the Roman Catholic Church and the accepted principles of commonplace morality were also the objects of his derision. But just as even in his most erotic vein Belli is never obscene, so his apparently most profane sonnets are never really impious; they register rather a passing mood of rebellion. Belli's greatest gift is for observing and describing the people of Rome. In hundreds of small perfect portraits he describes their speech and habits, vices and virtues, pleasures and sufferings, and also all the varied aspects of their life, including the theatres, the lotteries and the colourful processions.

An edition of Belli's sonnets (introduction by G. Vigolo) appeared in three volumes in 1952.

See E. Veo, *I poeti romaneschi* (1927), with bibliography. (F. Di.)

BELLIGERENCY, the condition of being in fact engaged in war. A nation is no less a belligerent by reason of having resorted to aggressive war in violation of international law. Nor is a declaration of war necessary to create a state of belligerency. The United States and Communist China were belligerents during the Korean conflict despite the fact that both parties avoided characterizing the hostilities as war. The 1949 Geneva Conventions for the Protection of War Victims apply not only to declared war but to any armed conflict between parties to the conventions and to the occupation of the territory of a party even if unresisted. Under the Geneva Prisoners of War convention of 1949, lawful belligerents comprise members of the armed forces as well as members of militias, volunteer corps and organized resistance movements who are commanded by a person responsible for his subordinates, have a distinctive sign, carry arms openly and conduct operations lawfully.

Nonbelligerency, or benevolent neutrality, describes the conduct of a nation in departing from a neutral's duties of impartiality by giving assistance to one of the contending factions in a war. Such departures are, under certain circumstances, authorized or even required by the United Nations charter.

If a state recognizes the belligerency of parties to a civil war, it thereby indicates that those parties have belligerent rights and duties similar to those existing in an international war and also binds itself to assume a position of neutrality toward those parties. Recognition of insurgency is only a recognition that revolt exists and does not accord belligerent standing to the insurgents. It may, however, involve limited contact with the insurgents and some acquiescence in the measures they take.

Under the Geneva conventions of 1949, to which many nations are parties, certain general safeguards of a humanitarian character, but not all the protections of the law of war, are granted persons involved in a civil war. *See* also Aggression; War. (R. R. Br.)

BELLINGHAM, a city near the northwest corner of Washington, U.S., on the east shore of Bellingham bay, 18 mi. south of the U.S.-Canadian border; a port of entry and seat of Whatcom county. Bellingham is the nearest major town to the San Juan Islands, and lies just west of the wilderness area of the northern Cascade mountains. It was first visited by Francisco Eliza in 1791.

In 1792 the British explorer, Capt. George Vancouver, named Bellingham bay in honour of his associate Sir William Bellingham. The first settlers came in 1852 when Capt. Henry Roeder built a sawmill on the falls of Whatcom creek. At the end of the illusory Fraser river gold rush (1857–58) the community became a ghost town, but recovered in the 1880s with the opening of coal mines and the building of lumber mills.

Railroad construction to Bellingham Bay increased the population and in 1903 the towns of New Whatcom and Fairhaven merged to form the present city. Its main industries are pulp and paper processing, cement manufacturing, fish canning and pleasure craft and shipbuilding. The Western Washington College of Education,

which enrolls more than 2,800 students annually, was established in Bellingham in 1899.

For comparative population figures *see* table in WASHINGTON: *Population.* (K. A. M.)

BELLINGSHAUSEN, FABIAN GOTTLIEB VON (Russ. FADDEI FADDEEVICH BELLINSGAUZEN) (1779–1852), Russian antarctic explorer, was born on the island of Osel in the Baltic, Aug. 18, 1779. At the age of ten he entered the imperial Russian navy; he died an admiral and governor of Kronstadt. His greatest achievement was his voyage of exploration of 1819–21, when he commanded the "Vostok" and "Mirny" in a circumnavigation of Antarctica. He discovered certain of the South Sandwich Islands, Peter I Island and Alexander I Island (these two were the first sightings of land within the Antarctic circle). He almost certainly sighted, but did not recognize as land, two coastal areas between longitude 5° W. and 20° E.; the first was on Jan. 28, 1820, two days before E. Bransfield's discovery of Palmer peninsula, which, if Bellingshausen is left out of account, is the first-known sighting of the Antarctic continent. Bellingshausen died at Kronstadt on Jan. 13, 1852. His narrative was reprinted (1949) and translated into English (Hakluyt Society, 1945). (T. E. A.)

BELLINI, the name of a family of craftsmen in Venice, three members of which fill a great place in the history of the Venetian school of painting in the 15th and early 16th centuries.

JACOPO BELLINI (*c.* 1400–*c.* 1470) was the son of a tinsmith or pewterer, Niccolò Bellini, by his wife Franceschina. When the accomplished Umbrian master Gentile da Fabriano came to practise at Venice, where art was backward, several young men of the city took service under him as pupils. Among these was Jacopo Bellini, who probably followed his teacher to Florence. There the progress made in fidelity to natural fact and in sense of classic grace and style, by masters like Donatello and Ghiberti, Masaccio and Paolo Uccello, offered Jacopo better instruction than he could obtain even from his Umbrian teacher. By 1429 Jacopo was settled at Venice and married to a wife from Pesaro named Anna, who bore her husband two sons, Gentile and Giovanni (though some evidences have been thought to point rather to Giovanni having been his son by another mother), and a daughter Nicolosia. In 1436 Jacopo was at Verona, painting a Crucifixion in fresco for the cathedral (destroyed by order of the archbishop in 1750). About 1440 he must have paid a visit to the court of Ferrara, where there prevailed a spirit of free culture and humanism most congenial to his tastes. His relations with the house of Este, which seem to have begun with a portrait of Lionello d'Este, son of the reigning *marchese* Niccolò III, appear to have been kept up; among Jacopo's extant drawings are several that probably belong to the scheme of a monument later erected in memory of Niccolò. He was also employed by Sigismondo Malatesta at the court of Rimini. In 1453 he received a grant from the confraternity of the Scuola di San Giovanni Evangelista for the marriage of Nicolosia to Andrea Mantegna. In 1456 he painted a figure of Lorenzo Giustiniani, first patriarch of Venice, for his monument in S. Pietro di Castello, and in 1457 three figures of saints in the great hall of the patriarch. His activity can be traced in documents down to Aug. 1470, but in Nov. 1471 his wife Anna describes herself as his relict, so he must have died some time in the interval.

The materials which have reached posterity for a critical judgment on his work consist of a few pictures only, together with two important and invaluable books of drawings. These prove him to have been a worthy third (following the Imbrian Gentile da Fabriano and the Veronese Pisanello) in that trio of artists who, in the first half of the 15th century, carried toward maturity the art of painting in Venice and the neighbouring cities. Of his pictures, an important signed example is a life-size "Christ Crucified" in the archbishop's palace at Verona. The rest are almost all Madonnas, three signed—one in the Tadini gallery at Lovere, another in the Venice academy and another, dated 1448, in the Brera gallery at Milan; a fourth, much damaged, in the Venice academy; and a fifth, richest of all in colour and ornamental detail, in the Uffizi at Florence. Plausibly, though less certainly, ascribed to him are a Madonna at Bergamo, a Crucifixion in the Civico Museo Correr and a "Christ in Limbo" at Padua.

But an abundance of drawings and studies are preserved in two precious albums in the British museum and the Louvre, Paris. The former, which is the earlier in date, belonged to the painter's elder son Gentile and was bequeathed by him to his brother Giovanni. It consists of 99 paper leaves, each covered on both sides with drawings made with a lead point, an instrument unusual at this date. Two or three of the drawings have been worked over in pen; of the remainder many have become dim from time and rubbing. The album at the Louvre, discovered in 1883 in the loft of a country house in Guienne, is equally rich and better preserved, the drawings being all highly finished in pen, probably over effaced preliminary sketches in chalk or lead. The range of subjects is much the same in both collections, and in both extremely varied, proving Jacopo to have been a craftsman of many-sided curiosity and invention. Jacopo's influence on the development of Venetian art was very great, not only directly through his two sons and his son-in-law Mantegna, but also through other workshops of the city.

GENTILE BELLINI (*c.* 1429–1507), the elder son of Jacopo, first appears independently as the painter of a Madonna, much in his father's manner, now in Berlin. His earliest signed work is the St. Lorenzo Giustiniani of 1465 in the Venice academy. In July 1466 he contracted with the officers of the Scuola di San Marco as an independent artist to decorate the doors of their organ. These paintings still exist in a blackened condition. They represent four saints, colossal in size, and designed with much of the harsh and searching austerity which characterized the Paduan school under F. Squarcione. In 1469 Gentile was knighted by the emperor Frederick III who was visiting Venice. He must have risen steadily in the esteem of his fellow citizens, since in 1474 he was commissioned by the senate to restore, renew and, when necessary, replace the work of an earlier generation of artists, a series of paintings that were perishing from damp on the walls of the hall of the great council in the ducal palace. In continuation of this work, Gentile undertook a series of independent paintings on subjects of Venetian history for the same hall, but had apparently only finished one, representing the delivery of the consecrated candle by the pope to the doge, when his labours were interrupted by a mission to the east.

The sultan Mohammed II had dispatched a friendly embassy to Venice, inviting the doge to visit him at Constantinople and at the same time requesting the dispatch of an excellent painter to work at his court. Gentile Bellini with two assistants was selected for the mission, his brother Giovanni being at the same time appointed to fill his place on the works for the hall of the great council. Gentile gave great satisfaction to the sultan, and returned after about a year with a knighthood, some fine clothes, a gold chain and a pension.

The surviving fruits of his labours at Constantinople consist of a portrait of the sultan himself, unfortunately in a hopelessly damaged condition, in the Layard bequest in the National gallery, London; an exquisitely wrought small portrait in water colour of a scribe, found in 1905 by a private collector in the bazaar at Constantinople and now in the Gardner museum at Boston; and two pen-and-ink drawings of Turkish types, now in the British museum. Early copies of two or three other similar drawings are in the Städel institute at Frankfurt am Main.

A place had been left open for Gentile to continue working beside his brother Giovanni in the ducal palace; and soon after 1480 he began to carry out his share in the great series of paintings (unfortunately destroyed by fire in 1577) illustrating the part played by Venice in the struggles between the papacy and the emperor Barbarossa. These works were executed not on the wall itself but on canvas (the climate of Venice having so many times proved fatal to wall paintings), and probably in oil, a method which all the artists of Venice, following the example set by Antonello da Messina, had by this time learned or were learning to practise. They received the highest praise both from contemporary and from later Venetian critics, but no fragment of them survived the fire of 1577, though a drawing in the British museum purports to be the artist's original sketch for the subject of the pope bestowing a sword and his blessing on the doge and his army. Their character can to some extent be judged by a certain number of kindred his-

torical and processional works by the artist which have been preserved. Of such the academy at Venice has three which were painted between 1490 and 1500 for the Scuola di San Giovanni Evangelista, and represent certain events connected with a famous relic belonging to the *scuola;* namely, a supposed fragment of the true cross. All have been much injured and repainted; nevertheless, one at least, showing the procession of the relic through St. Mark's square and the thanksgiving of a father who owed to it the miraculous cure of his son, still gives a good idea of the painter's powers and style.

Gentile's great accuracy and firmness of individual portraiture; his strong gift (derived no doubt from his father's example) for grouping and marshaling a crowd of personages in spaces of fine architectural perspective; the severity and dryness of his Paduan manner much mitigated by the dawning splendour of true Venetian colour—these are the qualities that no injury has been able to deface. They reappear still more forcibly in the last work undertaken by the artist—the great picture, now at the Brera in Milan, of St. Mark preaching at Alexandria; this was commissioned by the Scuola di San Marco in March 1505, and left by the artist in his will, dated Feb. 18, 1507, to be finished by his brother Giovanni. Of Gentile's single portraits, for which he was almost as famous as for his processional groups, there survive one of a doge at the Civico Museo Correr in Venice, one of Catarina Cornaro at Budapest and one of a mathematician at the National gallery, London, besides one or two others in private hands. A much damaged Madonna is in the Mond bequest in the National gallery. The features of Gentile himself are known from a portrait medallion by Camelio; they can also be recognized in two extant drawings, one at Berlin supposed to be by the painter's own hand, and another, much larger and more finished, at Christ Church, Oxford, which is variously attributed to Bonsignori and A. Vivarini.

Giovanni Bellini (*c.* 1430–1516) is generally assumed to have been the second son of Jacopo by his wife Anna; though the fact that she does not mention him in her will with her other son has thrown some slight doubt upon the matter. Until the age of nearly 30 both sons served as their father's assistants in works at Venice and Padua. In Giovanni's earliest independent works, he was more strongly influenced by the harsh and searching manner of the Paduan school, and especially of his own brother-in-law Mantegna, than by the more graceful and facile style of Jacopo. This influence seems to have lasted at full strength until after the departure of Mantegna for the court of Mantua in 1460. The earliest of Giovanni's independent works no doubt date from before this period. Three of these exist at the Correr museum in Venice: a Crucifixion, a Transfiguration and a "Dead Christ Supported by Angels." Two Madonnas of the same or even earlier date are in the United States, one at the Metropolitan museum, New York city, the other in the Johnson collection, Philadelphia; a third, that of G. Frizzoni, is now in the Civico Museo Correr at Venice; while two beautiful works in the National gallery of London seem to bring the period to a close. One of these is of a rare subject, the "Blood of the Redeemer"; the other is the fine picture of "Christ's Agony in the Garden," formerly in the Northbrook collection. The last-named piece was evidently executed in friendly rivalry with Mantegna, whose version of the subject hangs nearby; the main idea of the composition in both cases was taken from a drawing by Jacopo Bellini in the British museum sketchbook.

In all these pictures Giovanni combines with the Paduan severity of drawing and complex rigidity of drapery a depth of religious feeling and human pathos which is his own. They are all executed in the old tempera method, and in the last-named the tragedy of the scene is softened by a new and beautiful effect of romantic sunrise colour. Other works from Giovanni's early period include parts at least of the four triptychs from the church of the Carità, now in the Venice academy, and the polyptych of St. Vincent Ferrer in the church of SS. Giovanni e Paolo. The above-named works are no doubt earlier than the date of Giovanni's first appointment to work along with his brother and other artists in the Scuola di San Marco, where among other subjects he was commissioned in 1470 to paint a "Deluge With Noah's Ark." None of the master's works of this kind, whether painted for the various schools or confraternities or for the ducal palace, have survived. The final triumph of Giovanni Bellini's earlier style is the Pietà in the Brera gallery at Milan.

In a somewhat changed and more personal manner, with less harshness of contour and a broader treatment of forms and draperies, but not less force of religious feeling, are the two pictures of the "Dead Christ Supported by Angels" (in those days one of the master's most frequent themes) at Rimini and at Berlin. Chronologically to be placed with these are two Madonnas, one at the church of the Madonna del Orto at Venice and one in the Lochis collection at Bergamo; devout intensity of feeling and rich solemnity of colour being, as in the case of all these early Madonnas, combined with a singularly direct rendering of the natural movements and attitudes of children.

To the middle of the decade following 1470 must be assigned the great altarpiece of the "Coronation of the Virgin" at Pesaro; and to the beginning of the next decade the "Transfiguration" at Naples and the "St. Francis in Ecstasy" in the Frick collection, New York city. After 1479–80 very much of Giovanni's time and energy must have been taken up by his duties as conservator of the paintings in the great hall of the ducal palace. Besides repairing and renewing the works of his predecessors he was commissioned to paint a number of new subjects, six or seven in all, in further illustration of the part played by Venice in the wars of Barbarossa and the pope. Not a trace of these survived the fire of 1577; neither have any other examples of his historical and processional compositions come down. Of his religious works, including both altarpieces with many figures and simple Madonnas, a considerable number have fortunately been preserved. They show him gradually throwing off the last restraints of the 15th-century manner, gradually acquiring a complete mastery of the new oil medium introduced in Venice by Antonello da Messina in 1475, and mastering with its help all, or nearly all, the secrets of the perfect fusion of colours and atmospheric gradation of tones. The old intensity of pathetic and devout feeling gradually fades away and gives place to a noble, if more worldly, serenity and charm. The enthroned Virgin and Child become tranquil and commanding in their sweetness; the personages of the attendant saints gain in power, presence and individuality; enchanting groups of singing and viol-playing angels symbolize and complete the harmony of the scene. The full splendour of Venetian colour invests alike the figures, their architectural framework, the landscape and the sky.

BY COURTESY OF NATIONAL GALLERY, LONDON

PORTRAIT OF THE DOGE LOREDAN BY GIOVANNI BELLINI. IN THE NATIONAL GALLERY, LONDON

The altarpiece of the Frari at Venice; the altarpiece of S. Giobbe, now at the academy; the "Virgin Between St. Paul and St. George," also at the academy; and the altarpiece with the kneeling doge Barbarigo at Murano, are among the most conspicuous examples. Simple Madonnas of the same period (about 1485–90) are in the Venice academy, in the National gallery, at Turin and at Bergamo. An interval of some years seems to separate the last-named altarpieces from that of S. Corona at Vicenza, a "Baptism of Christ" in a landscape; while that of the church of S. Zaccaria at Venice, which is perhaps the most beautiful and imposing of all, is dated 1505. That of S. Giovanni Crisostomo at Venice, where the aged Saint Jerome, seated on a hill, is raised high against a resplendent sunset background, with St. Christopher and St. Augustine standing facing each other below him, in front, is dated 1513. The examples which remain of Giovanni's activity in the interval between the altarpieces of S. Giobbe and of Murano and that of S. Zaccaria, consist of one allegorical picture in the Uffizi at Florence, and a set of five other allegories or moral emblems, on a smaller scale and very romantically treated, in the academy at Venice. To these should probably be added, as painted toward

the year 1501, the portrait of the doge Loredan in the National gallery, the finest portrait by the master which has been preserved, and in its own manner one of the most masterly in the whole range of painting. Another beautiful work, probably painted about the same time as the S. Zaccaria altarpiece, is the "Madonna of the Meadow" in the National gallery.

The last 10 or 12 years of the master's life saw him besieged with more commissions than he could well complete. Albrecht Dürer, visiting Venice for a second time in 1506, reports Giovanni Bellini as still the best painter in the city, and as full of all courtesy and generosity toward foreign brethren of the brush. In 1507 Gentile Bellini died, and Giovanni completed the picture of the "Preaching of St. Mark" which he had left unfinished. In 1514 Giovanni painted a "Feast of the Gods" for the duke Alfonso of Ferrara which was afterward altered by Titian and is now in the National Gallery of Art, Washington, D.C. He died in 1516.

Both in the artistic and in the worldly sense, the career of Giovanni Bellini was upon the whole the most serenely and unbrokenly prosperous, from youth to extreme old age, which fell to the lot of any artist of the early Renaissance. He lived to see his own school far outshine that of his rivals, the Vivarini of Murano; he embodied, with ever growing and maturing power, all the devotional gravity and much also of the worldly splendour of the Venice of his time; and he saw his influence propagated by a host of pupils, two of whom at least, Giorgione and Titian, surpassed their master. Giorgione he outlived by six years; Titian, as has been shown, challenged an equal place beside his teacher. Among the best known of his other pupils were, in his earlier time, Andrea Previtali, Cima da Conegliano, Marco Basaiti, Niccolò Rondinelli, Pier Maria Pennacchi, Martino da Udine, Girolamo Mocetto; in later time, Francesco Bissolo, Lorenzo Lotto and Sebastiano del Piombo.

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BELLINI, LORENZO (1643–1704), Italian physician and anatomist whose description of the terminal straight uriniferous tubules of the kidneys and their orifices is commemorated by the eponyms Bellini's tubules and Bellini's ducts, was born at Florence on Sept. 3, 1643. He studied at the University of Pisa under F. Redi and G. A. Borelli and, when a mere youth of 19, published *Exercitatio anatomica de structura e usu renum* (1662), in which he showed for the first time that the kidney consists of an immense number of tiny canals. Appointed professor of philosophy, theoretical medicine and anatomy at Pisa in 1663, he stressed the value of urinalysis as an aid to diagnosis (1685), described the organs of taste (1665) and supported iatromathematical theories which were later forgotten. Retiring to Florence in 1693, he became physician to Duke Cosimo III and to Pope Clement XI. He died on Jan. 8, 1704, having achieved both fame and fortune.

(Wr. R. B.)

BELLINI, VINCENZO (1801–1835), Italian opera composer whose chief gift was an ability to create vocal melody at once pure in style and sensuous in expression, usually of an elegiac character. His influence is reflected not only in later operatic composers, even early Wagner, but also in the instrumental music of Chopin and Liszt.

Born at Catania, Sicily, on Nov. 3, 1801, Bellini came of a family of musicians. In 1819 he went, with financial help from a Sicilian nobleman, to study at the Naples conservatory under Nicola Zingarelli. While a student, he attracted the notice of Domenico Barbaia, director of the San Carlo opera, Naples, and La Scala, Milan, who commissioned an opera for Naples. When that proved successful, Bellini graduated to La Scala, where his first important opera, *Il Pirata*, was enthusiastically received in 1827. He was fortunate in having as librettist the best Italian theatre-poet of the day, Felice Romani, with whom he collaborated in his next six operas. Of these the most important are *I Capuletti ed i Montecchi*, based on Shakespeare's *Romeo and Juliet* (Venice, 1830), *La Sonnambula*, an *opera semi-seria* given at one of the smaller Milanese theatres in 1831, and *Norma*, his masterpiece, which was performed at La Scala on Dec. 26, 1831, with Giuditta Pasta in the title part. In 1833 Bellini spent some time in London, where *Beatrice di Tenda* (produced in Venice earlier in the year) was given without much success. In the same year he moved to Paris, where Rossini's influence secured him a commission to compose an opera for the Théâtre Italien. This was *I Puritani*, produced in 1835 with Giulia Grisi, G. B. Rubini, Antonio Tamburini and Luigi Lablache in the cast. Unfortunately an inept libretto has handicapped Bellini's most ambitious and beautiful work. Soon after its production he went to visit an English friend at Puteaux, outside Paris. Never robust in health, he fell ill, and died there, Sept. 23, 1835.

Bellini's fame was so closely bound up with the *bel canto* style of the great singers of his day that it was inevitably eclipsed by the music of the later 19th century with its greater resources of dramatic power and orchestral colour. Bellini was, indeed, no forceful reformer, but with gentle perseverance he did correct some of the grosser abuses of opera in his day. While he subordinates the orchestral accompaniment to the singers and places upon their voices the responsibility for dramatic expression, his harmony is more enterprising than Donizetti's and his handling of the orchestra in introductions and interludes is far from perfunctory. It is, however, for the individual charm and elegance of his luminous vocal melody that Bellini deserves to be remembered. In *Norma* he used his gift to breathe life into the frigid figures of classical opera and created a masterpiece that will always enchant and move an audience whenever singers able to sustain its radiant melody appear.

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BELLINZONA, the political capital of the Swiss canton of Ticino (*q.v.*), lies 105 mi. from Lucerne by the St. Gotthard railway, and 14 mi. from Locarno. The city's population in 1960 was 13,435, mainly Roman Catholic and Italian-speaking. Until 1881 it was joint capital of the canton, with Lugano and Locarno. The old town is built on high ground rising from the level valley floor of the Ticino river a little below the junction of the Val Mesocco. It thus blocked the road from Germany to Italy, and a great wall was built from the town to the river bank. Bellinzona still possesses three picturesque castles (restored in modern times), dating in their present form from the 15th century. They belonged for several centuries to the three Swiss cantons that were masters of the town. The most westerly, Castello Grande (or San Michele), belonged to Uri; the central castle, that of Montebello, was the property of Schwyz; while that of Sasso Corbaro was in the hands of Unterwalden. The church of San Biagio (Blaise) has a remarkable 14th-century fresco, while the collegiate church of SS. Peter and Stephen dates from the 16th century.

Bellinzona is possibly of Roman origin; it is first mentioned in 590. It played a considerable part in the early history of Lombardy, being a key to the St. Gotthard, Lukmanier and San Bernardino passes. In the 8th century it belonged to the bishop of Como, while in the 13th and 14th centuries it was tossed to and fro between the cities of Milan and Como. In 1499 (like the rest of the Milanese) it was occupied by the French, but in 1500 it was taken by Uri. In 1503 the French king ceded it to Uri, Schwyz and Unterwalden. It became in 1798 the capital of the canton Bellinzona of the Helvetic republic, but in 1803 it was united to the newly formed canton of Ticino.

BELLMAN, CARL MICHAEL (1740–1795), Swedish poet, one of the outstanding poet-musicians of the 18th century, was born on Feb. 4, 1740, at Stockholm. The son of a wealthy

civil servant, he studied at Uppsala university and entered the government service, but his salary and a stipend from King Gustav III hardly allowed him to support himself and his family. In early youth, he published religious and satirical works and translations from German and French. By the 1760s, his popular drinking songs and biblical parodies were being sung throughout Scandinavia, circulated by word of mouth, handwritten copies and printed sheets. About 1765, Bellman began to write a cycle of songs, *Fredmans epistlar,* the title alluding to the Pauline epistles which were parodied in the early songs. "Fredman" was conceived as a respected clockmaker who took to drinking and died in poverty. Following the burlesque style of Jean Joseph Vadé and other French writers, Bellman began by adapting minuets, *contredanses* and arias from French musical comedies, in a highly original manner, but several songs in this collection were entirely of his own composition.

Fredmans epistlar was not published until 1790, when it appeared with an introduction by the famous critic J. H. Kellgren. During this time Bellman had strengthened the narrative and dramatic elements in his work, and had added many new figures to his gallery of middle-class Stockholmers. The 82 songs in the final collection reflect his poetic and personal development. Its feeling for nature and vivid characterizations make it unique in Swedish poetry. It was followed in 1791 by *Fredmans sånger,* also a varied collection, but containing mainly drinking songs. *Bacchi tempel* (1783), a poem in alexandrines, contained also some songs and engravings. Bellman died at Stockholm on Feb. 11, 1795. His other works, including plays and occasional poems, were published posthumously. Little known outside Scandinavia, Bellman has had great influence and continued popularity there.

There is a free adaptation in English of Bellman's works in H. W. Van Loon and G. Castagnetta, *The Last of the Troubadours* (1939); and a French prose version by N. Afzelius and P. Volboudt, *Les Épitres de Fredman* (1953). There are also translations into German, *Bellman-Brevier* by H. von Gumppenberg (1909); and *Fredmans Episteln* by F. Niedner (1909).

See N. Afzelius, *Myt och bild. Studier i Bellmans dikt* (1945) and *Bellmans melodier* (1947). (N. A. A.)

BELLO, ANDRÉS (1781–1865), South American poet and scholar, regarded as the intellectual father of South America, was born at Caracas, Venez., on Nov. 29, 1781. His early reading in the classics, particularly Virgil, influenced greatly his literary style and theories. At the University of Caracas he pursued widely divergent courses in philosophy, jurisprudence and medicine. Acquaintanceship with Baron von Humboldt (1799) led to the intense interest in geography so apparent in his later writings. He was friend and teacher of the great South American liberator, Simón Bolívar, with whom he was sent to London in 1810 on a political mission for the Venezuelan revolutionary junta. There Bello elected to stay for 19 years, acting as secretary to the legations of Chile and Colombia, spending his free time in study, teaching and journalism.

In 1829 he accepted a post in the Chilean ministry of foreign affairs, settled at Santiago and took a prominent part in the intellectual and political life of the city. He was named senator of his adopted country and founded the University of Chile (1842), of which he was rector until his death at Santiago on Oct. 15, 1865. Bello was mainly responsible for the Chilean civil code, promulgated in 1855, which was also adopted by Colombia and Ecuador and had much the same influence throughout South America as the Napoleonic code in Europe.

Bello's prose works deal with such varied subjects as law, philosophy, literary criticism and philology. Of the last, the most important is his *Gramática de la lengua castellana* ("Grammar of the Spanish Language," 1847), the leading authority in its field. As a defender of "purisms" in the Spanish tongue, Bello found himself in the midst of a literary polemic carried on through two rival periodicals, one of which was the medium for the romantic ideas of the great Argentinian educator D. F. Sarmiento. Branded as a conservative and under personal attack, Bello withdrew from the fight. Although his movement toward spelling reform finally succumbed against the stone wall of the Spanish Academy, it later did achieve some significant results.

Bello's position in literature proper is secured by his *Silvas americanas,* two poems written during his residence in England, which convey with extraordinary force the majestic impression of the South American landscape. These were published in London (1826–27) and were originally projected as part of a long, never-finished epic poem, *América.* The second of the two, *Silva a la agricultura de la zona tórrida* ("Ode to the Agriculture of the Torrid Zone")—undoubtedly inspired by Bello's contacts with Humboldt—is a poetic description of the products of tropical America, extolling the virtues of country life in a manner reminiscent of Virgil. It is one of the best-known poems in 19th-century Spanish-American letters.

Bello's complete works were issued in 15 volumes by the Chilean government (1881–93). He is the subject of an excellent biography by Miguel Luis Amunátegui (1882).

See also Ernesto Ardura, "El Sabio Andrés Bello," *Américas* (Nov. 1956). (J. C. D.)

BELLOC, (JOSEPH PIERRE) HILAIRE (1870–1953), French-born poet, historian and essayist, was among the most versatile English writers of the first quarter of the 20th century. He was born at La Celle, St. Cloud, on July 27, 1870, the son of a French barrister and his wife, Bessie Rayner Parkes (1829–1925), who was prominent in the early women's suffrage movement. Belloc was educated at the Oratory school, Edgbaston, Birmingham, and then worked as journalist under W. T. Stead. After nine months' military service, as a French citizen, with the artillery at Toul, he entered Balliol college, Oxford, in 1894. He took a first in history, was president of the Union and in 1896 married Elodie Hogan (1870–1914) of Napa, Calif. He was naturalized in 1902 and sat as M.P. for Salford (1906–10), first as a Liberal and then as an Independent.

Verses and Sonnets (1895) and *The Bad Child's Book of Beasts* (1896) launched Belloc on his literary career. His *Danton* (1899) and *Robespierre* (1901) proved his lively historical sense and powerful prose style. This was characterized by strong rhythm and a great felicity in the description of landscape. It was also marred by occasional latinisms. *Lambkin's Remains* (1900) and *Mr. Burden* (1904) showed his mastery of satire and irony. In *The Path to Rome* (1902), perhaps his most enduring work, he interspersed his account of a pilgrimage on foot from Toul to Rome with comments on the nature and history of Europe. No one in his time did more than Belloc to restore the sense of Europe to English letters. Born and brought up a Roman Catholic, he showed in almost everything he wrote an ardent profession of his faith. This coloured with occasional inaccuracy and overemphasis most of his historical writing, which includes *Europe and the Faith* (1920), *History of England,* 4 vol. (1925–31), and a series of biographies ranging in period from *James II* (1928) to *Wolsey* (1930). But he had, in a high degree, the power he so admired in Michelet—that of bringing history to life.

The Four Men (1912) described a walk through Sussex, the county where he made his home; and his love of sailing was vividly illustrated in *The Cruise of the Nona* (1925). Both books were a highly personal mixture of travel and mature reflection on history, philosophy and contemporary events. In political and economic matters Belloc was a follower of William Cobbett. He traced the economic maladies of modern England to the sequestration of monastic and common land by the nobility and mercantile classes, and his efforts were directed toward a more even distribution of wealth.

Belloc will probably, however, be best remembered for his essays and his poetry, especially his lighter verse, such as *The Modern Traveller* (1898) and the *Heroic Poem in Praise of Wine* (1932). His Taylorian lecture *On Translation* (1931) showed critical acumen, and *Belinda* (1928) was something more than a perfect pastiche. He also wrote a number of satirical novels, for which his close friend G. K. Chesterton did the illustrations.

Belloc engaged in much heated controversy, particularly with H. G. Wells, whose *Outline of History* he vigorously attacked, and with the Protestant scholar and historian G. C. Coulton; and this reflected his incapacity to devote himself for very long to

literature in any of its purer forms. But he remains one of the masters of modern English prose, a good poet, and a great literary personality. He died on July 16, 1953, at Guildford, Surrey.

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BELLONA (originally DUELLONA), in Roman cult the goddess of war (*bellum, duellum*), identified with the Greek Enyo. Sometimes known as the sister or wife of Mars, she has been identified with his cult partner Nerio. Her temple at Rome, dedicated by Appius Claudius Caecus (296 B.C.) during a battle with the Samnites and Etruscans, stood in the Campus Martius, near the Flaminian Circus and outside the city's gates. There the senate met to discuss a general's claim to a triumph and to receive foreign ambassadors. In front of it was the *columna bellica,* where the ceremony of declaring war by the *fetialis* (*see* HERALD) took place.

The Asiatic Bellona, whose worship was introduced into Rome from Comana, in Cappadocia, apparently by Sulla during the first Mithridatic war, is to be distinguished from this native Italian goddess. A new temple was built for her and a college of priests instituted to conduct her fanatical rites, at which, wearing black dresses, they lacerated their arms and loins and sprinkled the blood on the spectators.

BELLOTTO, BERNARDO (called CANALETTO) (1720–1780), Venetian view-painter whose carefully drawn scenes of town and country are dark in tone and cold in colour, was born in Venice on Jan. 30, 1720. He studied under his uncle, Canaletto (*q.v.*), and was himself known by that name. He painted scenes of Venice until 1742 when he left the city and, after traveling in Northern Italy for a time, left the country permanently in 1747. He spent the rest of his life at Dresden, in Vienna and in Warsaw, where he became court painter to Stanislaw II of Poland in 1770. His paintings of these northern cities are of a similar character to his uncle's Venetian views but darker and colder in tone and marked by heavy shadows.

Bellotto died on Oct. (?Nov.) 17, 1780, in Warsaw.

See H. A. Fritzsche, *Bernardo Bellotto genannt Canaletto* (1936); R. Pallucchini, *Pittura veneziana del settecento* (1951).
(F. J. B. W.)

BELLOWS, ALBERT FITCH (1829–1883), U.S. painter and etcher, particularly popular for his landscapes, was born at Milford, Mass., Nov. 29, 1829. He first studied architecture, then turned to painting, and worked in Paris and in the Royal Academy at Antwerp. He painted much in England; was a member of the National Academy of Design, and of the American Water Color society, New York city; and an honorary member of the Royal Belgian Society of Water-Colourists. His earlier work was genre, in oils; after 1865 he used water colours more and more exclusively and painted landscapes. Among his paintings are "Afternoon in Surrey" (1868); "Sunday in Devonshire" (1876), exhibited at the Philadelphia exposition; "New England Village School" (1878); and "The Parsonage" (1879). Bellows died in Auburndale, Mass., on Nov. 24, 1883.

BELLOWS, GEORGE WESLEY (1882–1925), U.S. painter, whose characteristic style of broad, fluid brush strokes full of energy and vitality manifested itself in sporting subjects, urban scenes and portraits, was born in Columbus, O., on Aug. 12, 1882, of sober New England and Long Island seafaring stock. Before completing his course at Ohio State university, where he excelled in baseball, his interest in art led him to move in 1904 to New York city, where he became a pupil of Robert Henri. In a remarkably short space of time Bellows developed great facility, as shown in the portrait of his father done during a visit with his family at Christmas time in 1906. His reputation was established the following year with "Forty-Two Kids," a sprawling group of city youngsters scattered over an old dock, diving and swimming. Immediately following this he caused a sensation with a series of prize fight pictures done after enthusiastic visits to Tom Sharkey's club where professional fights were staged. "Stag at Sharkey's" and "Both Members of This Club" showed violent action and a wholehearted robustness that was a new element in U.S. art. Thomas Eakins had depicted the prize ring realistically but in completely static renderings. During Bellows' early years in New York he was associated with the group known as The Eight and was later active in the organization of the Armory show.

Bellows was interested in charming and gaily painted groups of women and children, in parks or skating, as well as in city and river scenes. His wife Emma and his daughters Anne and Jean, either singly or as a group, were frequent models, "Emma and Her Children" and "Lady Jean" being two of his most noted canvases. Another subject that he treated with both sympathy and character was old age. "Mrs. T. in Cream Silk," "Aunt Fannie" and "My Mother" show the dignity of age, which no one but Eakins had treated so admirably since John Singleton Copley.

In 1916 Bellows took up lithography and became almost as well-known in this medium as in painting. His numerous drawings show, also, his fine ability as a draftsman. He died in New York city on Jan. 8, 1925.

See *George Bellows: a Retrospective Exhibition,* National Gallery of Art (1957). (F. A. Sw.)

BELLOWS, an appliance that produces a current of air through compression of a collapsible bag or receptacle into which air has been admitted. Bellows were used as early as the period of the Greek occupation of Egypt.

The modern bellows consists, in its simplest form, of two flat boards of rectangular, circular or pear shape, connected around their edges by a wide band of leather so as to include an air chamber whose volume can be increased or diminished by separating the boards or bringing them closer together. The leather is kept from collapsing, on the separation of the boards, by wire rings. The lower board has a hole in the centre, covered inside by a leather flap or valve that can only open inward; there is also an open outlet, generally in the form of a pipe or nozzle, the aperture of which is much smaller than that of the valve. When the upper board is raised air rushes into the cavity through the valve to fill up the partial vacuum produced; when the upper board is depressed the valve is closed by the air seeking an outlet, and this air is discharged through the open nozzle with a velocity depending on the pressure exerted.

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART, GIFT OF THE MEMBERS OF THE COMMITTEE OF THE BERTHA KING BENKARD MEMORIAL FUND, 1946

AMERICAN LACQUERED BELLOWS, EARLY 19TH CENTURY

To avoid the drawback of an intermittent discharge of air, the double bellows are used. To understand their action it is only necessary to conceive an additional board with valve, like the lower board of the single bellows, attached in the same way by leather below this lower board. Thus there are three boards, forming two cavities, the two lower boards being fitted with air valves. The lowest board is held down by a weight and another weight rests on the top board. In working these double bellows the lowest board is raised, driving the air from the lower cavity into the upper. On lowering the bottom board again a fresh supply of air is drawn in through the bottom valve, to be discharged again when the board is raised. As the air passes from the lower to the upper cavity it is kept from returning by the valve in the middle board, and in this way a quantity of air is sent into the upper cavity each time the lowest board is raised. The weight on the top board provides the necessary pressure for the blast, and at the same time causes the current of air delivered to be fairly continuous.

BELL ROCK (INCHCAPE), a sandstone reef in the North sea, stands 12 mi. S.E. of Arbroath, Angus, Scot. It measures 2,000 ft. in length, is under water at high tide, but at low tide is exposed for a few feet, the sea for a distance of 100 yd. around being then only three fathoms deep. Lying in the fairway of vessels making or leaving the Tay and Forth, besides ports farther north, it was a constant menace. In the great gale of 1799, 70 sailing ships were wrecked off the reef; the next year Robert Stevenson (1772–1850), grandfather of R. L. Stevenson, modeled a tower and reported that its erection was feasible, but parliamentary powers were only obtained in 1806 and operations began in Aug. 1807. Though John Rennie had meanwhile been associated with Stevenson as consulting engineer, the design and details are wholly Stevenson's work. The tower is 100 ft. high; its diameter at the base is 42 ft., decreasing to 15 ft. at the top. It is solid for 30 ft. at which height the doorway is placed.

A bust of Stevenson by Samuel Joseph (d. 1850) was placed in the tower. According to tradition an abbot of Aberbrothock (Arbroath) had ordered a warning bell—whence the name of the rock—to be fastened to the reef so as to respond to movements of the waves. This was destroyed by Sir Ralph the Rover, whose ship was afterward wrecked at this very spot. Sir Ralph and his men being drowned. Robert Southey made the incident the subject of his ballad of "The Inchcape Rock."

BELLUNO, a city of northeastern Italy in the district of Veneto, capital of the province of Belluno, lies in the valley of the upper Piave at its confluence with the Ardo in the Dolomites 114 km. (71 mi.) N.N.E. of Padua by road. Pop. (1957 est.) 30,344. The 16th-century cathedral was partly rebuilt after an earthquake in 1873; in the Piazza del Duomo are the town hall, the Renaissance Palazzo dei Rettori, and the museum in a 17th-century building. The church of S. Pietro contains a high altarpiece by Sebastiano Ricci (1659–1734), a native of Belluno; outside the 15th-century church of S. Stefano is a Roman sarcophagus. Agriculture and the tourist trade provide the chief occupations. Of pre-Roman origin, the city was known to the Romans as Bellunum. It joined Venice voluntarily in 1405 and remained Venetian until taken by the French in 1797. It passed to Austria in 1813 and became part of the Italian kingdom in 1866. In World War II it was captured by the Allies in April 1945.

BELLWORT (*Uvularia*), the name given to a group of handsome woodland plants of the lily family, native to eastern North America. There are five or six species, all low perennials with slender, creeping root stocks which send up leafy stems from 6 to 20 in. high, bearing large pale yellow flowers, usually solitary and drooping at the ends of the branches, and blooming from April to June.

The most conspicuous is the large-flowered bellwort (*U. grandiflora*). This bears ovate leaves, somewhat hairy below when young, and narrowly bell-shaped, lemon-yellow, six-parted flowers about one and one-half inches long. It is found from Quebec westward to Minnesota and southward to Georgia and Kansas. The somewhat smaller perfoliate bellwort (*U. perfoliata*), with more pointed leaves, which are smooth below, occurs from Quebec and Ontario south to Florida and Mississippi. In the two foregoing species the leaves appear as if impaled upon the stem (perfoliate). The other much smaller species, by some authorities regarded as belonging to the genus *Oakesia*, have sessile leaves. The sessile-leaved bellwort (*U. sessilifolia*) ranges from New Brunswick to Minnesota and south to Georgia and Arkansas. The mountain bellwort (*U. puberula*) is restricted to the mountains of Virginia, West Virginia and North Carolina, while the delicate *U. floridana* is found only in central Florida.

BELMONT, AUGUST (1816–1890), U.S. banker and diplomat, was born at Alzey, Rhenish Prussia, Dec. 8, 1816. At 14 he entered the banking house of the Rothschilds at Frankfurt am Main and later transferred to the Naples office. In 1837 he moved to New York, opened a small office on Wall street where he served as American agent for the Rothschilds and laid the foundations for the banking house of August Belmont & Co. He took an active interest in politics as a Democrat. From 1853 to 1855 he was chargé d'affaires for the United States at The Hague and from 1855 to 1858 he served as resident minister there. He was opposed to slavery and supported Stephen A. Douglas, but after the American Civil War began he became a loyal supporter of President Lincoln, exerting strong influence upon merchants and financiers in England and France in favour of the Union. He died in New York on Nov. 24, 1890.

His eldest son, PERRY BELMONT (1851–1947), was a member of congress (1881–88) and became U.S. minister to Spain in 1888–89. Another son, August Belmont (1853–1924), took a prominent part in financing and building the New York subway.

See A. Belmont, *A Few Letters and Speeches of the Late Civil War* (1870); R. J. H. Gottheil, *The Belmont-Belmonte Family* (1917).
(R. E. AT.)

BELO HORIZONTE, a city of southeast Brazil, capital of Minas Gerais state. Pop. municipality (1950) 352,724; city, 338,585. Lying at 2,811 ft. above sea level, it has an annual average temperature of 68° F. and about 60 in. of rainfall.

Belo Horizonte was inaugurated as Cidade de Minas in 1897, succeeding Ouro Prêto as capital of the state; its present name was adopted in 1901. Belo Horizonte, built on a plateau, was created on a plan approximating the pattern of Washington, D.C. Affonso Penna, chief executive of the state and subsequently president of the republic, had an important role in the development of the city. Belo Horizonte is located near the centre of the state with an area for expansion and is separated from the most heavily populated districts by the Serra do Espinhaço. The city is situated north and west of this uplift, while most of the state's inhabitants live to the south and east of the barrier.

Belo Horizonte is an attractive city, carefully planned and executed with many impressive buildings. It is the seat of the University of Minas Gerais. The city is a centre for important agricultural and mining industries, as well as diamond cutting. An increasing number of industrial establishments are found on its periphery, including chemical plants, furniture factories and food-processing plants. Cotton for textile mills is supplied from the São Francisco valley. Belo Horizonte can be reached from Rio de Janeiro, a distance of about 375 mi., by air, rail or automobile.
(J. L. TR.)

BELOIT, a city of Rock county, Wis., U.S., at the confluence of Rock river and Turtle creek 70 mi. S.W. of Milwaukee. (For comparative population figures *see* table in WISCONSIN: *Population.*)

Beloit was settled in 1837 by the New England Emigrating company, on land obtained from Caleb Blodgett, who had previously purchased it from trader Joseph Thibault at the conclusion of the Blackhawk War. It was incorporated as a city in 1856. The village early pledged labour, land and money to bring a college to its site, and Beloit college was founded in 1846–47. After mid-20th century the college enrolled about 1,000 students annually.

The town developed as an industrial site, and centre of a rich farming and dairy area. Industrial plants in Beloit manufacture such products as air conditioning equipment, pumps, knives, paper and paper boxes, grinders, taps, dies, punch presses, rotary ovens, shoes, stokers, refrigerating units, light plants, radiators, hosiery and gloves, farm engines, electric brakes, machine-precision tools and paper-making machinery. (R. H. I.)

BELON, PIERRE (1517–1564), French naturalist and the first to indicate the homologies between the bones of the bird and human skeletons, was born near Le Mans in 1517. He received a medical degree at Paris, studied botany under Euricius Cordus at Wittenberg, and traveled as far as Syria and Egypt. In 1564 he was murdered in Paris. Belon's writings include *Les Observations de plusiers singularités et choses mémorables trouvées en Grèce, Asie, etc.* (1553), an account of his travels; *De aquatilibus* (1553), which describes and figures various animals that live in water; and *L'Histoire de la nature des oyseaux* (1555), one of the finest 16-century ornithological works. It illustrates, classifies and describes, with many original observations, about 200 birds.

See accounts of Belon in *Dictionnaire biographique française* (1951) and in L. C. Miall, *The Early Naturalists* (1912). (J. W. TI.)

BELORUSSIAN SOVIET SOCIALIST REPUBLIC (Belorusskaya Sovetskaya Sotsialisticheskaya Respublika; also Belorussia, Byelorussia or, as it is often known, White Russia) is one of the 15 constituent republics of the U.S.S.R. It covers an area of 80,154 sq.mi., and is bounded on the north and east by the Russian Soviet Federated Socialist Republic, on the south by the Ukrainian Soviet Socialist Republic, on the west by Poland and on the northwest by the Lithuanian and Latvian Soviet Socialist Republics.

Physical Geography.—The physical geography of Belorussia bears evidence of the Ice Age. The limit of the last advance of the ice-sheet lay across the territory of the modern republic and is marked by a line of terminal moraines, known as the Belorussian ridge (Belorusskaya Gryada). This ridge runs west-southwest to east-northeast from the Polish frontier north of Brest toward Smolensk and consists of low, rolling hills. Transverse river valleys cut the ridge into a series of uplands, the sequence being: Volkovysk upland, Shchara valley, Novogrudok upland, Neman valley, Minsk upland, Berezina valley, Orsha upland, Dnieper valley and a final group of uplands along the eastern boundary. The highest group is the Minsk upland, which reaches 1,168 ft. in Gora Dzerzhinskaya and 1,135 ft. in Gora Lysaya.

North and south of the ridge lie extensive lowlands. To the south is the broad, shallow trough known as Polesye (Polesic) which is drained by the Pripet (Pripyat) and its tributaries. These flow eastward to join the Dnieper (*q.v.*) which crosses the eastern part of Polesye from north to south. The trough of Polesye collected the meltwater of the ice sheet and great quantities of material were deposited in the form of sands, lake clays, etc. These deposits, together with the flatness of the lowland, hamper drainage and have caused the formation of very extensive swamps (Pripet marshes) through which the rivers wind sluggishly. Spring floods are widespread, and along the Pripet often extend for ten miles on either side of the river.

North of the Belorussian ridge lie two more large lowlands: the Neman lowland, drained by the river of that name, in the northwest, and the Polotsk lowland, drained by the Western Dvina, in the north. These two lowlands are separated by two morainic ridges, the Oshmyany and Sventsyany (Švenčionys) ridges, with the Viliya (Neris) valley between them. The former ridge rises to 1,060 ft. This, with the Minsk and Novogrudok uplands, are the only areas of Belorussia to exceed 1,000 ft. The two northern basins contain many lakes of glacial origin, the largest of which is Lake Naroch. Thus Belorussia falls into three main drainage basins, the Dnieper-Pripet basin draining to the Black sea, and the Neman and Western Dvina basins, draining to the Baltic. (*See* also Dnieper; Dvina, Western.)

The continental climate is relatively moderate and humid with temperatures averaging 20° F. in January and 65° in July. Annual precipitation is 20–24 in. The whole area lies in the zone of mixed forest, with podsol soils dominant. Although great inroads have been made for centuries into the natural forest cover, about 29% of the area of Belorussia remains forested. The largest forests are in Polesye, where many parts are more than 50% forested. Pine is the commonest tree, occurring on the widespread sands of glacial origin. Birch is ubiquitous, while alder is very common in wetter areas. Spruce, widely found in the north, tends to die out southward and is rarely found south of the Pripet. Oak and hornbeam are the commonest hardwoods, although they make up only 5% of all forests. Maple, elm, ash and linden also occur. In the west, on the Polish frontier, is the Belovezh forest (*q.v.*), one of the largest surviving areas of primeval forest in Europe, noted for its wide range of flora and fauna. There a large reservation has been established. Along the rivers are extensive flood plain meadows, with damp clay soils. The largest swamp and bog areas occur in the south, in Polesye, and are mostly of the "lowland" type, with a vegetation of reeds, sedges and grasses, often with areas of swamp-forest of willow, alder and birch. Sphagnum bogs are less frequent (only about 14% of the total swamp area) and are found mainly in the north and central areas of Belorussia.

Of the fauna of Belorussia undoubtedly most interesting is the *zubr*, or European bison, the last survivors of which are found in the Belovezh forest reservation. Elk, beaver, wolf, fox, hare, wild pig, marten, deer and even a rare brown bear are all to be found.

History.—The Belorussian region has long been settled by man. Archaeology provides evidence of prehistoric cultures as early as the Magdalenian, while Neolithic remains are widespread. One theory holds that the original home of the Slav peoples was in the marshes of Polesye and, although it is more widely believed that the Slavs originated farther to the southwest, between there and the Carpathians, there is no doubt that the Belorussian area was one of the earliest to be settled by Slavs (*q.v.*). The early Slavic tribes, the Dregovichi, Radimichi, Krivichi and Drevlyane, had formed petty princedoms by the 8th–9th centuries A.D., such as those of Pinsk, Turov, Polotsk, Slutsk and Minsk. These all came, in time, under the general suzerainty of Kiev. The economy of the period was based on primitive, shifting agriculture on burned-over forest land, and on honey collecting. Along the rivers trade developed, particularly on the Dnieper, part of the "Water road" from Kiev to Novgorod. Along the rivers towns began to develop, most of the Belorussian towns being founded by the end of the 12th century. Polotsk and Turov are two of the earliest-mentioned towns of Slavic foundation—862 and 980. Brest is first recorded in 1017 and Minsk in 1067.

With the overthrow of Kiev by the Tatars in 1240, Kievan Rus broke up. Many of the Belorussian towns were laid waste. Almost all this area passed to the control of Lithuania. Although most of the aristocracy was Lithuanian and pagan, a number of Russian and Orthodox nobles remained as feudatories of the grand duke. Throughout the 13th and 14th centuries the power of Lithuania increased, encompassing Smolensk and Kiev and even reaching the shores of the Black sea. In 1386 the Lithuanian and Polish ruling houses were united under the Jagiellon dynasty and Catholicism became the official religion of Lithuania. Between Lithuania-Poland and the rising power of Muscovy there was an incessant and bitter struggle for this area. Although during the 15th and early 16th centuries the steppe areas and the region around Smolensk were lost to Moscow, Belorussia remained under Lithuanian control. During the 16th century a code of laws was drawn up, known as the Lithuanian statutes, defining civil and property rights. However, only the aristocracy and merchants derived any advantage. The position of the peasants became increasingly that of serfs.

In 1569 the Lublin union made Poland and Lithuania one state, although Lithuania retained its title of grand duchy and its code of laws. In Belorussia a mainly Polish-speaking, Roman Catholic aristocracy developed, although the peasants on the whole remained Orthodox. In 1596 the Union of Brest established the Uniate Church, but this made relatively little headway among the Orthodox. The rule of the Polish landowners was not popular and gave rise to a large-scale revolt in 1648–54, but Belorussia remained under Poland until the reign of Catherine the Great. Economic development was slight and the Belorussian population was almost entirely engaged in primitive agriculture. Trade lay in the hands of Poles and Jews. Conditions were particularly backward in the swamps of Polesye.

By the first partition of Poland, in 1772, Catherine the Great acquired eastern Belorussia, including the towns of Vitebsk, Mogilev and Gomel. The second partition (1793) gave Russia Minsk and all the central part, and in 1795 the third partition united the remainder of present-day Belorussia to the Russian empire. The area was divided administratively among the governments (*i.e.*, provinces) of Minsk, Mogilev, Vilnius and Vitebsk. Under the tsarist rule the Uniate Church was persecuted and many of its members became Orthodox. In 1812 Napoleon crossed Belorussia in his advance on Moscow and again during his retreat. The forcing of the Berezina river (*q.v.*) was one of the heaviest battles of the campaign.

The 19th century saw the beginning of industrial growth in the towns of Belorussia, largely based on local supplies: timber working, glassmaking and boatbuilding along the rivers. Following the emancipation of the serfs in 1861 the tempo of industrialization increased, particularly with the coming of the railways, from

the 1880s on. Nevertheless the area remained economically backward to 1917, particularly in rural areas. This resulted in considerable emigration, nearly 1,500,000 persons leaving Belorussia during the 50 years before the Russian Revolution. Most of the emigration was to the United States or to Siberia: between 1896 and 1915 more than 600,000 persons migrated to Siberia. In 1898 the first congress of the Russian Social Democratic Revolutionary party was held in Minsk, founding the Marxist party in Russia. The house where the congress was held is preserved as a museum.

In World War I heavy fighting took place in Belorussia, with great destruction. The peace treaty between the Soviet revolutionary government and the Germans was signed in Brest in March 1918. On Jan. 1, 1919, the revolutionaries proclaimed the founding of the Belorussian Soviet Socialist Republic, but fighting continued between the Soviets and the Poles. In 1919 the Poles advanced east to the Berezina, only to be thrown back again. Peace was finally achieved in March 1921 by the treaty of Brest, which divided Belorussia between the U.S.S.R. and Poland. The frontier was the same as that following the first partition. In 1924 the regions of Polotsk, Vitebsk, Orsha and Mogilev were added to the original Belorussian S.S.R. and in 1926 Gomel was included.

In 1939, after the German attack on Poland, the U.S.S.R. entered Poland from the east, occupying all Belorussia up to the Bug river and including the Bialystok region. In June 1941 the German attack on the Soviet Union rapidly overran Belorussia, although the garrison of the Brest fortress made a prolonged and courageous stand. Heavy fighting once more devastated the area during the German retreat and a number of major engagements took place, notably at Vitebsk, Minsk and Borisov. Damage to property and to the economy in the war years was grievous, and many towns, including Minsk, were almost entirely destroyed. Seventy per cent of the housing in the republic and more than 10,000 industrial undertakings were destroyed. After the war, in 1945, a treaty between the U.S.S.R. and Poland left western Belorussia in Soviet hands, with the exception of the Bialystok (*q.v.*) region which was returned to Poland. The Polish population of these areas was transferred en masse to Poland. With the establishment of the United Nations, the Belorussian S.S.R. was given a seat in the general assembly of that body.

Population, Administration and Social Conditions.—The population of Belorussia by the census of 1959 was 8,060,000. Belorussians accounted for 6,444,000 or 80.0% of these, while the next largest nationality groups were Russians (729,000—9.1%), Poles (539,000—6.7%), Jews (150,000—1.9%) and Ukrainians (150,000—1.9%). In addition to the Belorussians living in the republic, there are about 1,297,000 Belorussians living elsewhere in the U.S.S.R., of which the largest groups are 845,000 in the R.S.F.S.R., 291,000 in the Ukraine, 108,000 in the Kazakh S.S.R. and 102,000 in the Baltic republics.

The number of *oblasts* of the republic has been steadily reduced since 1945 and the abolition of Molodechno *oblast* in 1960 reduced them to six. These administrative divisions are Minsk, Vitebsk, Gomel, Mogilev, Brest and Grodno (*qq.v.*). The Supreme Soviet, elected in 1959, consisted of 407 deputies (1 per 20,000 population).

A much higher proportion of the population is rural than in the U.S.S.R. as a whole: 69% as against the all-Union figure of 52%. The major towns are Minsk, the capital (509,000), Gomel (166,000), Vitebsk (148,000), Mogilev (121,000), Bobruisk (97,000), Brest (73,000), Grodno (72,000) (*qq.v.*), Orsha (64,000), Borisov (59,000) (*q.v.*), Pinsk (*q.v.*) and Molodechno. In all, Belorussia has 69 towns and 115 urban districts ("urban and workers' settlements"). There are more than 32,000 villages and rural settlements. These are in general of medium or small size, averaging 50 households; more than half have fewer than 30 households. Only in the swamps of Polesye are villages larger, being concentrated on the patches of dry land. The trend to dispersed settlement of isolated farmsteads, which developed widely between 1861 and the Revolution, has been reversed and the peasants resettled in compact villages. Dispersed settlement remains common in the western areas, which were Polish up to 1939.

Industrial and other developments since World War II have done much to improve the very backward social conditions of Belorussia, although in many respects the republic still lags behind the other Union republics. In the early 1960s there were nearly 11,000 doctors and 1,000 hospitals and medical stations, providing about 52,000 beds. Despite progress, the Belorussian figures for doctors and beds remain below the national averages of 17.9 and 76.2 per 10,000 people. Education has also made great strides, and illiteracy, which was widespread in 1917, has been almost abolished. The republic has its own Academy of Sciences, founded in 1928, and a university, both located in Minsk. Many higher educational and technical institutions have been set up. Libraries and cinemas have been built in towns and rural areas. Both Belorussian and Russian are recognized as official languages.

The Economy.—Belorussia has a single council of national economy which was formed in 1958. Industry is primarily based on local raw materials, particularly from agriculture and the forests. Food-processing industries are found everywhere, in large and small towns alike. Flour milling, milk processing, butter- and margarine-making, meat packing, fruit and vegetable canning and jam and honey making are the major branches of this sector of the economy, which provides one-third of Belorussian industrial production. The forests are intensively exploited and the annual cut of timber significantly exceeds regeneration. Saw-timber and furniture are produced everywhere, while the two chief centres, Borisov and Bobruisk, together with the other main towns, produce a range of timber products: matches, paper and pulp, veneer, joinery and prefabricated houses. Equally widespread throughout the republic are the textile and footwear industries. The greatest concentration of the textile industry is in Vitebsk *oblast*, based on local flax, and centred on Orsha. Since the Russian Revolution engineering and metalworking have become very important in the larger towns and now occupy third place in industrial production, after food and textiles. Minsk supplies tractors and heavy commercial vehicles to all parts of the U.S.S.R. Gomel, Bobruisk and Lida make agricultural machinery; machine tools are manufactured in Minsk, Gomel, Vitebsk, Borisov and Baranovichi; while Gomel, Rechitsa, Bobruisk and Pinsk build river craft. The small but growing chemical industry produces wood chemicals and fertilizers. The glass industry, once widespread in Belorussia, is now concentrated in a few centres of large-scale production, notably Kostyukovka and Borisov. Power for industry comes largely from thermal generating stations, many of which operate on peat from the wide bog areas and on timber waste.

The climate and poor podsol soils are not suited for cereals, and livestock husbandry, particularly of cattle and pigs, is usually dominant, especially in the lowlands with their abundant pasture. Milk, meat and other dairy products are important. The highest proportion of arable land is found on the morainic uplands, and rye, wheat, buckwheat and barley are grown. Flax is widely grown, especially in the northern half of the republic. In the south, hemp, to some extent, replaces flax. Potatoes are a very important crop for human and animal consumption and for industrial purposes. Near Minsk is an area of intensive market gardening. In Polesye drainage operations have been undertaken in many areas and the peaty soils reclaimed give high yields.

Belorussia is well served by a relatively dense railway network. It lies on trunk rail and road links between Moscow and Warsaw. The Dnieper and Pripet are navigable and the latter is joined by the Dnieper-Bug canal to the Vistula river system of Poland. The Western Dvina and Berezina can take small craft and rafts.

(R. A. F.)

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BELOVEZH FOREST (BELOVEZHSKAYA PUSHCHA; Polish PUSZCZA BIALOWIESKA) is located in Brest and Grodno *oblasts* (provinces) of the Belorussian Soviet Socialist Republic, U.S.S.R., and in the Bialystok voivodship (province) of eastern Poland, in the drainage area of the headstreams of the Narev and Lesna, tributaries of the Western Bug. The forest is remarkable as one of the largest remaining areas of primeval mixed forest in Europe,

with a wide range of flora from western and eastern Europe. Trees include pine, spruce, oak, hornbeam, birch, elm and alder in various associations. Some trees are of very great size, one oak reaching 138 ft. in height. Along the rivers are swampy forest and meadow. The fauna (47 species of mammals and 181 of birds) include the elk, wild boar, lynx, deer and wolf and also the last survivors of the *zubr*, or European bison, the number of which is increasing after the grave depletions of World War II. Both Poland and the U.S.S.R. have established large nature reserves there. Bialowieza village in Poland, with the ruins of the tsar's hunting lodge, is a centre for tourists and scientists. (R. A. F.)

BELOVO, a town of Kemerovo *oblast* (province) of the Russian Soviet Federated Socialist Republic, U.S.S.R., lies on the small Bachat river, a tributary of the Inya. Pop. (1959) 107,000. It has become one of the more important coal mining centres of the Kuznetsk basin. A large zinc works, built in 1931, uses local ore from the Salair ridge and concentrated ore from Kazakhstan. A thermal electric plant has a capacity of 1,300,000 kw. Belovo lies on the axial railway of the Kuznetsk basin, from Novokuznetsk to Novosibirsk, at the junction with a branch line to Guryevsk. (R. A. F.)

BELPER, an urban district and market town of Derbyshire, Eng., lies on the east bank of the river Derwent, 7 mi. N. of Derby by road or rail. Pop. (1961) 15,563. Area 6.7 sq.mi. Edmund Crouchback, son of Henry III, held the manor and founded the church. His hunting seat there is said to have been called Beaurepaire or Bellerepaire, from which the name Belper may derive. The most famous name in Belper's industrial history is that of Strutt; Jedediah Strutt (*q.v.*), the inventor of a ribbing machine, built the town's first cotton mills about 1780. The staple trade, once nails, is cotton and hosiery, but the manufacture of food products and engineering are also carried on. There are river gardens and a boating station on the Matlock road.

BELSHAZZAR (Bel-shar-usur; Gr. Baltasar or Balthasar) (d. 539 B.C.), the coregent of Babylon who was killed at the capture of the city by the Persians. Until 1854 he was known only from the Old Testament narrative as told in the book of Daniel and from classical allusions to his reign, but from that year onward a number of references to Belshazzar were found in contemporary Babylonian inscriptions. In the accession year of Neriglissar (560–559 B.C.) he already held an important administrative post as a royal official. He was the eldest son of Nabonidus, who later became king of Babylon (556–539 B.C.), and of Nitocris, perhaps a daughter of Nebuchadrezzar II. This may account for the references in the book of Daniel to Belshazzar as "the son (*i.e.*, grandson) of Nebuchadrezzar." About 550 B.C. Nabonidus moved with part of the army to Tema (Taimah) in northern Arabia where he remained an exile for ten years. He handed over the major part of the army to the crown prince Belshazzar "and entrusted the kingship to him" (Nabonidus chronicle). During his coregency, documents continued to be dated by the regnal years of Nabonidus, though there may well have been a local practice of naming the years by Belshazzar's reign. Belshazzar continued to administer both the government and his own private estates as well as those of the king during the absence of Nabonidus, with whom he kept in touch by camel caravan. There was famine in the land and economic setback for a few years prior to the return of Nabonidus, *c.* 540 B.C.

The story of Belshazzar's feast and death is known only from the book of Daniel (ch. v) and from Xenophon's *Cyropaedia* (vii, 5). His death occurred after the city of Babylon had fallen to the Persian general Gobryas without resistance on Oct. 12, 539 B.C., and probably before Cyrus entered the city 17 days later. The Nabonidus chronicle reports the capture of Nabonidus when he returned to the city soon afterward. *See* Babylonia and Assyria.

See R. P. Dougherty, *Nabonidus and Belshazzar* (1929). (D. J. Wi.)

BELT AND PULLEY: *see* Pulley and Belt.

BELTANE (Beltene, Beltine or Beal-Tene) (Scot.-Gael. *bealltain*), the Celtic name for May day, on which was held a festival originally common to all the Celtic peoples. The most important ceremony in later centuries was the lighting of the bonfires known as beltane fires, which is believed to represent the druidical worship of the sun-god. He who had the misfortune to get the charcoal-blackened bit of the cake cooked at the fire became *cailleach bealtine* (the beltane carline), a term of great reproach.

In the northeast of Scotland beltane fires were still kindled in the latter half of the 18th century. Cormac, archbishop of Cashel about the year 908, furnishes in his glossary the earliest notice of the custom. The Highlanders have a proverb, "He is between two beltane fires."

The derivation of the word beltane is obscure. Following Cormac, it was once usual to regard it as a combination of the name of the god Bel or Baal or Bil with the Celtic *teine*, "fire." Theories thereby connecting the Semitic Baal with Celtic mythology are now repudiated by philologists.

See John Ramsay, *Scotland and Scotsmen in the 18th Century* (1888); A. Macbain, *Celtic Mythology and Religion* (1917).

BELTRAFFIO (Boltraffio), **GIOVANNI ANTONIO** (1467–1516), Italian painter of the Lombard school, influenced by Leonardo da Vinci. He belonged to a distinguished Milanese family and occupied important civic posts in his native town, painting as an accomplished amateur rather than as an artist by profession. His epitaph, which was removed from S. Paolo in Compito in Milan to the Archaeological museum, states that in his early youth he studied painting but in his later years was occupied with other work besides art. Leonardo came to Milan in 1485 and Beltraffio became one of his ardent followers, conforming closely to his master's designs in his early work. He was a distinguished portraitist.

In 1500 he was commissioned to paint an altarpiece (now in the Louvre) for the church of the Misericordia, near Bologna, by Giacomo Casio, a merchant and poet, whose portrait Beltraffio painted several times (Chatsworth, Eng.; Brera gallery, city of Milan). The National gallery, London, possesses a "Madonna and Child" which, according to Morelli, is the master's best work, two pictures from the Salting Bequest and a portrait from the Mond collection. Other works are in Milan (Brera gallery and Poldi-Pezzoli collection), Bergamo and in the Borromean palace on the Isola Bella. In Rome he painted a fresco in the church of S. Onofrio representing the "Madonna With the Founder" (1513). In the nuns' choir of San Maurizio, Milan, are 26 medallions of holy women painted in fresco by Beltraffio. His drawings can be studied in the Ambrosiana, Milan.

BELUGA (White Whale), a cetacean, *Delphinapterus leucas*, of the suborder Odontoceti (toothed whales), inhabiting arctic seas, where it is plentiful, and extending south to the Gulf of St. Lawrence and Cook inlet in Alaska. It reaches a length of 18 ft., is white with gray dapplings and has no back fin. Its voice, unlike that of many cetaceans, is audible to human ears and its liquid, musical trill gave it the name of "sea canary" among the old arctic whalers. The voice is probably used, as in many other whales, for echo-location. The food includes squids and fish; a single calf is born annually. *See* also Whale. (L. H. M.)

BELVEDERE (Belvidere), an architectural structure built in the upper part of a building or in any elevated position to command a fine view. The belvedere assumes various forms, such as an angle turret, a cupola, a loggia or open gallery. The name is sometimes applied to the whole building, as the Belvedere gallery in the Vatican at Rome, or the Belvedere palace in Vienna.

BELY, ANDREI (real name Boris Nikolaevich Bugaev) (1880–1934), a leading Russian Symbolist poet, novelist and critic, was born in Moscow, Oct. 26 (new style; 14, old style), 1880, the son of a professor of mathematics. Bely studied first natural sciences and then philosophy and philology at Moscow university. Influenced by Vladimir Soloviev, Kant, Schopenhauer and Nietzsche, he later became a follower of Rudolf Steiner. His best volumes of poetry are *Zoloto v lazuri* ("Gold in Azure," 1904), *Pepel* ("Ashes," 1909), *Urna* ("The Urn," 1909) and a charming autobiographical poem, *Pervoe svidanie* ("First Meeting," 1921). His prose fiction, even more important, includes the four experimental novels which he called *Simfonii* (1902–08), in which he applied

the principles of musical composition to prose narrative, and several others, of which *Serebryany golub* ("The Silver Dove," 1909), *Peterburg* (1913; Eng. trans. 1959) and *Kotik Letaev* (1922) are the most significant. Bely's bold experiments in narrative technique, especially in *Peterburg* and *Kotik Letaev* (which offered some parallels with James Joyce and reflected Steiner's teachings) strongly influenced younger postrevolutionary writers. While away from Russia (1912–16), he took part in the building of Steiner's anthroposophic temple at Dornach, near Basel. Of the books he wrote after his return from a short time as an *émigré* in Berlin (1922–23), his three volumes of memoirs (1929–37), though erratic and unreliable, are the most interesting. His most important critical works are *Simvolizm* (1910), his essay on Gogol in *Lug zelëny* ("The Green Meadow," 1910), his book on Lev Tolstoi and Dostoevski (1911), on Pushkin's *Medny vsadnik* (1929) and on Gogol's art (1934). He died in Moscow, Jan. 7, 1934.

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BELZONI, GIOVANNI BATTISTA (1778–1823), Italian showman, engineer and explorer of Egyptian antiquities, was born at Padua on Nov. 15, 1778. He went to England in 1803 and, by means of his gigantic physique, earned a living in circuses in England, Spain and Portugal. In 1815 he went to Cairo to offer to Mohammed Ali pasha, the founder of modern Egypt, a hydraulic machine which he had invented. Through the British consul general, Henry Salt, Belzoni went to Thebes to remove the colossal head of Rameses II ("the Young Memnon") for the British museum. He then explored the temple of Edfu, visited Philae and Elephantine and cleared the great temple of Rameses II at Abu Simbel. He excavated at Karnak and, in 1817, discovered in the Valley of the Kings the tomb of the pharaoh Seti I, containing the aragonite sarcophagus sent to Sir John Soane's museum. Belzoni was the first to penetrate into the second pyramid of Giza (1818) and the first modern European to visit the oasis of Siwah. He also identified the ruined city of Berenice on the Red sea. He returned to England in 1819, and published in 1820 his *Narrative of the Operations and Recent Discoveries Within the Pyramids, Temples, Tombs and Excavations, in Egypt and Nubia . . .* (2 vol., atlas of plates, 3rd ed., 1822). In 1823 Belzoni set out for Timbuktu in west Africa, but died at the village of Gwato, near Benin, Nigeria, on Dec. 3, 1823. In 1825 his widow exhibited in Paris and London his drawings and models of the royal tombs of Thebes. (W. R. D.)

BEM, JOZEF (1794–1850), Polish army officer, who was one of the heroes of the Hungarian revolution of 1848–49, was born at Tarnow in Galicia on March 14, 1794, and was educated at the military school at Warsaw. Joining a Polish artillery regiment in the French service, he took part in the Russian campaign of 1812 and brilliantly distinguished himself in the defense of Danzig (Jan.–Nov. 1813). After 1815 he returned to the Polish service, but became involved in secret societies and lost his post. In the rising of 1830–31 his skill as an artillery officer won the battle of Iganie for the Poles (April 10, 1831), and he distinguished himself at the indecisive battle of Ostroleka (May 26). He took part in the desperate defense of Warsaw against I. F. Paskevich (Sept. 6–7, 1831). Then he emigrated and tried in vain (1833) to form a Polish legion in the service of Queen Maria of Portugal. In the Austrian revolution of 1848 he attempted to hold Vienna against the imperial troops (October) and, after the capitulation, hastened to Pressburg (Bratislava) to offer his services to the Hungarian leader Lajos Kossuth. He was entrusted with the defense of Transylvania at the end of 1848, and in 1849, as the general of the Szeklers, he performed miracles with his little army, notably at the bridge of Piski (Feb. 9), where, after fighting all day, he drove back a superior force of pursuers. After recovering Transylvania he was sent to drive the Austrian general A. von Puchner out of the Banat. Bem occupied the Banat but the Russian invasion recalled him to Transylvania. From July 12–22 he was fighting continually, but finally, on July 31 his army was annihilated by overwhelming numbers near Segesvár (Sighisoara), Bem only escaping by feigning dead. Bem was in command and was seriously wounded in the last pitched battle of the war, fought on Aug. 9 at Temesvár (Timisoara). On the collapse of the rebellion he fled to Turkey, adopted Islam and, under the name of Murad Pasha, served as governor of Aleppo, where, at the risk of his life, he saved the Christian population from being massacred. He died there on Dec. 10, 1850.

See Johann Czetz, *Memoiren über Bems Feldzug* (1850); E. Kovács, *Bem József* (1954). (S. KI.)

BEMA, a word of Greek origin meaning a raised platform. Thus it was applied to the tribunal from which orators addressed assemblies of the citizens at Athens. That in the Pnyx, where the ecclesia (the Athenian assembly of freemen) often met, was a stone platform 10 to 11 ft. high. In the Athenian law court counsel addressed the court from such a platform, but it is not known whether each had a separate bema. Another bema was the platform on which stood the urns for the reception of the bronze disks by which at the end of the 4th century B.C. the judges recorded their decisions.

In ecclesiastical architecture the bema was originally the end of a Christian church where the higher clergy sat and the altar was placed. Later it took the form of a raised platform directly behind the altar in the apse of a basilica.

BEMBA (known also as BABEMBA or AWEMBA), a Bantu tribe about 150,000 in number, which inhabits the northeastern plateau of Northern Rhodesia, sparsely distributed in sandy deciduous woodland, 4,000 ft. above sea level, which stretches from longitude 29° W. to 32.5° E. and from latitude 9° N. to 12° S. The poor soil and lack of communications have made it difficult to introduce cash crops. The people practise shifting cultivation, pollarding the forest trees, firing the branches piled up on small circular patches beneath and sowing the staple crop, finger millet, in the ash bed so formed. By the early 1960s about 60% of the men were leaving the area to find work in the copper mines more than 400 mi. to the south.

The Bemba claim to be an offshoot of the Luba (*q.v.*) empire and are thought to have left the Congo in the late 18th or early 19th century. They were the largest and most warlike tribe of a group of agricultural and hunting peoples which practise matrilineal descent and matrilocal marriage and are commonly known as the Central Bantu. They dominated their neighbours and achieved a centralized government under a supreme chief, the *Chitimukulu.* This ruler, and the major territorial chiefs under him, were drawn from a single royal clan and succeeded to office by matrilineal rule. They were believed to have supernatural powers over the fertility of the land and the welfare of their people. Their powers rested on the sacredness of their persons and their prayers to ancestral spirits at relic shrines at their capitals, particularly at the annual tree-cutting, sowing and harvesting ceremonies. Their burial and accession ceremonies are among the most elaborate found among the Bantu.

The Bemba are divided into 40 matrilineal, exogamous, totemic clans with members dispersed over the country. The local group is the village, which is largely composed of the matrilineal relatives of the headman. It contains about 30 huts and moves every four or five years when the soil is exhausted. Crafts are little developed. Marriage is matrilocal in the first instance. Bemba bridegrooms used to do service for their fathers-in-law but this period of service is now being replaced by money payments. Also characteristic were elaborate nubility rites for girls known as *Chisungu,* but these are falling into disuse.

Chibemba, the language of the Bemba, has become the lingua franca of Northern Rhodesia. As it is closely related to the language of the Bisa, Lamba, Lala and Aushi, the term "Bemba-speaking peoples" is often applied to all the inhabitants of northeastern Rhodesia. *See* also BANTU LANGUAGES.

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BEMBO, PIETRO (1470–1547), Italian cardinal and scholar, whose writings reflect the spirit of the early Italian Renaissance, was born at Venice on May 20, 1470. He was principally educated by his father, Bernardo Bembo, a man of great authority in the Venetian republic who introduced his son to the Florence of Lorenzo the Magnificent. Pietro accompanied Giulio de' Medici to Rome, where in 1513 he was appointed secretary to Leo X. On the pope's death he retired to Padua, and in 1529 he accepted the office of historiographer to his native city, being shortly afterward appointed librarian of St. Mark's. The offer of a cardinal's hat took him in 1539 again to Rome, where he devoted himself to theology and classical history, receiving as reward of his conversion the bishoprics of Gubbio and Bergamo. He died in Rome in 1547.

Bembo's works are entirely characteristic of the early Renaissance. His collected works *(Opere de Pietro Bembo,* 4 vol., 1729) include a history of Venice from 1487 to 1513, dialogues, poems and essays. Among the dialogues is *Gli Asolani* (1505), extolling platonic love though dedicated to the renowned Lucrezia Borgia whom Bembo had unsuccessfully courted. Other of his more original writings are the *Prose della volgar lingua* (1525), the earliest published examples of popular as opposed to Florentine Italian, and the *Rime* (1530), a collection of amorous poems.

For a portrait of Bembo *see* ITALIAN LITERATURE.

BEMIDJI, a city of the scenic lake region of north-central Minnesota,, U.S., about 150 mi. W. of Duluth; seat of Beltrami county. A council-manager form of government has been in effect since 1953.

The city grew up around a trading post established on Lake Bemidji in 1888. In the 1890s large-scale lumbering operations were begun, and for 30 years Bemidji was a major logging and sawmilling centre. After mid-20th century the chief industries included creameries and woodworking plants. The largest city within a radius of 100 mi., Bemidji is an important trade centre. The region has long attracted tourists and sportsmen, and the numerous summer resorts in the vicinity entertain thousands of visitors annually.

Bemidji State college, which enrolls about 1,700 students annually, was founded there in 1913 and opened in 1919.

Bemidji is an Indian word first applied to the nearby lake; it was also the name of a Chippewa chief.

For comparative population figures *see* table in MINNESOTA: *Population.* (H. T. H.)

BÉMONT, CHARLES (1848–1939), French scholar, who made a notable contribution to the study of English and European medieval history, was born in Paris on Nov. 16, 1848. He became in 1887 a lecturer at the École des Hautes Études in Paris and in 1896 was appointed assistant director. Many of his writings appeared in the *Revue historique,* founded in 1876, of which he was later editor. Among his most important works are: *Simon de Montfort, comte de Leicester* (1884); *Les Chartes des libertés anglaises* (1892); and *Histoire de l'Europe au moyen âge, de 395 à 1270* (1896, with G. Monod). During 1896–1906 he published the second and third volumes in the series *Rôles gascons.* He died in Paris on Sept. 20, 1939.

BENARES (BANARAS): *see* VARANASI.

BENAVENTE Y MARTÍNEZ, JACINTO (1866–1954), one of the foremost Spanish dramatists of the 20th century, who received the Nobel prize for literature in 1922. He was born in Madrid on Aug. 12, 1866, the son of a noted children's doctor. He studied law at Madrid university, but abandoned it for the theatre. His early plays, *Gente conocida* (1896) and *La comida des las fieras* (1898), satirizing the corrupt Spanish society before the so-called disaster (the Spanish-American War of 1898), created a new movement in the Spanish theatre, which had been dominated by the blood-and-thunder melodramas of José Echegaray (1832–1916). In *Lo cursi* (1901) Benavente attacked the new bohemians in literature who used the word *cursi* ("vulgar") to describe everything admired by the *bourgeoisie.* After a series of cosmopolitan plays, such as *La noche del sábado* (1903), in 1907 Benavente produced his most celebrated work *Los intereses creados,* based on the Italian masked *commedia dell' arte.* It sums up his philosophy derived from *Don Quixote:* the clown-servant creates bonds of interest with society and by his loyalty enables his master, the idealist, to fulfill his dreams, thereby earning his own salvation. In 1908 followed *Señora Ama,* said to be his own favourite play, an idyllic comedy set among the people of Castile. Its popularity led to the production of his rural tragedy with the theme of incest, *La malquerida* (1913), which was his greatest success in Spain and in North and South America. In 1928 his play *Para el cielo y los altares,* prophesying the fall of the Spanish monarchy, was prohibited by the government of Primo de Rivera. During the Spanish civil war Benavente lived in Barcelona and Valencia and was for a time under arrest. In 1941 he re-established himself in public favour with *Lo increible* and his quasi-legendary fertility as a dramatist recalled the "golden age" of Lope de Vega. However, with the exception of the harsh tragedy *La Infanzona* (1948), recalling the drama of Eugene O'Neill, and *El Lebrel del cielo* (1952), inspired by Francis Thompson's "Hound of Heaven," Benavente's later works did not add much to his fame. He died in Madrid on July 14, 1954. A number of his plays have been translated into English.

See W. F. Starkie, *Jacinto Benavente* (1924); I. Sánchez Estevan, *Jacinto Benavente y su teatro* (1954). (W. F. SE.)

BENBOW, JOHN (1653–1702), English admiral, whose exploits against the French and death on active service made him a popular hero, was the son of William Benbow, a burgess owning the Tannery house, Shrewsbury. He served in the navy and merchant service from 1678. He was master of the fleet at the battle of La Hogue (1692) and commanded a squadron at the bombardment of St. Malo (1693) and in chase of privateers like Jean Bart in the Channel. In 1696, as master attendant at Deptford dockyard, he rented the house of John Evelyn, which he sublet to Peter the Great of Russia, from whom he claimed substantial compensation for damage done to his property. In 1698 he sailed in command of a squadron to the West Indies, where he compelled the Spaniards to restore two vessels belonging to Scottish colonists at Darien. On Aug. 19, 1702, as commander in chief of the West Indies squadron of seven ships, Benbow chased four French ships commanded by J. B. Ducasse near Santa Marta. The insubordinate conduct of his captains left the flagship "Breda" unsupported. Although the admiral's right leg was shattered by a chain shot, he continued on the quarter-deck until the next morning, when his captains compelled him to return to Jamaica. Two of them were court-martialed and shot, but Benbow died of his wounds on Nov. 4, 1702, and was buried at Kingston.

See Sir Geoffrey Callender and C. J. Britton "Admiral Benbow: Fact and Fiction," *Mariner's Mirror,* vol. XXX (1944). (C. C. L.)

BENCH: *see* CHAIR AND SOFA.

BENCHLEY, ROBERT CHARLES (1889–1945), U.S. writer of humorous essays and drama criticism, and an actor, was born in Worcester, Mass., on Sept. 15, 1889, and graduated in 1912 from Harvard. After a variety of minor jobs, he joined the staff of the old *Life* magazine in 1920 as drama critic. A monologue, "The Treasurer's Report," delivered as a skit in an amateur revue in 1922 and made later into one of the first all-talking motion pictures, brought him recognition as a humorist and a stage personality, and eventually led to his writing and acting in motion-picture short subjects, one of which, "How to Sleep," won an award from the Academy of Motion Picture Arts and Sciences in 1935. In all, he made 46 "shorts" and appeared in minor roles in about 50 feature pictures. Although motion pictures brought him his widest public acclaim, Benchley's writing was his best work.

Benchley was drama critic on the *New Yorker* (1929–1940) for which he also wrote "The Wayward Press" column under the pseudonym Guy Fawkes. His humorous essays were collected into 15 books, illustrated by Gluyas Williams' caricatures, among them *My Ten Years in a Quandary and How They Grew* (1936), and *Benchley Beside Himself* (1943). His writing was characterized by its warmth and the often nonsensical and *non sequitur* quality

of its humour, which capitalized on what he considered his own inadequacies; his satire, although sharp, was never cruel. He died Nov. 21, 1945, in New York city.

Benchley Roundup (1954) was a selection from his writings edited by his son, Nathaniel Benchley, who also wrote his biography (1955). (N. By.)

BENCKENDORFF, ALEKSANDR KHRISTOFOROVICH, COUNT (1783–1844), Russian general and statesman, distinguished for his military service during the Napoleonic wars and for his later role as chief of police and suppressor of liberal thought, was born at Tallinn (Reval) in 1783, of Baltic German origin. He was a member of a band of officers who murdered the emperor Paul in 1801. Between 1806 and 1815 he took part in many campaigns. Named commandant of Moscow after Napoleon's retreat, he participated in the pursuit of the French forces, won distinction in numerous battles in German territory (including the Russian drive into Berlin) and spearheaded action against the French in the Netherlands and Belgium.

Benckendorff became aide-de-camp to the emperor Alexander I in 1819. In 1821, as lieutenant general, he was appointed commander of the cuirassier division of the guards. During the rising of 1825, he commanded the troops that acted against the Dekabrists (*q.v.*). Thereafter, he took a leading role in the prosecution of the Dekabrists. The relentless way in which he and fellow generals of German origin in Russia tracked down members of eminent Russian noble families who had been connected with the Dekabrist movement aroused popular belief that the German generals were trying to liquidate their Slav rivals in the government. His proposals for a more efficient, centralized organization of the police met with the emperor Nicholas I's approval, and in July 1826 he was appointed chief of *gendarmerie* and chief of the imperial chancellery's third section, which embraced the general direction of police corps and the work of the secret department of the ministry of police. Benckendorff died in St. Petersburg on Oct. 5 (new style; Sept. 23, old style), 1844. (G. A. Ln.)

BENDA, the name of a family of Czech musicians who settled in northern Germany in the time of Frederick the Great. The most famous are Frantisek (Franz), who was regarded as the greatest violinist in 18th-century Germany, and Jiri Antonin (Georg), also a violinist but more famous as a composer. Sons of Jan Jiri Benda (1685–1757) and his wife, Dorota Brixi, both talented musicians, they were born at Staré Benátky, Bohemia, Frantisek on Nov. 25, 1709, and Jiri on June 30, 1722.

Frantisek became a violinist, attracted the attention of the crown prince, Frederick, whose orchestra he joined, and, on Frederick's accession (1740), settled in Berlin, where the rest of his family joined him in 1742. He remained in the royal orchestra, becoming *Konzertmeister* in 1771, until his death at Potsdam, March 7, 1786.

Jiri, after playing in the royal orchestra (1742–50), was for nearly 30 years *Kapellmeister* to the duke of Gotha. He toured Italy in 1765–66 and composed Italian operas and intermezzi, but the works that won him renown throughout Europe were the melodramas *Ariadne auf Naxos, Medea* (both 1775) and *Pygmalion* (1779), and several Singspiele, of which the most famous was *Der Dorfjahrmarkt* (1775). Although not the inventor of the musical melodrama—a form in which spoken words are accompanied by illustrative music—Benda was a more solid musician than J. J. Rousseau, who is usually regarded as its creator, and his works enjoyed far greater fame than Rousseau's *Pygmalion*.

He retired from Gotha in 1778 and later settled at Köstritz, where he died, Nov. 6, 1795. Both he and Frantisek had sons called Friedrich, after the Prussian king, who were well-known violinists and composers. (Cs. Ch.)

BENDA, JULIEN (1867–1956), French philosophical writer, a vigorous defender of reason and the intellect against romanticism and the cult of emotion, was born in Paris on Dec. 26, 1867, of lapsed Jewish parents who brought him up in an austerely rational way. Benda's first publications were articles on the Dreyfus case in the *Revue blanche* (1898; collected as *Dialogues à Byzance*, 1900). *L'Ordination* (1912) was his first novel. *Le Bergsonisme ou une Philosophie de la mobilité* (1912) inaugurated his lifelong assault on the philosophy of Henri Bergson. In 1927 appeared *La Trahison des clercs*, his most important work, a denunciation of those who put the intellect, which he believed ought to be devoted to universal spiritual values, to the service of racial or political ends. The evolution of his thought can be traced in the autobiographical works *La Jeunesse d'un clerc* (1936) and *Un Régulier dans le siècle* (1938). He regarded France as standing for the classical tradition, both ancient and modern, for intellectualism and for the disinterested love of truth and justice. Benda died in Paris on June 7, 1956.

BEN DAY PROCESS, a mechanical process for producing line or dot patterns or tints in photoengraved plates developed by Benjamin Day in the U.S. in 1879. Though fast becoming obsolete in the early 1960s because of relatively less costly and time-consuming methods, it was still being extensively used to produce plates for printing comic magazines and strips of Sunday newspapers.

For a job to be made in a multiple of colours, the engraver required a black and white drawing keyed for the overlapping of colours, by means of a tissue overlay placed over the drawing or on a photostat of it, as a guide in selecting tints and values for desired effects. A negative is made photomechanically from the drawing, and a flat piece of sensitized zinc is exposed to this negative and then developed. The plate is then ready to accept the Ben Day tints. Those sections not requiring tints are covered with a chemical to which the Ben Day ink, applied later, will not adhere, and which resists etching in the acid bath. The Ben Day shading machine is a steel bar with two micrometers mounted on it between which is fastened the Ben Day screen, a gelatinous film on which appear patterns in relief. The patterns are many and varied as to size, detail and shape: single lines in various weights and sizes; round and square dots; herringbone, basket weave, stippled, etc. The screen is fastened to a four-sided frame, kept taut and placed over a pad so as not to injure the film. Then the pattern is rolled up with an acid-resisting ink and placed in contact with the image-bearing zinc. The inked Ben Day pattern is transferred to it by rollers and bone burnisher, the ink acting as a protective coating during etching. Changing the angles of the screen pattern by using the gauges to shift the screen horizontally and vertically gives many varied effects.

In most colour production one plate is used for each colour. Black is used to reproduce the key plate, usually an exact reproduction of the drawing. By changing the size of the dot formations, different strengths of colour can be obtained; *i.e.*, a heavier pattern printing blue over yellow will give a greener blue. In a black and white plate, a selected Ben Day tint can be "layed" in any area where a gray tone value is desired. (Cr. A. M.)

BENDERY, a town of the Moldavian Soviet Socialist Republic, U.S.S.R., formerly the Rumanian Tighina, lies on the right bank of the Dniester, below its confluence with the Byk. The town is very ancient and as Tigin or Tungaty is mentioned in the early Russian chronicles. From 1538 to 1812 Bendery was held by the Turks, who built a fortress, still in existence. Standing at a crossing of the Dniester, the town was strategically important ("The Gate of Bessarabia"); a battle was fought there in the 1770 Russo-Turkish campaign. Between World Wars I and II Bendery belonged to Rumania. Its present importance is as a centre of communications on the navigable Dniester, where it is crossed by the Odessa-Kishinev main line, with a branch to southern Moldavia. Population (1956 est.) was 38,000. The centre of a fertile area of vineyards and market gardens, Bendery produces jam and other foodstuffs and repairs rolling stock and river craft. (R. A. F.)

BENDIGO, a city in Victoria, Austr., is situated on the inner flank of the Eastern highlands, 101 mi. N.N.W. of Melbourne by rail. Pop. (1954) 28,726 (36,918 including suburbs). The climate is suitable for fruit, vegetable and wheat growing: mean temperature varies from 70° F. in January to 45° in July; average annual rainfall is 21.5 in., with a marked dry period from January to March. Bendigo, which was created a city in 1871 and officially called Sandhurst until 1891, is well laid out. It possesses 176 mi. of tree-lined streets, including the ironbarks which in spring and summer are alive with parakeets. There are fine public buildings,

an Anglican and a Roman Catholic cathedral, and 485½ ac. of parks and gardens.

More than 1,000,000 sheep and 50,000 cattle are sold annually in the market, making Bendigo the third largest livestock market in Australia. It is especially noted for its tomato crop and sends early fruit and vegetables to Melbourne. Iron foundries, potteries and the manufacture of food and textiles are among the main industries. There is also a large commonwealth ordnance factory and the city is important as a railway centre. Since 1870 large-scale conservation works (Coliban river and reservoirs at Malmsbury) have provided a plentiful water supply.

Bendigo's development started when alluvial gold was discovered on a sheep run in 1851, the richness of the finds rapidly attracting population. In 1853 about £A3,000,000 worth of gold was obtained and later the quartz reefs, which everywhere intersect the country as ridges and rises, were attacked. The ores are not of a high grade, but the great bulk available, together with improved mining and milling techniques and a cheap, assured supply of water, made working continuous. It was conducted at deep levels (953 shafts more than 2,000 ft., several more than 4,000 ft. and one at 4,593 ft.). About 22,000,000 oz. (worth £A90,000,000) were obtained, but because of high production costs gold mining had ceased, at least temporarily, by 1954.

See George Mackay, *The History of Bendigo* (1891).

BENDIS, a Thracian goddess in whom the Greeks recognized a figure similar to their own Artemis. In the Greek world, apart from areas adjacent to Thrace, the cult gained prominence only in Athens. At the outbreak of the Peloponnesian War, as a gesture of good will toward Thrace, the Athenians allowed the Thracians resident in the city to found a sanctuary, and shortly after, perhaps as a result of the great plague, took the unprecedented step of creating a state festival for the barbarian goddess. The first celebration, held on the 19th Thargelion (= May–June), 429 B.C., provides the dramatic setting for Plato's *Republic*. It included separate processions of Athenians and Thracians, a torch race on horseback and nocturnal rites. The chief sanctuary was in Piraeus, the harbour town, with later affiliates in Athens itself and on Salamis. *See* also Artemis.

See M. P. Nilsson, *Geschichte der griechischen Religion*, 2nd ed., vol. i, pp. 833–834 (1955). (F. R. Wn.)

BENDIX, VINCENT (1882–1945), U.S. inventor and industrialist important in the history of automobile manufacture and air transportation, was born on Aug. 12, 1882, in Moline, Ill. At the age of 16 he ran away to New York city, where he studied mechanics. By his 25th year he had organized the Bendix company, a pioneer producer of automobiles. During 1910–12 he developed the Bendix starter drive, which made the automobile self-starter practicable. In 1912 he formed the Bendix Brake company, which introduced mass production of four-wheel automobile brakes. The Bendix Aviation corporation, organized in 1929, manufactured a wide range of automotive, aviation, marine, radio and radar equipment. Keenly interested in aviation, Bendix founded the Bendix Transcontinental Air race in 1931. In 1942 he resigned as chairman of the board of the Bendix Aviation corporation and organized Bendix Helicopters, Inc. He died in New York city on March 27, 1945. (M. J. Bi.)

BENEDEK, LUDWIG AUGUST, Ritter von (1804–1881), commander of the Austrian army at Königgrätz (Sadowa), was born the son of a doctor, at Ödenburg (Sopron), Hung., on July 14, 1804. From the Maria Theresa military academy, he entered the Austrian army in 1822. Appointed to the general staff in 1833, he distinguished himself during the insurrection of 1846 in western Galicia and in the Hungarian campaign of 1849. But he made his reputation chiefly in Italy—in 1848 at Curtatone against the Piedmontese, in 1849 at Mortara and Novara and in 1859 at Solferino, where his successful fighting at San Martino enabled him to cover the Austrian retreat to the Mincio—and was Radetzky's chief of staff 1850–57. He was made quartermaster general to the army in 1860. Having been governor general and commander in chief in Hungary, he became commander in chief in Venetia in 1861, resigning the quartermaster generalship in 1864 and devoting himself exclusively to the command in Italy. When the Seven Weeks' War (*q.v.*) was imminent in 1866, the emperor Francis Joseph appointed Benedek to the command against the Prussians. He accepted reluctantly, as a stranger to the country and to the troops and with no confidence in the equipment at his disposal. His leading staff officers moreover obstructed him and Benedek was completely defeated by the Prussians at Königgrätz on July 3, but made good his retreat in magnificent order. He was suspended from his command and a court-martial was ordered, but the emperor stopped the inquiry. Benedek retired to Graz, having given his word that he would not attempt to rehabilitate himself. He died at Graz on April 27, 1881.

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BENEDETTI, VINCENT, Comte (1817–1900), French diplomat remembered chiefly for his role, as ambassador in Berlin, in the events leading to the outbreak of the Franco-German War in 1870, was born at Bastia in Corsica on April 29, 1817. He studied law and in 1840 entered the French consular service, serving in Cairo and at Palermo. In 1852 he was promoted first secretary of the embassy at Istanbul. From 1855 to 1861 he was director of political affairs in the French foreign office. As such he gave his support to the cause of Italian independence. When France recognized the new kingdom of Italy, he was appointed ambassador in Turin (1861), but he resigned in 1862 because of differences of policy with his government.

Benedetti's most important post was that of ambassador to Prussia from Nov. 1864 to Aug. 1870. This was a crucial period in Franco-German relations, in which Benedetti showed himself to be an efficient civil servant but hardly of sufficient stature to guide events, and he was certainly completely outclassed by Bismarck—on two occasions in particular. First, after Prussia's great gains in the Seven Weeks' War (1866), Benedetti negotiated with Bismarck with a view to obtaining compensation for France on its eastern frontier. Bismarck seemed to be willing to let France annex Belgium, and a draft treaty was in fact prepared to effect this. Bismarck kept a copy of it, in Benedetti's handwriting, which he published in 1870 as proof of France's expansionist ambitions; and this coup did much to alienate European sympathy from France. Second, in July 1870, it was Benedetti who was instructed to present the French government's request that the king of Prussia should confirm the prince of Hohenzollern's withdrawal of his candidature for the Spanish throne and that he should promise that the candidature would never be renewed. When Benedetti made this request in his famous interview at Ems, the king refused; Bismarck misrepresented their conversation to suggest that Benedetti had been insulted, and this was the immediate cause of the war. Benedetti's diplomatic career was ended; he retired to Corsica and took up practice at the bar there. He published a book, *Ma Mission en Prusse* (1871), to defend himself against the attacks made on him; he insisted that he simply carried out the instructions of his government, that the policy of compensation was not his own but that of the foreign minister, Edouard Drouyn de Lhuys, and that he gave his government ample information about events in Prussia. He also published *Essais diplomatiques* (1895; Eng. trans., *Studies in Diplomacy*, 1896). He died in Paris on March 28, 1900.

Bibliography.—E. Ollivier, *L'Empire libéral*, vol. 13 and 14 (1908–09); R. H. Lord, *The Origins of the War of 1870* (1924); G. Bonnin (ed.), *Bismarck and the Hohenzollern Candidature for the Spanish Throne* (1958). (T. Ze.)

BENEDICT, SAINT, of Nursia (*c.* 480–*c.* 547), the patriarch of western monks. The only authority for the facts of St. Benedict's life is book ii of the *Dialogues* of St. Gregory the Great (Pope Gregory I). Gregory declares that he obtained his information from four of St. Benedict's disciples, whom he names, and there can be no serious reason for doubting that it is possible to reconstruct the outlines of Benedict's career. A precise chronology and a pedigree have been supplied for Benedict, according to which he was born in 480, of the great family of the Anicii; but Gregory says only that he was born of good family in Nursia, near Spoleto

in Umbria. His birth must have occurred within a few years of the date assigned; the only fixed chronological point is a visit of the Gothic king Totila to him in 542, when Benedict was already established at Monte Cassino and advanced in years. He was sent by his parents to the Roman schools, but shocked by the prevailing licentiousness, he fled. It was once usual to represent him as a mere boy at this time, but various considerations have been pointed out which make it more likely that he was a young man. He retired to Enfide (modern Affile), a remote spot in the Simbruinian hills, and somewhat later to the ruins of Nero's palace and the artificial lake at Subiaco (*q.v.*), 40 mi. from Rome. Among the rocks on the side of the valley opposite the palace he found a cave in which he took up his abode, unknown to all except one friend, Romanus, a monk of a neighbouring monastery, who clothed him in the monastic habit and secretly supplied him with food. In the cave Benedict spent three years of opening manhood in solitary prayer, contemplation and austerity.

After this period of formation, his fame began to spread abroad, and the monks of a neighbouring monastery induced him to become their abbot; but their lives were irregular and dissolute, and on his trying to put down abuses they attempted to poison him. He returned to his cave, but disciples flocked to him, and in time he formed 12 monasteries in the neighbourhood, placing 12 monks in each, and himself retaining a general control over all. Patricians and senators from Rome entrusted their young sons to his care, to be brought up as monks; in this manner came to him his two best-known disciples, Maurus and Placid. Driven from Subiaco by the jealousy and molestations of a neighbouring priest, but leaving behind him communities in his 12 monasteries, he journeyed south, accompanied by a small band of disciples, until he came to Cassino, a town halfway between Rome and Naples. Climbing the high mountain that overhangs the town, he established on the summit the monastery with which his name has ever since been associated. Historians see a certain significance in the fact that this event occurred *c.* 529, the year in which Justinian closed the schools of Athens, for certainly in the centuries which followed this monastery was one of the principal centres of religious and cultural life in western Europe. Benedict destroyed the remnants of paganism that lingered on about Cassino, and by his preaching gained the rustic population to Christianity. Few other facts of his career are known, though there is record of his founding a monastery at Terracina. His feast day is March 21.

Rule of St. Benedict.—In order to understand St. Benedict's character and spirit, and to discover the secret of the success of his institute, it is necessary, as St. Gregory says, to turn to his rule. Gregory's characterization of the rule as "conspicuous for its discretion" touches the most essential quality. The relation of St. Benedict's rule to earlier monastic rules, and of his institute to the prevailing monachism of his day, is explained in the article MONASTICISM. Here it is enough to say that nowadays it is commonly recognized by students that the manner of life instituted by St. Benedict was not intended to be, and as a matter of fact was not, one of any great austerity, when judged by the standard of his own day. His monks were allowed proper clothes, sufficient food, ample sleep. The only bodily austerities were the abstinence from flesh meat and the unbroken fast till midday or even 3:00 P.M., but neither would appear so onerous in Italy even now as they do to more northern peoples. Midnight office was not a part of St. Benedict's rule: the time for rising for the night office varied from 1:30 to 3:00 A.M., according to the season, and the monks thus had unbroken sleep for 7½ or even 8 hours, except in the hot weather, when in compensation they were allowed the traditional Italian summer siesta after the midday meal. The canonical office was chanted throughout, but the directly religious duties of the day can hardly have taken more than four or five hours—perhaps eight on Sundays. The remaining hours of the day were divided between work and reading, in the proportion (on the average of the whole year) of about six and four hours, respectively. The reading in St. Benedict's time was probably confined to the Bible and the Fathers. The work contemplated by St. Benedict was ordinarily field work, as was natural in view of the conditions of the time and best suited to the majority of the monks; but the principle laid down is that the monks should do whatever work is most useful. There were from the beginning young boys in the monastery, who were educated by the monks according to the ideas of the time. It has been noted that St. Benedict evangelized the pagan population around Monte Cassino, and a considerable time each day was assigned to the reading of the Fathers. Thus the germs of all the chief works carried on by his monks in later ages were to be found in his own monastery.

The rule consists of a prologue and 73 chapters. Though it has resisted all attempts to reduce it to an ordered scheme, and probably was not written on any set plan, still it is possible roughly to indicate its content. After the prologue and introductory chapter setting forth St. Benedict's intention, follow instructions to the abbot on the manner in which he should govern his monastery (2, 3); next comes the ascetical portion of the rule, on the chief monastic virtues (4–7); then the regulations for the celebration of the canonical office, which St. Benedict calls "the work of God" or "the divine work," his monks' first duty, "of which nothing is to take precedence" (8–20); faults and punishments (23–30); the cellarer and property of the monastery (31, 32); community of goods (33, 34); various officials and daily life (21, 22, 35–57); reception of monks (58–61); miscellaneous (62–73).

The most remarkable chapters, in which St. Benedict's wisdom stands out most conspicuously, are those on the abbot (2, 3, 27, 64). The abbot is to govern the monastery with full and unquestioned patriarchal authority; on important matters he must consult the whole community and hear what each one, even the youngest, thinks; on matters of less weight he should consult a few of the elder monks; but in either case the decision rests entirely with him, and all are to acquiesce. He must, however, bear in mind that he will have to render an account of all his decisions and to answer for the souls of all his monks before the judgment seat of God. Moreover, he has to govern in accordance with the rule and must endeavour, while enforcing discipline and implanting virtues, not to sadden or "overdrive" his monks or give them cause for "just murmuring." In these chapters pre-eminently appears that element of "discretion," as St. Gregory calls it, or humanism as it would now be termed, which without doubt has been a chief cause of the success of the rule. That success is attested by the more than 900 editions and translations printed since 1489, when the *editio princeps* was published in Venice.

The following modern editions of the text are especially useful: O. Hunter-Blair, Latin and English (1886; 4th ed., 1934); E. C. Butler, *S. Benedicti regula monasteriorum* (1912; 2nd ed., 1927; 3rd ed., 1935); B. Linderbauer, *S. Benedicti regula monachorum* (1922), *S. Benedicti regula monasteriorum* (1928); Philibert Schmitz (1946); Gregory Arroyo (1942); Justin McCann, Latin and English (1952); Gregorio Penco (1958); and R. Hanslik (1960), as vol. 75 of the Corpus *Scriptorum Ecclesiasticorum Latinorum*. Of the many commentaries the most valuable are those of Smaragdus and Hildemar (both 9th century); Calmet (1732, 2nd ed. 1734); Martène (J. P. Migne, *Patrologia Latina*, lxvi); P. Delatte (1913; Eng. trans., 1921); I. Schuster (1942; reprinted, 1945); Abbot I. Herwegen (1944); A. Lentini (1947); T. F. Lindsay, *The Holy Rule for Laymen* (1947); B. A. Sause, *The School of the Lord's Service*, 3 vol. (1948 *et seq.*); B. Steidle (1952); Van Zeller (1958). *See* also BENEDICTINES.

BIBLIOGRAPHY.—On the life of St. Benedict, *see* book ii of the *Dialogues* of St. Gregory the Great in English translation of all four books by P[hilippe] W[oodewarde] (1608; reprinted, 1874, 1911); book ii only, *Life and Miracles of St. Benedict*, trans. by Odo J. Zimmerman and Benedict R. Avery (1949); critical edition of the Latin original, *Gregorii Magni Dialogi, Libri IV*, prepared by U. Moricca (1924). *See* also the excellent modern works on the saint's life and institute: Montalembert, *Monks of the West*, vol. i (Eng. trans., 1896); L. Tosti, *Della vita di S. Benedetto* (1892; Eng. trans., 1896); E. C. Butler, *Benedictine Monachism* (1919; 2nd ed., 1924); I. Herwegen, *St. Benedict* (Eng. trans., 1924); J. Chapman, *St. Benedict and the Sixth Century* (1929); H. Leclercq, *L'Ordre Bénédictin* (1930); F. Cabrol, *Saint Benoît* (1933; Eng. trans., 1934); Justin McCann, *St. Benedict* (1937); Philibert Schmitz, *Histoire de l'Ordre de Saint-Benoît*, vol. i, ch. 1 (but the special value and importance of this entire work of 7 vol. must here be stressed) (1941); T. F. Lindsay, *St. Benedict: His Life and Work* (1949); G. Aulinger, *Das Humanum in der Regel Benedikts von Nursia* (1950); I. Schuster, *St. Benedict and His Times*

(Eng. trans., 1951); Theodore Maynard, *St. Benedict and His Monks* (1954). Valuable, too, are the relevant sections of certain larger works: Thomas Hodgkin, *Italy and Her Invaders*, vol. iv, 2nd ed. (1896); F. Gregorovius, *History of the City of Rome in the Middle Ages* (Eng. trans.; 1894); F. H. Dudden, *Gregory the Great*, vol. i, ii (1905); H. M. Gwatkin *et al.* (ed.), *Cambridge Medieval History*, vol. i (1911). Mention also must be made of the controversy after 1938 on the priority of the *Rule* of St. Benedict over the so-called *Regula Magistri* ("Rule of the Master"), concerning this *see* edition of the *Rule* by G. Penco cited above. (E. C. B.; Am. S.)

BENEDICT (Benedictus), the name of several popes and antipopes.

Benedict I (d. 579), pope from 574 to 579, was elected to succeed John III, probably just after the latter's death (July 574), but was not consecrated until June 3, 575. He ruled the church during a period made calamitous by invasion and by famine and died during a siege of Rome by the Lombards.

St. Benedict II (d. 685), pope from 683 to 685, was elected to succeed Leo II in 683. His consecration (June 26, 684) was delayed until the approval of the emperor Constantine IV Pogonatus could be obtained. Benedict died on May 8, 685, and his feast is celebrated on the anniversary.

Benedict III (d. 858), pope from 855 to 858, was chosen by the Roman clergy and people as successor to Leo IV in July 855. The election was not immediately confirmed by the western emperor Louis II, who set up Anastasius the Librarian as antipope; but by the beginning of October the imperial government's opposition to Benedict was dropped, and he was consecrated pope. He died April 17, 858.

Benedict IV (d. 903), pope from 900 to 903, was the successor of John IX. It was he who crowned the emperor Louis III in 901. He died in July 903.

Benedict V, called "the Grammarian" (*Grammaticus*) (d. 965/966), pope or antipope from May to June 964, was elected by the Romans on the death of John XII. The emperor Otto I, however, having already deposed John and designated Leo VIII as his successor, thereupon forced his way into Rome and convened a synod, which deposed and degraded Benedict. Removed as a prisoner to Hamburg, Benedict died there. Either Benedict or Leo may be considered an antipope.

Benedict VI (d. 974), pope from 973 to 974, was elected to succeed John XIII and was consecrated on Jan. 19, 973, under the emperor Otto I's protection. Otto's death was followed by a resurgence of the Roman baronage, and Benedict was strangled in the summer of 974 by order of Crescentius, son of the notorious Theodora, who replaced him by the deacon Franco (Boniface VII).

Benedict VII (d. 983), pope from 974 to 983, formerly bishop of Sutri, was elected in Oct. 974 through the intervention of the emperor Otto II's representative Count Sicco, who expelled Boniface VII. Benedict governed Rome quietly for nearly nine years, and died there on July 10, 983.

Benedict VIII (Theophylact) (d. 1024), pope from 1012 to 1024, was a son of Count Gregory of Tusculum, and his elevation, in succession to the last nominee of the Crescentian faction, Sergius IV, inaugurated a series of Tusculan popes. He eliminated a rival pope, Gregory, and placed the government of Rome in the hands of his brother Romanus (later pope as John XIX). His rule was acceptable to the German king Henry II, whom he crowned emperor in 1014. Benedict was more of a feudal baron than a pope: he restored papal authority in the Campagna and in Roman Tuscany by force of arms, repelled a Saracen attack on northern Italy (1016–17) and encouraged the Norman freebooters in their attacks on the Byzantine power in the south. But the disciplinary decrees of the Council of Pavia (1022, unless it took place as early as 1018) suggest that he did not entirely neglect his pastoral office. He died on April 7, 1024.

Benedict IX (Theophylact), pope from 1032 to 1045, son of Alberic, count of Tusculum, was the nephew of the two previous popes, Benedict VIII and John XIX. He was thrust into the papacy by the Tusculan party. His violent and licentious conduct at length drove the Romans to insurrection, and in Jan. 1045 they elected the bishop of Sabina to succeed him as Silvester III. But Silvester was quickly driven out by Benedict's brothers and retired from the scene. At this point Benedict seems to have resolved on marriage and sold the papacy to the archpriest John Gratian, who, to deliver the Holy See from its scandalous occupant, offered Benedict a pension and became pope himself, as Gregory VI, in May. In 1046, however, the emperor Henry III came to Italy and, in December, held a council at Sutri where Gregory was deprived of the papacy, to be replaced by Suidger, bishop of Bamberg, who took the name of Clement II. In 1047, after Clement's death, Benedict reappeared in Rome and installed himself in the Lateran (Nov. 8); but at last, on July 17, 1048, the marquis of Tuscany drove him from Rome, where he was never seen again. He is supposed to have lived on until 1055 or 1056.

Benedict X (John Mincius) (d. *c.* 1080), antipope from 1058 to 1059, had previously been bishop of Velletri. His election (April 5, 1058) was secured by the Roman barons on the death of Stephen X (IX). This intrusion caused his successor, Nicholas II, to enact the electoral decree of 1059, which vested the right of designation in the cardinal bishops. Expelled from the papacy in Jan. 1059, Benedict died *c.* 1080, a prisoner in the monastery of Sant' Agnese.

Blessed Benedict XI (Niccolò Boccasini) (1240–1304), pope from 1303 to 1304, was born at Treviso, Italy, the son of a notary. Entering the Dominican order in 1254, he became its general in 1296. Created cardinal priest of Sta. Sabina in 1298 and cardinal bishop of Ostia and Velletri in 1300, he loyally supported Boniface VIII against Philip IV of France. He was legate in Hungary in 1302. Unanimously elected to succeed Boniface on Oct. 22, 1303, he did much to conciliate his predecessor's enemies, France, the Colonnas and Frederick of Sicily. Nevertheless, while he demanded no retribution for the outrage done to Boniface at Anagni, he excepted Guillaume de Nogaret (*q.v.*) from the general pardon. Benedict died at Perugia on July 7, 1304. Clement XII confirmed the Dominicans in their cult of him (1736), and Benedict XIV included his name in his martyrology (1748); his feast is July 7.

Benedict XII (Jacques Fournier) (d. 1342), pope from 1334 to 1342, the third Avignon pope, was born at Saverdun in the Pays de Foix, France. Entering the Cistercian order and graduating doctor of theology at Paris, he became abbot of Fontfroide in 1311, bishop of Pamiers in 1317 and bishop of Mirepoix in 1326. He was created cardinal priest of Sta. Prisca in Dec. 1327. His distinction as an inquisitor and theologian recommended him to the cardinals in Avignon, who elected him to succeed John XXII on Dec. 20, 1334. His bull *Benedictus Deus* (1336) put an end to the controversy concerning the Beatific Vision which had agitated the close of the previous pontificate. Benedict applied himself to a reform of the papal court and forced ecclesiastics holding a cure of souls to quit Avignon and to reside on their benefices. He also tried to recall the religious orders to their primitive observance by constitutions of 1335, 1336 and 1339: that for the Benedictines (*Summi magistri*, 1336) remained in force until the Council of Trent. Most of his reforming work, however, was undone by his successors. He died on April 25, 1342.

Benedict XIII (Pedro de Luna) (*c.* 1328–1423/24), antipope from 1394 to 1423, was born at Illueca, of one of the noblest families of Aragon. His birth, his legal knowledge (he had risen to be professor of canon law at Montpellier) and his good morals recommended him to Pope Gregory XI, who made him cardinal priest of Sta. Maria in Cosmedin in 1375. On Sept. 28, 1394, he was elected by the cardinals of Avignon to succeed Clement VII (Robert of Geneva). It had been hoped that he would help to end the great schism by abdicating voluntarily, but this he refused to do despite severe pressure: the French princes appealed to him in vain, 18 of his 23 cardinals deserted him and the papal palace in Avignon was besieged (1398). Then, in 1403, Benedict escaped from the palace, rallied his cardinals and, largely because of the support of Louis, duc d'Orléans, won back the obedience of France. On the instances of the French government, he began negotiations for an interview with Pope Gregory XII in 1407, with a view to their simultaneous abdication; and it was not entirely Benedict's fault that no interview took place. In 1408, however, the French declared themselves neutral in the dispute between Rome and Avignon, and in June 1409 the Council of Pisa pronounced both popes deposed. Benedict, still recognized by Aragon (with Sicily), Cas-

tile, Navarre, Armagnac and its dependencies and Scotland, meanwhile had convened a council of his own at Perpignan (Nov. 1408–Feb. 1409). Subsequently he had to take refuge in the impregnable castle of Peñíscola, on the coast of Valencia (1415). When the Council of Constance in its turn pronounced him deposed (July 26, 1417), he had lost all governmental recognition save that of Armagnac and Scotland. But Benedict, who had maintained his claims against three Roman popes (Boniface IX, Innocent VII and Gregory XII) and two Pisan ones (Alexander V and John XXIII), was not going to yield to Martin V.

Shortly before his death Benedict had created four new cardinals, three of whom elected a new antipope, Clement VIII (Gil Sánchez Muñoz). The other cardinal, in Nov. 1425, tried by himself to set up a Bernard Garnier, of Rodez, as rival antipope. This Garnier first took the name of BENEDICT XIV. (C. H. LE.)

BENEDICT XIII (Pierfrancesco Orsini) (1649–1730), pope from 1724 to 1730 and at first styled Benedict XIV, was born on Feb. 2, 1649. Entering the Dominican order in 1667, he taught philosophy at Brescia before being made a cardinal in 1672. He was successively archbishop of Manfredonia (1675), of Cesena (1680) and of Benevento (1686). As one of the *zelanti* whose endeavour it was to promote the purely ecclesiastical interests of the church, Orsini had taken part in five conclaves before that which resulted in his own promotion to the papal chair at the age of 75 on May 29, 1724. He had proved himself during his 40 years of diocesan experience to be pious, scholarly (his many theological works were published in three volumes at Ravenna in 1728) and exacting in matters of discipline, but his pontificate produced no spectacular results. His attack on the luxurious living of the cardinals and on the worldliness of the lesser ecclesiastics, made particularly at the Council of Rome (1725), had little effect. State affairs he left entirely to the venal and unpopular cardinal Niccolò Coscia, so that the drift toward disaster in the papal relations with the Bourbon monarchies of France and of Spain was left unchecked. Naturally an opponent of the Jesuits, Benedict continued to allow the Dominicans to preach the Augustinian doctrine of grace, even though he had insisted that the bull *Unigenitus* should be received without reservation in France. He died on Feb. 21, 1730.

BENEDICT XIV (Prospero Lambertini) (1675–1758), pope from 1740 to 1758, was born at Bologna, Italy, on March 31, 1675. At the age of 13 he entered the Collegium Clementinum in Rome. He served the curia in many and important capacities, yet devoted his leisure time to theological and canonistic study. Benedict XIII made him archbishop of Theodosia in partibus (1725), then archbishop of Ancona (1727) and cardinal (1728). In 1731 Clement XII translated him to his native city of Bologna, where, as archbishop, he was both efficient and popular. In a conclave that had lasted for months he was elected on Aug. 17, 1740, the successor of Clement XII. In many ways Benedict was the papal counterpart of the 18th-century enlightened despots: in the papal states he reduced the burden of taxation, tried to restrain usury, encouraged agriculture and supported a policy of free trade. He was conciliatory in his relations with the secular powers, making vast concessions to the kings of Spain, Portugal, Sardinia and Naples in matters of patronage, the right of nomination to vacant sees and secular jurisdiction over ecclesiastical changes. To oblige Frederick the Great, he abandoned his predecessors' custom of addressing the Prussian king merely as "margrave of Brandenburg." Similarly, Benedict had little sympathy with the extreme notions of the Jesuits: in the bulls *Ex quo singulari* (1742) and *Omnium sollicitudinum* (1744) he rebuked their missionary methods in accommodating their message to the heathen usages of the Chinese and of the natives of Malabar. In 1756 he condemned the practice of automatically refusing the last rites to French ecclesiastics who still opposed the bull *Unigenitus*. He reduced the number of holy days in several Catholic countries. To the end of his life he kept up his studies and his intercourse with other scholars. He founded several learned societies. Benedict was widely admired by contemporaries, both Catholic and Protestant; but his moderation perhaps too often bordered upon weakness, and he was thought by some to be too ready to compromise with the secular spirit of his age. He died May 3, 1758.

Benedict XIV's most valuable writings are *De servorum Dei beatificatione et beatorum canonizatione*, 4 vol. (1734–38); *Annotazioni sopra le feste di Nostro Signore e della beatissima Vergine*, with *Annotazioni sopra gli atti di alcuni santi de' quali si fa l'uffizio in Bologana*, 2 vol. (1740; Latin trans., 1745); *De sanctorum missae sacrificio* (1745); and *De synodo dioecesana* (1748), an English translation of extracts from which was published in 1926. There are three editions of his collected works, and his letters were edited by F. X. Kraus (1884).

BENEDICT XV (Giacomo Della Chiesa) (1854–1922), pope from 1914 to 1922, was born at Pegli, Italy, on Nov. 21, 1854. He graduated from the University of Genoa and studied for the priesthood in the Collegio Capranica in Rome before entering the papal diplomatic service. Then he spent four years in Spain before being employed in the department of the secretary of state in 1887. Pius X made him archbishop of Bologna on Dec. 16, 1907, and cardinal on May 25, 1914. He was elected pope as Pius X's successor on Sept. 3, 1914, a month after the outbreak of World War I, and the greater part of his papacy was taken up in dealing with the problems that the war raised. He endeavoured to follow a policy of strict neutrality, concentrating the efforts of the church initially toward the alleviation of unnecessary suffering. Later he made positive efforts toward re-establishing peace, though hampered in these by the pro-Austrian sentiments of the majority of the cardinals. When the United States entered the war and took up the Allies' attitude that peace could not be restored to Europe until Germany had been defeated, Benedict's most elaborate proposal, contained in his note to the powers of Aug. 16, 1917, was doomed to frustration. His last years were concerned with the readjustment of the machinery of papal administration made necessary by the territorial changes which followed the war. Official relations were resumed with France, and a British representative was accredited to the Vatican for the first time since the 17th century. Benedict died on Jan. 22, 1922. (I. F. B.)

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BENEDICT, SIR JULIUS (1804–1885), German-born conductor and composer, best known for his opera *The Lily of Killarney* (Covent Garden, 1862), a melodious work that held the stage for over 50 years, was born at Stuttgart, Nov. 27, 1804. He was a pupil of J. C. L. Abeille, Hummel and Weber. Between 1823 and 1834 he conducted in Austria and Italy and wrote operas on Italian texts. He went to England in 1835 and his first English opera, *The Gypsy's Warning*, was produced at Drury Lane in 1838. He visited the U.S. in 1850 and on his return to England became conductor at Her Majesty's theatre, in 1852. In 1860 he wrote the recitatives for the production in Italian of Weber's *Oberon*.

In 1871 Benedict was knighted, having earlier been naturalized, and from 1876 to 1880 he conducted the Liverpool Philharmonic society. He died in London, June 5, 1885.

BENEDICT, RUTH (née FULTON) (1887–1948), U.S. anthropologist widely known for her concepts of culture and personality, was born on June 5, 1887, in New York city. After graduating from Vassar college, Poughkeepsie, N.Y., in 1909, she taught English in a secondary school in California until her marriage in 1914. From an early age until the 1930s she wrote and published poetry under the pseudonym of Anne Singleton. Turning to anthropology in the 1920s, she took her Ph.D. under Franz Boas at Columbia university, where she became assistant professor in 1930 and professor in 1948. Her field work was among tribes of the southwest, the Serrano of California and the Canadian Blackfoot. During her first 11 years of research and teaching she concentrated on American Indian religion and folklore, out of which came the two-volume study, *Zuni Mythology* (1935). In her famous book, *Patterns of Culture* (1934), which was translated into 14 languages, her principal interest became the study of cultures as "personality writ large," and she emphasized how small a part of the range of possible human behaviour is included among the accepted forms of any one society. The dependence of cultures on the temperamental possibilities of human beings

and the dependence of individuals on their cultural background provided complementary themes for a treatment combining scientific and literary talent. While her work was sometimes criticized as stating cultural contrasts too dramatically, it continued to provide a stimulating approach to anthropological theory. As a contribution to problems of human equality, she wrote *Race: Science and Politics* (1940), and, after applying anthropological methods to the study of Japanese culture, *The Chrysanthemum and the Sword* (1946). Ruth Benedict was a president of the American Anthropological association (1947), and, at her death on Sept. 17, 1948, in New York city, was director of a project for the anthropological study of contemporary European and Asian cultures.

See Margaret Mead (ed.), *An Anthropologist at Work: Writings of Ruth Benedict* (1959). (M. Md.)

BENEDICT BISCOP, SAINT (Biscop Baducing) (*c.* 628–689/690), English Benedictine abbot, of noble family, was for a time a thegn of Oswy, king of Northumbria. He then went abroad and after the second of five journeys to Rome lived as a monk at Lérins (666–667). It was under his conduct that Theodore of Tarsus went from Rome to Canterbury as archbishop in 668–669, and in 669 Benedict was appointed abbot of St. Peter and St. Paul (later St. Augustine's), Canterbury. Five years later he built the monastery of St. Peter at Wearmouth, in his native Northumbria, and in 682 a sister foundation (St. Paul) at Jarrow nearby, enriching them with relics and manuscripts from the continent. He died on Jan. 12, 689 or 690. His feast day is Jan. 12. Bede was one of his monks and pupils.

See A. Butler, *Lives of the Saints*, ed. by H. Thurston and D. Attwater, vol. i, pp. 72–74 (1956). (Pl. Gn.)

BÉNÉDICTINE, D.O.M., is an amber-coloured liqueur made at Fécamp on the coast of Normandy. It contains 43% alcohol by volume and 30 different herbs as well as brandy, honey and sugar; formerly it also contained China tea. The exact recipe is the secret of the manufacturers.

The liqueur was first made in 1510 by Dom Bernardo Vincelli, "a very learned monk" of the abbey of Fécamp, a Benedictine monastery dating back to A.D. 658. Being a botanist and a chemist, he devoted himself to the preparation of medicinal beverages; his liqueur soon became known as Bénédictine, *ad majorem Dei gloriam* ("for the greater glory of God"). It acquired a wide reputation as a refreshing and recuperative cordial, and met with praise from Francis I when he visited the abbey in 1534.

In 1793, when religious orders were expelled from France, the monastery was burned to the ground and the liqueur ceased to be made. However, the recipe for it was given with other monastic documents to the civil administrator, whose descendant Alexandre le Grand found it 70 years later. He was a wine merchant, and after careful experiments began to produce the liqueur again. His business soon grew, and the present distillery and Bénédictine museum were built upon the grounds that formerly belonged to the abbey. Every bottle now bears the initials D.O.M., or *Deo Optimo Maximo* ("To God most good, most great"). (C. C. H. F.)

BENEDICTINES (Black Monks; Ordo S. Benedicti; O.S.B.) take their name from St. Benedict of Nursia (*c.* 480–*c.* 547) whose rule they follow, but they are not alone in following that rule, and the name was not adopted till the late 14th century, on the analogy of such names as Franciscan and Dominican. In modern usage the title is applied to the main body of monks, wearing the black habit, who are the descendants of the traditional monasticism of the early medieval centuries in Italy and Gaul, as distinguished from other monks, such as the Cistercians, who follow the rule but are organized independently in a centralized order of their own. (For the rule, *see* Benedict, Saint.)

Monastic Centuries.—St. Benedict wrote his rule *c.* 535–540 with his own abbey of Monte Cassino in mind; he founded no order and his rule spread slowly in Italy and Gaul by reason of its excellence as a practical code, and it was gradually substituted for, or adopted alongside, existing codes and customaries. The first great agent in its diffusion, after the sack of Monte Cassino (*c.* 580–590) and the consequent dispersal of the monks, was Pope St. Gregory the Great, himself a monk, who knew, and possibly had followed, the rule, and who used monks as a bulwark of Roman orthodoxy in Italy, and as apostles of Christianity, as in the mission of St. Augustine to England. Between his death (604) and the days of Charlemagne (800) the rule spread gradually throughout western Europe save for the Celtic regions and some parts of Italy (including Rome), where a pre-Benedictine type of monachism survived in the monasteries serving city churches. In Gaul and the Rhineland Charlemagne, intent on monastic reform, could ask if there were any rule other than Benedict's, and he insisted on its exact observance throughout his empire. Henceforward Black Monks everywhere in northern and western Europe regarded St. Benedict as their patriarch.

Meanwhile monasteries had multiplied and grown both in size and in wealth, and were often great institutions with many ranges of buildings and manifold activities (*see* Monasticism; Monastery), though in wilder districts, such as northern England, simpler establishments continued to exist. During the six centuries following the death of St. Benedict these monasteries were the sole repositories of learning and literature in western Europe, and almost the sole executants of the small-scale arts and crafts of civilization, such as the writing, binding and illumination of books. They were also the principal educators, their recruitment coming largely from the children committed to their care, and at certain times and in certain regions they also maintained schools for outside pupils. As a result of these employments, and of the increasing frequency with which monks proceeded to holy orders, the practice of agricultural and heavy craft work ceased.

Charlemagne had endeavoured to unite all the monasteries of his empire in a great federation governed by the rule and a single code of customs. The attempt was too grandiose for the age, but the code was widely applied and imitated and the monks came to have a new sense of family relationship, though each abbey remained autonomous. The first real attempt at closer organization came from the Burgundian abbey of Cluny, founded near Mâcon as a reformed house in 910 by William the Pious, duke of Aquitaine. Cluny often was approached to reform other monasteries, and a succession of saintly, able and long-lived abbots, outstanding among whom were Odo, Maieul, Odilo, Hugh and Peter the Venerable, gradually built up in every country a great network of monasteries that followed the Cluniac customs and looked to Cluny for the maintenance of discipline. In time this control was tightened and regulated; the dependencies, most of which either were founded as or degraded into priories, were under the direct jurisdiction of the abbot of Cluny, to whom the monks took their vows and who had the right of appointing all superiors. The daughter-houses depended in a similar way upon their founders, and the whole "order," as it came to be called, formed a great quasi-feudal family long distinguished by strict discipline and a rich and exacting round of liturgical services. Nevertheless, though Cluniac houses were found as far apart as England, Spain and Italy, the monasteries of certain groups and regions, including (with a few exceptions) England, Germany, Normandy and southern Italy, remained outside the Cluniac organization, though they adopted, to a greater or less extent, the Cluniac customs.

Meanwhile, in England the character and rhythm of the monastic movement had been somewhat different. The only monastery known with certainty to have been founded by Augustine was at Canterbury, and there, very probably, the rule was known, but the monasteries that later were founded throughout the country seem either to have been modeled on pre-Benedictine abbeys in Gaul or, as in Northumbria, to have been offshoots of Celtic monachism. The rule was first introduced into the north by St. Wilfrid, but the real father of Benedictine monachism in England was Benedict Biscop, a Northumbrian who visited Rome and Gaul and in 668 was appointed abbot of St. Peter and St. Paul at Canterbury; later he went to Northumbria, where he founded Wearmouth (674) and Jarrow (682) in the primitive simplicity recorded by Bede, but equipped with books and a zeal for learning that made them, for more than 50 years, the brightest centre of letters and art north of the Alps. In them Bede and his disciples, and the artists of Lindisfarne, set up a tradition of learning and artistic achievement that influenced, through Alcuin and others, the whole of north-

western Europe. At the same time, learning of a more strictly classical kind had spread from Canterbury to houses in the west such as Malmesbury and Glastonbury. This first phase of English Black Monk life came to an end in the 9th century as a result of the Danish invasions, but a revival took place in the 10th century under Dunstan, Ethelwold and Oswald, assisted by King Edgar (959–975). It was then that the majority of the celebrated Black Monk abbeys—Glastonbury, Westminster, Winchester, Worcester, Ely, Abingdon and others—began or renewed their life.

During the "monastic" or "Benedictine" centuries the Black Monks were often also apostles of the faith. The work began with the mission to England, and in the two centuries that followed many of the notable apostolic bishops of England were monks, such as Paulinus of York and Wilfrid of Ripon, as were also the Celtic Aidan and Cuthbert of Lindisfarne. But the Benedictine missionaries who changed the course of European history were those of the 8th century, Willibrord the Northumbrian, the apostle of Frisia (northern Holland), and Boniface the Devonian, the apostle of Germany, with his successors Willibald and Wynbald of Wessex, who gave to the continent not only Christianity but also a church organized in the Roman tradition and the existing Anglo-Saxon monasticism. English monks, indeed, converted all Germany west of a line from Bremen to Regensburg on the Danube, and two centuries later English monks were the first successful missionaries in southern Scandinavia.

11th-Century Reforms.—When, therefore, the great age of revival and reform came in the 11th century, it found western Europe well supplied with great abbeys of the Black Monks, rich and populous. They had preserved classical and patristic literature, they had built great churches and filled them with precious and beautiful ornaments. They had given to the church all the writers and most of the outstanding bishops for more than 300 years; as feudal lords, with wide lands and extensive immunities, they were a social factor of the first importance. But their life, even when carefully regulated, might seem to differ from that supposed by the rule they professed to keep. A "family" of moderate size, composed principally of laymen, in which all the members contributed some kind of work to the common good, and in which the liturgical prayer in common was simple in form and relatively short, had given place to a large establishment of priests and clerics, who devoted a great part of their waking life to liturgical and intercessory prayer in common, and spent the residue either in sedentary literary work or in administering a large complex of buildings and estates. It is understandable, therefore, that one of the characteristic features of the reform movement was the appearance of new kinds of monastic life, usually simpler, more solitary and more austere in character. Several of these, such as the Vallombrosians (*q.v.*), Savignacs and Cistercians (*q.v.*), claimed to follow the rule more exactly or more strictly than the existing monasteries; but, since they speedily formed "orders" of their own more closely organized than the Cluniacs, they were regarded as having separated themselves from the traditional Benedictine monachism.

Yet despite these and other new forms of the religious life, the last of the monastic centuries was distinguished by the literary, intellectual and artistic achievements of the Black Monks. Lanfranc, Anselm and Abelard, who in succession led the van of the scholastic pioneers, were Black Monks, as were also the chroniclers Edmer, Orderic Vitalis and William of Malmesbury and the canonist Yves de Chartres. Throughout Europe the Romanesque style of architecture and sculpture achieved its masterpieces in Cluniac and Norman monasteries, and at St. Denis, near Paris, Abbot Suger encouraged and in some ways initiated the new style that was to become Gothic. Lanfranc in England and Suger in France also were statesmen of great eminence.

Nowhere, indeed, was the monastic order more powerful than in the domains of the Anglo-Norman monarch. At the time of the Conquest, Norman monasticism, a plant of recent growth, was reaching its height of maturity at Bec, Jumièges, St. Evroul and other abbeys, and William I drew heavily upon its resources to reform and rejuvenate the old English abbeys. Thus Bec and its daughter Caen gave no fewer than five bishops (three to Canterbury) and 13 superiors to England. At Bec in its heyday under Anselm a type of Black Monk life developed that became the model for many and is still recognizable in French and Belgian monasteries. In England at St. Albans, at Canterbury, at Westminster and at many another house, the century after the Norman Conquest was a time of material, intellectual and spiritual expansion. It was the moment, also, when the abbots of the larger monasteries of England were drawn into the feudal system, with its obligations of military service and the duty of attendance at the meetings of the great council, held three times a year.

Despite a growing entanglement in the social and political life of their world, and the competition of the new and more austere orders, the Black Monks remained throughout the 12th century in Europe the most numerous, the most wealthy and also the most active of all the orders in literary work and in the illumination of manuscripts.

From the middle of the 11th century onward there had been a tendency for a celebrated abbey to organize an "order" among its dependencies and allies for the preservation of good observance. In Normandy, Bec had an association of this type. This, however, was the work of private leaders, and in canon law, as in practice, the majority of the abbeys of Europe were still independent of any external ecclesiastical authority. In time, however, the example of the newer orders such as the Cistercians, and a certain decay of fervour in their own body, together with the tightening of organization throughout the church, led to some modification of their autonomy. In particular, the Cistercian institutions of annual chapter and visitation had proved so effective that at the fourth Lateran council (1215) they were imposed on all Black Monks, who were to be grouped for the purpose in each ecclesiastical province. The English took this decree more seriously than most, and for three centuries chapter and visitation functioned regularly. The bishops also claimed and often exercised the right of visitation, save among the newer orders, which generally were "exempted" from their control by the papacy, and in a number of individual houses that by ancient royal or more recent papal grant had secured exemption from all episcopal control.

Benedictine Monasticism in Decline.—Until after the middle of the 12th century the numbers of houses and monks continued to increase, and a constant stream of benefactions added to the Benedictines' extensive estates. Then, slowly but surely, they began to lose their paramount position all over Europe, and the centuries between the expansion of the Cistercians and the Reformation were for the older orders an autumnal season. The Black Monks had ceased to be the spiritual, intellectual and artistic leaders of western Europe, and they were ceasing also to provide great bishops and statesmen. As monks they had been outbidden by the Carthusians and the Cistercians, and the monastic ideal itself was soon to be challenged by the friars, while the new universities were drawing away the ablest young men.

Nevertheless the Benedictines, firmly established on great estates, were as wealthy and as socially important as ever. Their churches and buildings, constantly growing in size and splendour, reflected every change in architectural style and were full of precious and beautiful objects and vestments, and until the pestilences and wars of the 14th century there was no lack of recruits, though the number of monastic saints and writers was notably smaller than before. From time to time, especially in Italy, new families of reform appeared, such as the Sylvestrines and Olivetans (*see* below), and the monks somewhat tardily attempted to keep abreast of the times by frequenting Paris, Oxford and other universities, though they never made a great mark in the schools. At the same time, they were ceasing to have a monopoly in the copying and illuminating of books, and the crafts and arts of bookmaking were becoming commercialized in the towns.

Within the monasteries, meanwhile, the austerity, the solitude and the communal simplicity of life were modified; fasting and abstinence were decreasing, travel and regular periods of rest or holiday were becoming common. In many regions, of which England was one, the monks found it profitable to exploit their estates and to farm for the market, and themselves directed the

economic policy of their estates. This, and the multiplication of monastic officials, each with his own quota of land and revenues, gave employment, outside the routine of the cloister, to more than one-third of a large community. At the same time, the abbot, who in early times had shared the life of his monks and devoted himself to pastoral care of their welfare, became more and more an independent prelate with lands and a household of his own. Worse still, all over northwestern Europe (save for England) the practice grew up of popes, and later monarchs with papal privileges, bestowing abbeys *in commendam* to a secular prelate or lay magnate who then occupied the abbot's lodgings and enjoyed his revenues while the community was governed by a prior of his appointment. In France in particular, where the disasters of war had borne so hardly on the religious houses, the practice of *commendam* was universal in the 15th century.

These evils were attacked in several countries long before the cataclysm of the Reformation. Reformers had two objects in mind: the betterment of observance and of discipline in general, a return to a more regular and austere life, and, second, the provision of effective machinery to guarantee permanence to good endeavour. This machinery was found in the congregation, a development of the conciliar legislation of 1216 by which a group of like-minded or neighbouring houses came together not only for periodical chapters and visitations but as a permanent association, adopting a fixed set of constitutions and governed by a prelate or a council. Generally speaking, in Latin lands the plague of *commendam* drove reformers to take the revolutionary step of dropping the abbot and resting authority in an elected chapter, whereas in German lands the abbot remained but was made accountable to the chapter. The first and most important member of the former class was the congregation of Sta. Giustina of Padua (1424). In this congregation abbots were elected for three years, and the monks no longer took vows to a house but to the congregation; the ruling authority was general chapter acting through a small executive committee and a standing group of visitors under a president. This radical reform spread within a century to all the Black Monks of Italy and became known as the Cassinese congregation. The German reforms were less revolutionary. In that of Bursfeld in Westphalia (1434) the observance was based on Sta. Giustina: the abbot's domestic authority was retained, but over-all powers rested with the abbot president at Bursfeld, controlled by an annual general chapter. There were other smaller reforms in France and Hungary, and in Spain the congregation of Valladolid (1390–1492) came to resemble that of the Cassinese. A feature of most of these reforms was emphasis on private prayer and on creative intellectual work to replace the obsolete pursuit of writing and illuminating manuscripts.

The Reformation and After.—These reforms were powerless to hinder either the gradual decline of the church or the course of the 16th-century revolt. Within a few years (1525–60) the monasteries disappeared almost entirely from west Germany, Switzerland, Holland and Great Britain, and for almost a century there was a steady wastage in France and central Europe owing to the wars of religion; by 1600 only Italy and the Iberian peninsula remained intact. A revival began almost at once, and the century that followed was one of the brightest in Benedictine annals. France, in the epoch of its greatest splendour, took the lead with the congregations of St. Vanne (Verdun, 1604) and St. Maur (Paris, 1621), based on the model of Sta. Giustina, with temporary superiors and vows taken to the congregation rather than to the house. These remained for a century observant and well-disciplined, and are notable as having found an answer, at least for their country and century, to the problem of employment. They organized a higher education for their monks, undertook preaching and education, and above all encouraged creative historical and critical work. For more than a century the French monks, and above all the Maurists (*q.v.*), practised a vast literary activity that won for the whole Benedictine body the undeserved title of "learned." Meanwhile the Cassinese and Spanish congregations continued to flourish, as did a number of smaller bodies in German lands. Mention also may be made of the English congregation, consisting of four houses of exiles, modeled on the congregation of Valladolid; the monks took a special vow to go on the English mission, and for 70 years (1619–88) a steady flow of recruits, many of distinguished birth or talents, kept the houses at full strength.

In the early 18th century the blight of Jansenism and the chilling wind of rationalism withered the monasticism of France, and much of the spirit of fervour had vanished both there and in Italy before the Revolution, while in the Habsburg dominions the program of the emperor Joseph had reduced both numbers and hopes for the monks. What enlightenment had begun the Revolution and Napoleon completed, and the cataclysm that followed seemed at the time even more complete than that of three centuries earlier. The liberal revolution in Spain and elsewhere completed the ruin. In the third decade of the 19th century there were probably fewer Benedictine houses in existence than at any time since the days of Gregory the Great. Only in the German-speaking lands a few ancient abbeys managed to survive, and in them there was little enthusiasm.

The renascence came with unexpected rapidity, taking place principally in four foundations in France, Germany and Italy. In two of these a characteristic feature was the re-establishment of a fully liturgical life, reminiscent of the abbeys of the middle ages; in the other two the aim was to reproduce as nearly as might be the monastic life of the rule.

Solesmes.—The first in time was Solesmes, in the diocese of Le Mans, founded in 1837 by Prosper Guéranger (*q.v.*), one of the leaders of ultramontanism and author of popular works on the liturgy. His aim, continued by his successors, was to renew the tradition of learning of the Maurists and to revive a rich liturgical life with the accompaniment of plain chant in its purest form. There Guéranger began a tradition that was raised to the high level of scholarship and execution by J. Pothier and A. Mocquereau. The monks have produced successive critical editions of the Roman and monastic gradual and antiphoner that have been recognized by the Holy See as official. Solesmes became mother abbey of a congregation of autonomous houses, and remains celebrated for its performance and editions of the chant. At other abbeys—such as Ligugé (France), Silos (Spain), Farnborough (England) and Clervaux (Luxembourg)—higher studies in history and liturgy were developed. Monks of this congregation have worked also on the revision of the Vulgate, since 1932 in the abbey of St. Jerome at Rome. The names of Fernand Cabrol, J. Besse, Henri Leclercq, André Wilmart and Henri Quentin are among their scholars.

Beuron.—In Germany the ancient Bavarian congregation was revived in 1858, but a more notable event was the foundation of Beuron (Hohenzollern) by the brothers Wolter, and the inauguration of a congregation (1868) noted for its liturgical life and observance, with lay brothers for farm and craft work. The Beuronese, whose expansion coincided with the decades of German expansion before 1914, had houses in England, Portugal, Brazil and Belgium; in the last-named Maredsous became noted for its scholarship with A. Janssens, Germain Morin, J. Chapman and U. Berlière, the first editor of the *Revue Bénédictine*.

A third German congregation, that of St. Ottilien in Bavaria, devoted itself to foreign missions, with abbeys in east Africa, Manchuria, Venezuela and other places.

Subiaco.—Meanwhile in Italy Don Casarello established (1851) a group of houses forming the Subiaco congregation of Primitive Observance, with the restitution of the night office and the traditional monastic fasts; secularization in Italy and foreign foundations soon transformed this into an international body with regional provinces. Later, under revised (1872) constitutions and a more traditional form of government, this congregation spread widely, especially in and from the French abbey of Pierre-qui-Vire which stands, if the phrase may be allowed, at the extreme left wing of the order, almost indistinguishable from the reformed Cistercians.

England.—The English monks, who had continued to work as individuals on the English mission, returned corporately during the French Revolution, and throughout the 19th century St. Gregory's (Downside), St. Laurence's (Ampleforth) and St. Ed-

mund's (in Douai in France until 1903 and now in Berkshire) slowly developed. After 1900 the growth was more rapid, and by 1960 the congregation numbered eight autonomous houses in Britain, several of them running large boarding schools. Downside, with F. A. Gasquet, Cuthbert Butler, R. H. Connolly and others, gained a reputation for scholarship.

Other Countries.—In North America a foundation was made by the Bavarian congregation among German immigrants at St. Vincent's (Beatty, Pa.) in 1846, which later (1855) became archabbey of the American-Cassinese congregation, counting 17 houses in the early 1960s. Shortly after, Swiss monks from Einsiedeln settled at St. Meinrad's (Indiana) in 1855, which also became head (1881) of a congregation with 11 houses. Both of these subsequently made foundations in Canada. In South America foundations made by the Portuguese congregation (1827) were revived in Brazil by Beuronese monks; Silos (Spain) and Einsiedeln have houses in Argentina. In Africa and India (and until 1939 also in China and Korea) quasi missionary abbeys exist, and there are Spanish monks in northern Australia.

Summary.—The Benedictine world map is therefore something of a mosaic. Not only do national congregations exist side by side with international and missionary congregations, but the national congregations themselves have foundations abroad (*e.g.,* the English in the United States, the French in England and Canada). Similarly, observances and occupations of all kinds exist—the austere quasi Cistercian regime of Pierre-qui-Vire, the claustral liturgical life at Beuron and Solesmes, the more extroverted life of the English, American and Swiss congregations. It is easy to understand that Leo XIII, after his success with the Cistercians, should have desired to bring about some sort of unity among the Benedictines. The age-old spirit of the Black Monks, however, stood strongly for individuality and for what might be called the biological evolution of the monastic species. After building the international college of Sant' Anselmo at Rome (1890), the pope was content with the establishment of an abbot primate as its head, without direct jurisdiction over any other monks, but available as an arbiter, papal visitor and *officieux* representative of the Black Monks to the Holy See. After that date his office remained undeveloped; elected by the abbots of the order, he would probably always represent conservative opinion.

Despite two world wars with their casualties and moratorium on recruitment, and despite the dissolution of three colonial empires, the Benedictines continue to grow: the 6,000 of 1910 became the 12,000 of 1957. The survival and constant rejuvenation of the oldest and in many ways the most flexible religious institute is an interesting historical phenomenon. The Benedictines have remained, if the phrase be allowed, the least "professional" (one had almost said the least "clerical") of the militia of the church. They have never been identified with a particular school of theology or spirituality, or with a particular social or political program. Their faults throughout the ages have been the accumulation of wealth, the immobility of conservatism and the tendency to sink from the true golden mean to a mediocrity of comfort or even luxury. To the outside world they have stood for the beautiful performance of the liturgy, for the acquiring and imparting of learning and for a courteous and humane life in community.

INDEPENDENT ORDERS

When the expansive force of the Cistercians was exhausted, the middle ages saw the rise in Italy of three Benedictine reforms that in time became independent orders outside the main stream of Black Monk life.

Sylvestrines.—The Sylvestrines (Congregatio Silvestrina O.S.B.) were founded in 1231 by St. Silvester Gozzolini (1177–1267), a lawyer and canon, who when converted settled with his associates on Montefano near Fabriano in Italy. They followed the Benedictine rule, interpreted strictly with an emphasis on abstinence and poverty, and flourished in the middle ages in Italy, with later foundations in Portugal and Brazil. They founded half-a-dozen small houses in Italy, and after 1855 also organized a missionary abbey that administers the diocese of Kandy in Ceylon. They wear a Benedictine habit of dark blue cloth.

Celestines.—The Celestines were founded by the hermit Peter of Morrone (*c.* 1215–96), who took the name Celestine V when elected in 1294 to the papal office, and subsequently six months later made the "great refusal" and returned to his monks. Earlier approved by Urban IV (1264), the hermits of Monte Morrone, who applied the Benedictine rule to an eremitical institute, spread rapidly in Italy, France and the Netherlands, and numbered at one time 150 houses. Henry V of England proposed to make a foundation in his country, but the scheme fell through. The head house at Sulmona in the Abruzzi alone had an abbot, and the constitutions of the order, with its regular general chapters of priors and delegates under the abbot general, resembled those of the Franciscans. The Celestines, who wore a white tunic with black scapular and hood, disappeared in the Revolutionary era.

Olivetans.—The Olivetans (O.S.B. Montis Oliveti) owed their origin to Bernard Tolomei (d. 1348) of Siena, who retired in 1313 to Monte Accona in Umbria with two companions as hermits. They adopted the rule of St. Benedict, strictly interpreted, and were approved by Pope Clement VI in 1344, changing the name of their home to Monte Oliveto in honour of the Passion of Christ. Despite their austere regime they multiplied rapidly to about 100 houses, mostly in Italy, among which was S. Miniato at Florence. There are several houses in Italy and France with an abbey in Brazil and a colony in England (Cockfosters).

From the beginning their superiors were elected for short periods only; the abbot general is elected for life. In 1962 the Olivetans ceased to be an independent order and became a Benedictine congregation. Olivetan nuns exist in Italy, Switzerland, England (Cockfosters) and in the United States (Jonesboro, Ark.).

BENEDICTINE NUNS

Benedictine nuns count as their patroness Scholastica, the sister of St. Benedict who, as St. Gregory the Great tells, was a dedicated virgin living by her brother's counsel. There is no certainty, however, that the rule was applied to women before the 7th century. Thenceforward it spread, for women as for men, in Merovingian France and Anglo-Saxon England, though often alongside other customaries. In the 8th century English nuns corresponded with St. Boniface and followed him to Germany, where numerous important houses were founded. Later still in the English revival of the 10th century several abbeys, fully Benedictine, came into being in the kingdom of Wessex, among them Shaftesbury, Wilton, Romsey and Winchester. In the great monastic revival of the 11th century a rapid growth took place, when many celebrated nunneries were founded all over Europe and many great abbeys of monks had a corresponding house at no great distance. Thus Marcigny became a centre of Cluniac influence, and several of the new orders had from the beginning a sister institute. In France the aristocratic abbey of Fontevrault and in England the house of Sempringham became head houses of orders that included groups of chaplains and brothers but followed the rule of St. Benedict. Highly educated in the Anglo-Saxon age and in the 12th century, and throughout the middle ages serving as *pensionnats* for daughters of the well to do, the choir nuns were recruited almost entirely from the landed families and rich bourgeois, certain houses being strict preserves of the aristocracy. Germany in particular during the 12th and 13th centuries saw a golden age of spiritual achievement at Admont, Schönau and many other great abbeys, illustrated by the mystics Hildegard, Gertrude the Great and the two Mechtilds of Hackeborn and Magdeburg.

Save for the nuns of recognized "orders," women following the rule were normally under episcopal jurisdiction, though a few were directly governed by a neighbouring abbot. Isolated for the most part, they declined in fervour in the later middle ages when many houses became asylums for unmarried women with little or no sense of vocation, but the level of observance and virtue was generally higher than that of the contemporary monks. In the lands lost to the church at the Reformation, the nunneries, often unwillingly, were disbanded; in Catholic countries reformed and decadent houses existed side by side until the widespread revival of the 17th century.

The Council of Trent, by decreeing strict enclosure and other reforms, inaugurated a period of magnificent expansion, directed by Jesuits and Capuchins as well as by monks; France, south Germany and Austria were favoured countries, and new congregations came into being such as those of Perpetual Adoration in Paris (1653) and the penitential group of Our Lady of Calvary (1617). Though not unaffected by wealth, the nuns of Europe were in better heart than the monks when the Revolution came. Englishwomen had made several foundations in exile in France and the Low Countries; some of these in due course returned to England, among them that at Cambrai, which moved to Stanbrook, Worcestershire, and that at Brussels, which moved to Haslemere, Surrey.

The nuns followed the rhythm of the 19th-century monastic revival, and many of the new congregations, such as Solesmes and Beuron, had nunneries under their jurisdiction. In the late 19th and 20th centuries all kinds of new institutes following the rule arose; while the *moniales*, the traditional Benedictines, retain strict enclosure and the full liturgical, contemplative life, numerous groups of sisters (*sorores*) followed the rule while engaged in teaching, nursing and other social and missionary work all over the world, some under monastic superiors, others under bishops. By 1960 the total number reached about 20,000, almost treble the figure in 1900.

See ORDERS AND CONGREGATIONS, RELIGIOUS. *See* also Index references under "Benedictines" in the Index volume.

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BENEDICTUS, the song of thanksgiving of Zacharias on the occasion of the birth of his son, John the Baptist (Luke i, 68–79), so called from the opening word of the Latin version. The hymn has been used in Christian worship since at least the 9th century, being sung liturgically at Lauds in the Roman Catholic Church and from this usage adopted into the Anglican Order of Morning Prayer.

The name is also given to a part of the Roman Catholic Mass service beginning *Benedictus qui venit* ("Blessed be he who comes [in the name of the Lord]"; Matt. xxi, 9), following the Sanctus.

BENEDICTUS ABBAS (d. 1194), abbot of Peterborough, first makes his appearance in 1174 as the chancellor of Richard, the successor of Thomas Becket as archbishop of Canterbury. In 1175 Benedictus became prior of Holy Trinity, Canterbury; in 1177 he received from Henry II the abbacy of Peterborough, which he held until his death. Benedictus wrote two works, one dealing with the martyrdom and one with the miracles of Becket. Fragments of the former work have come down in the compilation known as the *Quadrilogus*, which is printed in the fourth volume of J. C. Robertson's *Materials for the History of Thomas Becket;* the work on the miracles is extant in its entirety, and is printed in the second volume of the same collection. Benedictus used to be regarded as the author of an important chronicle, the *Gesta Henrici regis secundi*, but in fact he merely caused the first section of this work to be transcribed for the Peterborough library. It is only through the force of custom that it is still occasionally cited under the name of Benedictus.

See W. Stubbs, *Gesta regis Henrici secundi Benedicti abbatis* (1867) and particularly the preface to the first volume.

(H. W. C. D.; F. M. P.)

BENEFICE, from the Latin *beneficium* ("a kindness," "a benefit"), came into use in the 8th century in the kingdom of the Franks as a term for a particular kind of land tenure. A Frankish sovereign or lord, the seigneur, leased an estate to a free man on easy terms *in beneficium* ("for the benefit of the tenant") and this came to be called a *beneficium*, a benefice. The lease normally came to an end on the death of the seigneur or of the tenant, though holders of benefices often succeeded in turning them into hereditary holdings. If the lease was reduced to writing there were two documents, one from the tenant called a *precaria*, one from the seigneur called a *praestaria*. As an ordinary form of land tenure, the benefice was eventually superseded by the fief or fee (*q.v.*).

Although benefice was dying out by the 12th century as a term for a feudal land tenure, it retained an important place in the law of the Roman Catholic Church and the Church of England. In the early days of the church its endowments in each city were centralized under the administration of the bishop; from them he paid the stipends of the clergy, but there was no endowment attached to a particular ecclesiastical office. Early village churches were founded largely by bishops, who committed the care of each church to a priest (or constituted him the priest of the village church). Each village church had its own endowments, administered by the priest under the supervision of the bishop, and from them were paid his own stipend and the stipends of the other clergy serving the church, but there was no particular endowment specially set apart for the payment of the priest. By the 8th century churches were being founded in villages by the seigneurs, usually laymen, who were allowed to appoint the priest. Parish churches thus fell into two groups, the earlier type founded and controlled by bishops, the later type under the control of the lay seigneur. Both bishops and lay seigneurs began to treat each church and its endowments as property to be leased like any other part of their estates, and appointed the priest by leasing to him as a piece of property the church and its endowment in return for carrying out the spiritual duties.

Various forms of lease were adopted, some involving the priest in a heavy rent and labour services, some like the *livello*, popular in Italy, giving the priest wide and lucrative rights over the property of the church. Among the leases adopted by bishops and lay seigneurs was the lease *in beneficium*. Sometimes the church was leased to a layman who paid a priest to carry out the spiritual duties. In this case, part of the endowment was set aside to be leased by him to a priest as a benefice and called a *beneficium*, or *presbyteratus* or *fevum presbyteri* ("the priest's fief"). The priest held the church for life, unless a term of years was specifically mentioned in the lease; and in return he paid a token rent to the seigneur (though he had to pay a heavy fee at the outset for the grant of the lease), kept the church and its farm buildings in repair and its lands in cultivation and conducted the church services. Benefice terminology was not used in England before the Norman Conquest. In Anglo-Saxon England the priest held his church for life, paying the seigneur or thane a rent of twopence an acre for the glebe.

In the 12th century benefice came to mean an ecclesiastical estate, consisting largely of tithe, glebe and offerings, which was permanently attached to an ecclesiastical office and had to be leased to the holder of the office for the time being. The procedure was made to conform to the ideals of Gregory VII (1073–85) and his school, one tenet of which was that a lay seigneur could not grant an ecclesiastical office directly to a priest or receive any rent or payment for it. The lay seigneur of the church therefore became the patron, owning not the church itself but its advowson or patronage; he chose the priest but could not lease him the church or receive any rent for it. The church had to be leased or granted to the priest by the bishop.

The procedure consisted of three stages. First, the patron presented the priest of his choice to the bishop. Second, the bishop admitted and instituted the priest to the church and cure of souls (he had only a very limited power of refusing the patron's nominee); in the middle ages the bishop accompanied the institution by an investiture with a ring and in the post-Tridentine period in Europe with a biretta. Where the bishop was patron, there was of course no presentation and the institution was called a collation. Third, on behalf of the bishop, the archdeacon inducted the priest into the benefice or invested him with it by placing his hand on the door key of the church, and the priest rang the bell to show he now had full possession of the benefice. This procedure has remained in use in the Church of England. Once inducted the priest holds the church for life or until he resigns and his resignation is accepted by the bishop. Otherwise he is only bound

to vacate the benefice if he is deprived of it in a court of law or if he is instituted to another benefice with a cure of souls, in which case he automatically vacates the first benefice unless he has a dispensation to hold two or more benefices in plurality. In the middle ages a dispensation to hold benefices in plurality had to be obtained from the pope, but in the Church of England after the Reformation the dispensing authority became the archbishop of Canterbury.

The procedure in the Church of England for giving a benefice to a priest and the terms on which he holds it have been modified in two respects. The bishop has wider powers of refusing the patron's nominee and, in a vacancy, the parochial church council has the right to be consulted before an appointment is made. The circumstances under which a priest can be removed from his benefice have been enlarged: a priest must vacate his benefice if he is found guilty of conduct unbecoming the character of a clerk in holy orders or of serious, persistent or continuous neglect of duty, or if he is found unable to discharge adequately the duties attaching to his benefice. In the Roman Catholic Church (*see* canon 2147 of the *Codex juris canonici*) the circumstances under which a priest can be removed from his benefice have similarly been enlarged. The benefice system, by making the parish priest dependent on no man's pleasure for his income or continuance in office, gave him an immeasurable status and strength in carrying out his duties.

See also PARISH; TITHES.

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BENEFIT SOCIETY, an association formed to provide its members, or the heirs or dependents of members, with certain benefits such as payments for funeral costs and allowances during illness and for other purposes. Burial societies were among the earliest of such associations in the United States. Benefit societies, usually known as "friendly societies" (*see* FRIENDLY SOCIETY) in the United Kingdom are, in fact, mutual insurance societies. Their activities range over a wide field, sometimes including social activities that are not necessarily associated with their principal purpose. In the United Kingdom most friendly societies have acquired a legal status as "approved societies" under the National Insurance Act. In the United States such societies are governed by the insurance laws of the several states. *See* also FRATERNAL ORGANIZATION. (FK. L. K.)

BENE-ISRAEL (BENI-ISRAEL), native Jews of India, who derive from the province of Bombay. The original company of Jews that landed on the western coast of India—about the 4th or 6th century A.D., according to their own tradition—received a charter, inscribed on copper tablets which have been preserved. The language is Tamil, the script is archaic, and the dates suggested by scholars vary from the 1st to the 11th century. There is no doubt that proselytes in large numbers joined the original community in the course of time, chiefly through slavery and polygamy, and in appearance the Bene-Israel differ little from their Hindu neighbours. They claim "pure" Jewish descent, however, pointing to the practice of separating the Black Jews, or former slaves, and treating them as a lower caste. The women wear Hindu dress, the men European.

For many centuries, the religious customs of the Bene-Israel varied greatly from those of talmudic Jews. Under Rahabi (*c.* A.D. 900) they underwent a religious revival and then, under Divekar (1796), were brought close to orthodox practice.

After the establishment of the state of Israel, many Bene-Israel emigrated there in the early 1950s, only to find that they were not regarded as Jews in good standing insofar as the right to marry other Jews was concerned; the chief rabbinate regarded them as a community in which bastards (in the technical sense that the prescribed talmudic procedures for marriage and divorce had not been followed) were intermingled, and thus barred on the basis of Deut. 23:3[2].

A compromise was finally worked out in 1964; the Israeli rabbinate recognized the community as a whole as being Jewish but reserved the right to question the legitimacy of any individual who might seek to marry a person from another community.

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BENELUX. The so-called Benelux customs union agreement was signed at London on Sept. 5, 1944, between the governments of Belgium, the Netherlands and Luxembourg. It was revised by the Hague protocol, March 14, 1947, and came into operation at the beginning of 1948. On July 25, 1921, Belgium and Luxembourg had previously formed an economic union which continued to exist independently.

Benelux was an agreement to abolish tariff duties within the union and to apply a common tariff to imports from other countries. The contracting governments retained their sovereignty and were separately represented abroad. For commodities appearing in the tariffs of the Netherlands and the Belgian-Luxembourg union, the common tariff imposed rates halfway between the Dutch and the higher Belgian duties.

The free list, which had been extensive in the Dutch tariff, was much reduced so that the net effect of the customs union was to raise tariffs against other countries. Within the union, quantitative restrictions such as import licences and quotas, as well as subsidies, remained, and elaborate provisions were adopted to safeguard any damage to national production that might result from their progressive removal. After 1950, in pursuance of trade liberalization under the European Payments union, most of these restrictions were eliminated; but the effect on wages and the mobility of labour and capital was limited, largely as a result of cartel action.

Benelux was once regarded as a promising experiment by which neighbouring countries would form customs unions which might then merge into wider unions. There were negotiations between France and Italy and some discussion of the merging of Benelux and a Franco-Italian union into one body (to be called Fritalux); but following the formation of the European Coal and Steel Community in 1953, interest shifted to wider plans for European integration resulting in the formation of the European Economic Community in 1958, of which Belgium, Luxembourg and the Netherlands were members, together with France, Italy and Germany.

See also BELGIUM; NETHERLANDS, THE; LUXEMBOURG; PAN-EUROPEAN MOVEMENT.

See Jacob Viner, *The Customs Union Issue* (New York, London, 1950). (J. B. CE.)

BENES, EDVARD (1884–1948), Czechoslovak statesman who served as foreign minister of his country from 1918 to 1935 and as head of state from 1935 to 1938 and from 1940 to 1948, was born on May 28, 1884, in the village of Kozlany in northwestern Bohemia. He was the tenth and youngest child of a Czech farmer but received a good education. He studied at the universities of Prague, of Paris and of Dijon, where he qualified as a doctor of laws in 1908. After lecturing at the Prague commercial academy from 1909, he began to teach at the Czech university in Prague in 1913.

Meanwhile Benes had come under the influence of T. G. Masaryk (*q.v.*), whose Realist party he joined; thereafter he tried always to serve Masaryk's conception of constitutional democracy. After the outbreak of World War I he was eager to follow Masaryk's lead in liberating the Czechs from Austrian rule and was high in Masaryk's confidence. In the autumn of 1915 he joined Masaryk in Switzerland, where they began their efforts to mobilize world opinion against the Habsburg regime. Masaryk then went to London, but Benes returned to Paris with the Slovak leader, Milan Stefanik. These men formed a Czechoslovak foreign committee, which in Jan. 1916 became the Czechoslovak National council, with Masaryk as president and Benes as secretary-general. The council gradually developed into the provisional government of emergent Czechoslovakia; on Oct. 14, 1918, Benes notified the Allied powers of the establishment of this interim regime with himself as minister of foreign affairs. By the end of the year

the first Czechoslovak republic was launched, and in 1919 Benes led the Czechoslovak delegation to the peace conference in Paris. (*See* CZECHOSLOVAKIA: *History.*)

Benes remained at the head of the Czechoslovak foreign office for 17 years; during one of these, 1921–22, he was also prime minister. From 1920 onward he led the Czechoslovak delegation to the new League of Nations, in which he played an important part. He was indeed one of the architects of the Geneva protocol drawn up in 1924, according to which the gap in the League covenant was to be filled and arbitration between its members made compulsory. As the representative of a newly created state, he looked to the new international organization for the preservation of the *status quo.* Within the framework of the League he initiated the triple alliance between Czechoslovakia, Rumania and Yugoslavia which became known as the little entente (*q.v.*).

In 1918 French opinion was divided on the future of the former Habsburg lands, and Benes would have wished to be at least as closely linked with London as with Paris. The British, however, fought shy of continental entanglements and opposed the Geneva protocol, leaving him little choice but to lean on France. From the beginning he was unpopular in the new state of Poland. There was an old feud between the Poles and the Czechs, for the latter preferred the Russians. In July 1920, when Poland faced a Soviet invasion, the Czechs blocked war material sent from France to the aid of Poland and took advantage of the situation in order to acquire the lion's share of the disputed territory of Tesin (Cieszyn). It would have been difficult for any Czech foreign minister to have been more conciliatory to the Poles, but Benes was held personally responsible in Warsaw. When Hitler came to power and Germany left the League of Nations in 1933 it was natural for that organization to look more favourably on the U.S.S.R. Thus in 1934, soon after Benes had established diplomatic relations with Moscow in June, the U.S.S.R. was admitted into the League. The propaganda which now poured from Nazi Germany depicted Benes as a Communist agent who oppressed the German minority in Czechoslovakia.

On Dec. 18, 1935, Benes was elected president of the republic in succession to Masaryk, who had retired and who died in Sept. 1937. Thus it became easier to focus hostile attacks on Benes, who was left in isolation to face the crisis of 1938. When it became clear in September of that year that the Czechoslovaks would have to fight Germany by themselves if they resisted Hitler's demands for the cession of the frontier districts which were mainly German-speaking, Benes bore the whole responsibility for the decision to give way. On Oct. 5, 1938, he resigned the presidency and went into exile.

After the outbreak of World War II Benes established a Czechoslovak national committee and military unit in France, but after the collapse of that country he had to begin again in Great Britain. He resumed the presidency of a provisional government in London on July 23, 1940, but it was not until July 18, 1941, that he was fully recognized as head of state by the British government. In spite of friction in London with his old rival, the Slovak Stefan Osusky, and with the Sudeten German Socialist Wenzel Jaksch, he was full of optimism during the war. On July 18, 1941, recognition had also come from the U.S.S.R. Above all things he hoped that the old link between Czechs and Russians would enable him to ride the crest of the wave of pro-Soviet feeling which swept over the western world after the battle of Stalingrad. On Dec. 11, 1943, he arrived in Moscow and on Dec. 12 signed a treaty of alliance with the U.S.S.R. From then onward he regarded himself as a special link between the U.S.S.R. and the west, although he felt obliged to support Moscow against the west over Poland.

On March 17, 1945, Benes visited Moscow a second time on his way to Kosice in Slovakia, where he set up the temporary headquarters of the restored Czechoslovak government on April 3. On May 16 he was welcomed back enthusiastically by the population of Prague. Soviet armies had liberated Czechoslovakia from the Germans, and Benes and his supporters were glad to have escaped the fate of the Polish and Yugoslav governments in exile; he seemed not to have realized that Stalin had no intention of giving him a free hand to rule the second republic democratically. He was only 61 but his health was impoverished, and in 1947 he suffered two strokes from which he only partially recovered. On Feb. 25, 1948, his Communist prime minister, Klement Gottwald, demanded from him that he should accept a Communist-dominated cabinet. All the Communist organizations in the country were mobilized to enforce the demand, and Benes was again obliged to make a fateful surrender: having refused to sign the new constitution, he resigned the presidency on June 7. After the death of his lifelong friend, Jan Masaryk (*q.v.*), in March, it is no exaggeration to say that he died of a broken heart at his home at Sezimovo Usti on Sept. 3, 1948. He wrote *My War Memoirs* (Eng. trans., 1928) and left unfinished his *Memoirs: From Munich to New War and New Victory* (Eng. trans., 1954).

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BENÉT, STEPHEN VINCENT (1898–1943), U.S. poet, novelist and writer of short stories, was best known for *John Brown's Body,* a long narrative poem on the Civil War. He was born in Bethlehem, Pa., July 22, 1898, into a military family with literary inclinations, and was reared in army posts. His father read poetry aloud to Stephen, an older brother, William Rose, and a sister, Laura. All of them became writers. Inspired by his father's and grandfather's campaign records, Stephen became an avid reader of military history as well as of Alexandre Dumas, Howard Pyle and William Morris. He began writing at an early age and published his first book at 17. Civilian government service during World War I interrupted his education at Yale university. He received his A.M. degree, after the war, submitting his third volume of poems instead of a thesis.

After publishing the much-admired *Ballad of William Sycamore 1790–1880* (1923), three novels and a number of short stories, he returned to France, with his wife, Rosemary Carr Benét. While there on a Guggenheim fellowship he wrote *John Brown's Body* (1928), which was called by the historian, Henry Steele Commager, "not only the best poem about the Civil War, and the best narrative," but also "the best history." The poem, however, has several weaknesses: it lacks unity of style and subject; the diction is often infelicitous; the verse forms are too facile and the characters lack depth. The best parts undoubtedly are the ballads. For this work, Benét received the Pulitzer award for poetry in 1929, and was probably read more widely in the United States than any comparable work. *A Book of Americans* (1933), poems written with his wife, brought many historical characters to life for U.S. school children. Benét's preoccupation with historical themes was also the basis for *Western Star,* an ambitious story of America, first planned in 1934 as possibly five books, but left uncompleted at the time of his death. Book I, complete in itself and finished in 1942, was published posthumously, and won for Benét a second Pulitzer prize. The poem lacks unity and depth; it is all too clear and all too facile.

Benét's models were minor contemporary poems, rather than the great traditional ones. He was at his best in his less ambitious work—in his light or ironic verse ("For City Spring" and "Evening and Morning"); in his ballads ("Captain Kidd," "Thomas Jefferson," "The Mountain Whippoorwill"); and in his New York poems ("Metropolitan Nightmare" and "Notes to Be Left in a Cornerstone"). In all Benét published over 17 volumes of prose and verse. His best-known short story, *The Devil and Daniel Webster* (1937), a humorous treatment of a folklore theme, was the basis for a play, an opera and a motion picture. He died in New York city on March 13, 1943.

His older brother, WILLIAM ROSE BENÉT (1886–1950), poet and critic, was born Feb. 2, 1886, at Fort Hamilton, N.Y., and died in New York city on May 4, 1950. His second wife was the poet, Elinor Wylie, whose *Collected Poems* (1932) he edited after her death. He held various positions as critic and editor, finally that of poetry critic for the *Saturday Review of Literature.* The weaknesses in his criticism result from his inability to be objective. He wrote 12 volumes of verse, one of which, *The Dust Which Is God,* won a Pulitzer prize in 1942, and four volumes of prose.

See Charles Fenton, *Stephen Vincent Benét* (1958), a biography.
(J. G. SH.)

BENEVENTO, a city of south central Italy in the region of Campania, capital of the province of the same name and an archiepiscopal see, is situated on a ridge between the Calore river and its tributary the Sabato, 62 km. (38.5 mi.) N.E. of Naples, by road. Pop. (1957 est.) 53,382. The cathedral (founded in the 7th century, enlarged in the 12th and 13th centuries and severely shattered during World War II, but later reconstructed) has magnificent bronze doors and the interior is divided into five aisles by Doric columns. The cloister of S. Sophia is of the 12th century. The Ponte Vanvitelli over the Calore was built by Luigi Vanvitelli. The most important monuments, however, are those from classical days and include Trajan's arch (Porta Aurea) erected in A.D. 114–115, the Roman theatre, and the Ponte Lebroso, a bridge over the Sabato.

Originally an Oscan or Samnite city, Malies, later known as Maleventum or Maluentum, it was supposedly founded by Diomedes, companion of Ulysses. The Romans changed its name to Beneventum (*Bonus Eventus*). With Capua it became an important town on the Appian way and was a base for Roman expansion in south Italy. In 275 B.C., Pyrrhus, king of Epirus, fought his last battle against the Romans at Maleventum. He was defeated by the combined forces of Lucius Cornelius Lentulus and Manius Curius Dentatus. Plutarch, Livy and Horace mention the battle. In the middle ages it passed, after partial destruction by Totila in A.D. 452, from the Lombards to the Byzantines and then to the papacy. On Feb. 26, 1266, Charles of Anjou, brother of "Saint" Louis IX, king of France, there defeated and killed Manfred, king of Naples and Sicily, son of the emperor Frederick II of Swabia. Charles had been appealed to by Pope Clement IV who feared the power of the Swabian rulers. His victory marked the beginning of the predominance of the Angevins in Sicily. Manfred is commemorated in Dante's *Purgatoria* (Canto III). The city remained in papal hands until 1806 when Napoleon granted it to Charles Maurice de Talleyrand-Périgord, with the title of prince. In 1815 it was returned to the papacy, but was united with Italy in 1860. Damaged by earthquakes, it was further devastated by air raids during World War II prior to its capture by Allied forces on Oct. 3, 1943.

The basic economy of the city is agriculture with wheat, grapes, olives and vegetables as the main products. Two characteristic products of Benevento are almond cakes and a liqueur called Strega. Bricks, matches, chocolate and biscuits are produced, as well as agricultural machinery. Benevento was one of the first places in Italy to grow tobacco.

BENEVENTO PROVINCE is entirely inland, situated in the Apennine mountains. Area 796 sq.mi.; pop. (1961) 313,950. After the capital, the main towns are Sant'Agata de Goti and San Bartolomeo in Galdo. The chief rivers are the Volturno and its tributary, the Calore. (M. T. A. N.)

BENEVOLENCE, a term used in a special sense to indicate sums of money, disguised as gifts, which were extorted by various English kings from their subjects without consent of parliament. Edward II and Richard II had obtained funds by resorting to forced loans, a practice which was probably not unusual in earlier times. Edward IV, however, discarded even the pretense of repayment, and in 1473 the word "benevolence" was first used with reference to a royal demand for a gift. Edward was very successful in these efforts. But when Richard III sought to emulate his brother's example protests led to the passing of an act of parliament in 1484 abolishing benevolences as "new and unlawful inventions." In spite of this act Richard demanded a further benevolence in 1485, although he kept technically within the letter of the law by calling it a loan and promising repayment. But it was Henry VII who made the most extensive use of the system. Indeed, in 1495 parliament passed an act making those who had promised gifts legally liable for any unpaid arrears. In 1528 Henry VIII demanded a benevolence, and in 1545 he demanded a "loving contribution" from all who possessed lands worth not less than 40*s.* a year or chattels to the value of £15.

The practice was abandoned by the later Tudors. In 1614, however, some bishops and courtiers offered free gifts to James I and the City answered his request for a loan by saying that it would rather give him £10,000 than lend him £100,000. These offers, which brought in more than £20,000, encouraged James to order the collection of a general benevolence from all persons of ability, and about £40,000 was collected. Four counties had, however, distinguished themselves by protests against this demand, and some objectors had cited the act of Richard III. Representatives from the four counties were called before the privy council, where Sir Edward Coke defended the action of the king, quoted the Tudor precedents and urged that the act of 1484 was to prevent exactions, not voluntary gifts. In 1615 an attempt to exact a benevolence in Ireland failed, and in 1620 it was decided to demand one for the defense of the Palatinate. Circular letters were sent out, punishments were inflicted, but many excuses were made, and only about £34,000 was contributed. In 1622 a further attempt was made; as in 1614, judges of assize and others were ordered to press for contributions, wealthy men were called before the privy council and asked to name a sum at which to be rated, and William Fiennes, 1st Viscount Saye and Sele, was imprisoned for six months for protesting. Yet only about £88,000 was raised instead of the £200,000 that had been hoped for. This was the last time benevolences were collected, although they were suggested later in 1622 and again in 1625 and 1633. (R. B. WM.)

BENFEY, THEODOR (1809–1881), German philologist and Sanskrit scholar, was born on Jan. 28, 1809. Benfey's interest in philology was awakened by the careful instruction in Hebrew which he received from his father. After studying at Göttingen he spent a year at Munich, where he was greatly impressed by the lectures of Friedrich von Schelling. He later settled as a teacher in Frankfurt am Main. His pursuits were at first chiefly classical, but his attention was diverted to Sanskrit by an accidental wager that he would learn enough of the language in a few weeks to be able to review a new book on it. This feat he accomplished, and in later years he rivaled it when he learned Russian in order to translate V. P. Vasilev's work on Buddhism. For the time, however, his labours were chiefly in classical and Semitic philology.

From 1839 to 1842 he published the *Lexicon of Greek Roots,* which gained him the Volney prize of the Institute of France. His attention from that time was principally given to Sanskrit. He published in 1848 his edition of the *Samaveda;* in 1852–54 his *Manual of Sanskrit,* comprising a grammar and chrestomathy; in 1858 his practical Sanskrit grammar, afterward translated into English; and in 1859 his edition of the *Panchatantra,* with an extensive dissertation on the fables and mythologies of primitive nations. In 1862 he was appointed ordinary professor at Göttingen, after 14 years' service as extraordinary professor. In 1866 he published his great Sanskrit-English dictionary. In 1869 he wrote a history of German philological research, especially oriental, during the 19th century. While engaged on a grammar of Vedic Sanskrit, he died at Göttingen on June 26, 1881.

BENGAL, a region of northeast India and East Pakistan and formerly a province of British India. It now comprises West Bengal (a state of the Republic of India) and East Pakistan (a province of Pakistan). West Bengal includes the remainder of the old province together with the state of Cooch-Behar, which was merged with West Bengal on Jan. 1, 1950; it has an area of 33,928 sq.mi. and at the 1961 census had a population of 34,967,634. East Pakistan consists of the Dacca and Chittagong divisions and parts of the Presidency and Rajshahi divisions of the former province, together with the greater part of the Sylhet district of Assam; it has an area of 55,134 sq.mi. and in 1961 the population was 50,844,000 of whom about 77% were Muslims.

The geographical limits of Bengal have varied throughout the centuries. Its boundaries have been altered either as the result of conquest or for administrative reasons. Before the 1947 partition it stretched from the Duars immediately south of Sikkim and Bhutan to the Sundarbans and the mouth of the Ganges. It was bounded on the west by Bihar and on the east by Assam and that part of Burma which lay to the east of the Chittagong coastal tract. It included the marshy, submontane tarai (*q.v.*), known as the Duars, and the Ganges-Brahmaputra doab, or region be-

DUNGAN-PIX FROM PUBLIX

THE PORT OF CALCUTTA ON THE EAST BANK OF THE HOOGHLY RIVER, WEST BENGAL. OCEAN VESSELS SAIL ABOUT 85 MI. UP RIVER FROM THE BAY OF BENGAL TO UNLOAD THEIR CARGOES TO SMALLER BOATS

tween the two rivers, together with the slightly elevated semi-laterite region known as the Barind. The most distinctive feature of the area is its network of rivers, the Ganges and Brahmaputra, with their affluents and distributaries.

History.—The name Bengal or Bangala is derived from the ancient deltaic kingdom of Vanga or Banga. References to it occur in early Sanskrit literature but it played no conspicuous part in the legendary warfare depicted in the *Mahabharata*. Its early history is obscure until the 3rd century B.C. when it formed part of the extensive Maurya empire inherited by Asoka. With the decline of Maurya power anarchy once more supervened. In the 4th century A.D. it was absorbed into the Gupta empire of Samudragupta, to whom tribute was paid by the frontier kingdoms of Samatata (the delta of the Brahmaputra), Kamarupa (Assam) and Nepal. The extent of Harsha's empire (A.D. 606–647) is controversial, but it apparently embraced Bengal, including the deltaic region of Samatata. From the death of Harsha to the rise of Pala power in the second half of the 8th century little is known of Bengal except that its anarchical condition was aggravated by repeated invasions. The Palas had great difficulty in maintaining their position in Bengal against attacks by the powerful Gurjara-Prathiharas of Kanauj and the Rashtrakutas of the Deccan. The Chinese pilgrims, Fa-Hsien in the 5th century and Hsüan Tsang in the 7th century, found the Buddhist religion prevailing in Bengal, but already engaged in a fierce struggle with Hinduism, which ended about the 9th or 10th century in the general establishment of the latter faith. The Pala dynasty ruled over Bengal for more than three centuries and is justly renowned for its cultural achievements. Its rulers were Buddhists but were tolerant of Hinduism. In the 12th century the Palas were overthrown by the Senas who were champions of Vaishnavism.

Muslim and Mogul Rule.—Between 1199 and 1202 Bihar and Bengal were overrun by Muslim invaders under an able general named Mohammed Bakhtiyar. Odantapuri, the capital of Bihar, was captured and the Buddhist monks in its monastery massacred. The advance into Bengal met with no resistance. Gaur, or Lakhnauti, was made the capital of the newly conquered territories. From the beginning of the 13th century to Robert Clive's conquest of the province in 1757, Bengal remained under Muslim rule, at times under governors acknowledging the suzerainty of the Delhi sultans, but chiefly under independent rulers. It formed part of the extensive empire of Mohammed Tughluq, but the decline of Tughluq power enabled its rulers to proclaim their independence in 1341. They continued to assert a precarious independence until 1540, from which date until the conquest of the province by the Mogul emperor, Akbar, in 1576 it remained under Afghan (Pathan) rulers. Mogul rule in Bengal saw the emergence of new forces which deeply affected the development of the Bengali people. It synchronized with the growth of European enterprise, especially the trading activities of the Portuguese. It was also a period when Bengal felt the effect of various religious movements: the neo-Vaishnava movement which laid great emphasis on the Bhakti (devotion) cult; the Vaishnava Sahajiya movement with its strong Yogic-Tantric bias; and the erotic Shakta-Tantric cult (*see* SHAKTISM).

The British in Bengal.—With the decline of Mogul power in the first half of the 18th century the provincial governors of the empire began to assume an independent attitude. In 1740 Sarfaraz Khan, the viceroy of the three provinces of Bengal, Bihar and Orissa, was overthrown by Ali Vardi Khan, a subordinate official in charge of the administration of Bihar. From this usurpation can be traced the rise of the independent dynasty of the *nawab-nazims* of Bengal, with whom Clive came into contact. Ali Vardi Khan had no sooner gained control of Bengal than he was called upon to defend his recent acquisitions against Maratha incursions. In addition to continuous raiding there were five separate invasions between 1742 and 1751. He was finally forced to come to terms and pay the Maratha demands for *chauth* which amounted to one-fourth of the standard land revenue assessment. His successor, the nawab Siraj ud-daula, in 1756 attacked and captured the English settlement at Calcutta, incarcerating a number of Englishmen in the notorious Black Hole. Clive easily recaptured Calcutta and forced Siraj ud-daula to subscribe to a treaty confirming all the privileges which the English had formerly enjoyed. His continued recalcitrancy and intrigues with the French led to war which ended with Clive's victory at Plassey in 1757, as a result of which the British became the *de facto* rulers of Bengal. Clive's policy was to govern Bengal through puppet nawabs. His successor, Henry Vansittart, deposed Clive's nominee, Mir Jafar, replacing him by Mir Kasim, who attempted to assert his independence and reverse the decision of Plassey. After the cold-blooded massacre of 150 Englishmen at Patna in 1763, Mir Kasim was defeated and fled the province. This was followed by the restoration of the more pliant Mir Jafar. A final attempt by the titular Mogul emperor, Shah Alam, and the ruler of Oudh, Shuja ud-Daulah, to overthrow the British power in Bengal was frustrated by Hector Munro's victory at Buxar in 1764. Thenceforward the British were the unchallenged rulers of the province.

In 1765 Shah Alam, the defeated Mogul emperor, in return for an annual tribute of 26 lakhs of rupees (£325,000) granted to the East India company the *diwani* of Bengal, Bihar and Orissa—that is, the right to collect and administer the revenues of this area. By the Regulating act of 1773 Warren Hastings, the governor of Bengal, became the first governor general of Bengal, which was declared to be the supreme government with powers of superintendence over the other two presidencies of Madras and Bombay. Warren Hastings' term of office was a period of consolidation after conquest and of experiment in the spheres of judicial and revenue administration. Under Lord Cornwallis in 1793, by what is known as the Permanent Settlement of Bengal, the government's land revenue demand was fixed in perpetuity and the existing landholders and revenue collectors, the *zamindars*, were transformed into landowners. His failure to protect the ryots and undertenants was rectified by the Bengal Tenancy acts of 1859, 1885, 1928, 1938 and 1941.

Partition.—In 1854 the governor general was relieved of the

direct administration of Bengal, which was placed under a lieutenant governor. Thenceforward the government of India became entirely distinct from that of Bengal. In 1874 Assam was transferred from the charge of the lieutenant governor and placed under a separate chief commissioner. It was felt in 1905 that Bengal had become too unwieldy a charge for a single administration and, in spite of violent Hindu protests, it was partitioned into two provinces, (1) Western Bengal, Bihar and Orissa and (2) Eastern Bengal and Assam, each under a lieutenant governor. In 1912, because of continued opposition to partition, Bengal was placed under a governor, Bihar and Orissa under a lieutenant governor and Assam once more under a chief commissioner. At the same time Delhi became the capital of India in place of Calcutta. Under the Government of India act, 1935, Bengal was constituted an autonomous province in 1937. This was the situation until the Indian subcontinent was partitioned into the two dominions of Pakistan and India after the British withdrawal in 1947. Boundary disputes arising out of the Radcliffe award of Aug. 1947 were settled by the report of the Bagge tribunal in Feb. 1950. In Feb. 1952 a proposal to make Urdu the national language of Pakistan produced serious rioting in East Bengal. *See* ASSAM; BIHAR; CALCUTTA; INDIA-PAKISTAN, SUBCONTINENT OF; PAKISTAN; WEST BENGAL; *see* also references under "Bengal" in the Index.

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BENGAL, BAY OF, part of the Indian ocean north of lat. 10° N., between the Indian peninsula on the west and the Arakan coasts of Burma and the continuation southward of the Arakan Yoma mountains in the Andaman Islands on the east. The bay is roughly triangular in shape, the blunted northern apex coinciding with the delta of the Ganges-Brahmaputra. The vast volumes of silt and mud brought down by these rivers result in a very shallow sea; it is 100 or 150 mi. from the shore before a depth of 600 ft. (100 fathoms) is reached in the north. Similarly, on the west the Mahanadi, Godavari and Krishna (formerly Kistna) have built up considerable deltas extended seaward by shallow water. The Arakan coast, on the other hand, is a Pacific type of coast with fringing islands. The main part of the bay, however, reaches a maximum depth of 13,920 ft. (2,320 fathoms) and has no islands. The numerous large rivers result in reduced salinity of surface waters on the margins of the bay. The western coast has no natural harbours but artificial protection has been provided at Madras and Vishakhapatnam. Surface movements of the waters change direction with the season, the northeast monsoon giving them a clockwise circulation, the southwest monsoon a counterclockwise movement. Severe storms occur at the change of monsoon, particularly in the southern areas in October. (L. D. S.)

BENGALI LANGUAGE. Bengali, Bihari, Oriya and Assamese comprise the eastern group of the Indo-Aryan languages (*q.v.*) which have been identified as immediate descendants of the Māgadhī Prakrit (*see* PRAKRIT LANGUAGES) of south Bihar. Bengali is spoken in the area comprising the Indian state of West Bengal and East Pakistan by more than 70,000,000 persons. The land of "Bangala" is mentioned a number of times in the accounts of European travelers (Marco Polo's being one of the first) between the 13th and 17th centuries A.D. The English word "Bengal" is a variation of this, and the term "Bengali" is derived from it. Bengalis refer to their language as "Bāṅglā" or "Bāṅgālā" and write it in a script derived from an early form of the Nagari character of northern India.

A significant dialectal difference in Bengali is that between the literary speech (*Sādhu-Bhāṣā*) and the colloquial (*Colit-Bhāṣā*), the latter being based on the dialect of Calcutta and the districts along the Hugli river. *Colit-Bhāṣā*, with its contracted forms and colloquialisms, is spoken by all educated Bengalis, as contrasted with *Sādhu-Bhāṣā*, whose highly Sanskritized vocabulary and numerous archaic or pseudo-archaic grammatical forms render it unintelligible to the uneducated who knows the colloquial. When a colloquial or *tadbhava* word occurs in literature, it appears as its corresponding *tatsama* or Sanskrit loanword, although the *tadbhava* is read.

Phonetics.—Standard Colloquial Bengali, the speech of the educated classes of Calcutta, has these sounds: *Vowels—ā i e ē æ u o ō,* and their nasalized counterparts, *ã̄ ĩ ẽ ẽ̄ æ̃ ũ ȭ ō̃.* Diphthongs consist of combinations of any one of the vowels with any one of the other vowels, *e.g., ōi ou āē ōē iō ui,* etc., with the exception of *e* and *æ* which do not occur as second members. *Consonants—k g c j ṭ ḍ ṛ t d p b* and their aspirated counterparts, *kh gh ch jh ṭh ḍh ṛh th dh ph bh* (*ph* has a variant *f,* and *bh, v*), *n* (with positional variants *ṇ ñ*) *ñ, m r l h ś s* (with positional variant *ṣ*). "Long" or "doubled" consonants, indicated by writing the consonant twice, are pronounced by arranging the pertinent vocal organs for making the single sound and holding the closure longer than for the single sound. With aspirated plosives (*ph, bh, th,* etc.) and affricates (*ch, jh*) only the stop element is lengthened, *e.g., pph, tth, cch,* etc. In compound words and in certain phrase-groups, when plosives of the same class, such as gutturals (*k, g*), palatals (*c, j*), dentals (*t, d*) and others, are in contact, the first consonant is assimilated to the second. When the first is an aspirate it loses the aspiration in the process.

In isolated words, stress falls on the initial syllable. Word stress is subsidiary to sentence stress. Sentence stress usually falls on the initial syllable of the first significant word of a phrase. Each of the phrases comprising a sentence has approximately the same time interval, resulting in a rhythm which is especially marked in recitation or reading.

Declension.—There is no special system of declension for masculine, feminine or neuter. Sex is indicated either by terms such as "male" or "female," or by noun pairs, as in English "bull" and "cow," "stallion" and "mare." The noun has two numbers, singular and plural. The usual plural suffixes are *-rā -ērā* (nominative) and *-dĕr -ēdĕr* (oblique) for rational beings and *-gulā, -gulī* for both animate and inanimate nouns. Plurality can also be indicated by words meaning "all, group, collection." Case suffixes are attached to the nominative forms. Usually, these are employed with specific postpositions. Postpositions are also used with the oblique forms.

The adjective does not change for gender, number or case.

Of the three personal pronouns, the second person has three forms, "common," "inferior" and "honorific," and the third has two forms, "common" and "honorific." The three pronouns of the third person also serve as demonstrative pronouns. The personal pronouns, together with the relative, interrogative, indefinite and reflexive pronouns, have plural and oblique forms to which are added case suffixes.

Conjugation.—The Bengali verb does not distinguish between singular and plural. The same set of personal endings serves both functions. The second person ending has three forms, corresponding to those of the pronoun ("common," "inferior" and "honorific"), and the third person two ("common" and "honorific"). Bengali verbal bases fall into two groups: (1) simple bases or roots to which the personal endings are attached directly; and (2) complex bases, comprising verbal roots which undergo suffixation before the endings are attached. The first is exemplified by the simple present tense; the second by the bases of the causative, and the past, future and conditional (including the past habitual) tenses. The suffix of the past tense base is *-l-*, that of the future *-b-*, and of the last two *-t-*. Compound tenses (the "present" and "past progressive" and the "present" and "past perfect"), are fashioned with the appropriate forms of the auxiliary verb *āch-* "be."

Colloquial Bengali differs most from the literary dialect in the

conjugation of the verb. A prominent feature of the colloquial Bengali verb is the operation of vowel alternation in the root through the influence of a following vowel.

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BENGALI LITERATURE. The earliest extant work of Bengali literature—that is, literature in the Bengali language (*q.v.*)—is a pre-12th-century collection of lyrics entitled *Caryācaryaviniścaya* contained in a manuscript discovered in Nepal in 1907 by Haraprasād Śāstrī. These poems reflect the beliefs and practices of the Sahajiya sect. The 12th century was an age of poetic activity, but the language used was Sanskrit, not Bengali. The principal poets were Jayadeva, who composed *Gītagovinda*, a sequence of lyrics on the mythological Rādhā-Kṛṣṇa theme, and Umāpati Dhar, of whose work little has survived. The Muslim invasion in 1199 dispersed the poets, and there is no evidence of further activity until the mid-14th century. Bengali literature is thereafter divisible into medieval (1360–1800) and modern (after 1800).

The Medieval Period.—Medieval Bengali literature consists entirely of verse composed to be sung and transmitted orally. It falls mainly into three streams: *maṅgalkāvya*, narrative poems based on stories connected with popular religious cults; *mahākāvya*, epic poems on the *Rāmāyaṇa* and *Mahābhārata* (*qq.v.*) themes; and Vaiṣṇava lyrics (*padāvalī*) on the Rādhā-Kṛṣṇa theme (*see* VISHNUISM; KRISHNA; HINDUISM).

Maṅgalkāvya.—These narrate the campaigns waged by various deities to establish their worship on earth. The stories and characters differ, but the general pattern is similar: the deity descends to earth and appoints an agent for the new cult, who, after much conflict with religious antagonists, ultimately succeeds, and the ending is happy for all. Many deities are represented, including principally: Manasā, a goddess indigenous to Bengal, who is mistress of all snakes; Caṇḍī and Kālī, two manifestations of the Mother Goddess; and Dharmaṭhākur, a non-Aryan deity. The human characters are mostly of low caste, which suggests that they lived originally in a pre-Brahmanical era. The literary interest of the *maṅgalkāvya* lies in the character and suffering of the human participants, the deity being little more than a *deus ex machina* who keeps the action moving. The principal *maṅgalkāvya* poets are: for Manasā: Vijay Gupta (d. *c.* 1494), Vipradās (d. *c.* 1495), Vaṃśivadan (16th century), Kṣemānanda Ketakādās (d. *c.* 1641), Rāmjīvan Vidyābhūṣaṇ (d. *c.* 1703), and Jivankṛṣṇa Maitra (d. *c.* 1744); for Caṇḍī: Māṇik Datta (15th century), Mādhavācārya (d. *c.* 1579), Mukundarām Kavikaṅkan (d. *c.* 1594), Dvijaharinām (17th century), and Janārdan (17th century); for Kālī: Śrīdhar (d. *c.* 1533), Kṛṣṇarāmdās (end 17th century), Bhāratcandra Rāy (d. *c.* 1760), and Rāmprasād Sen, the composer of Śākta lyrics (latter part of the 18th century); for Dharmaṭhākur: Rūprām (late 17th century), Rāmdās, and Sītārāmdas (both 17th century).

Mahākāvya.—Kṛttibās Ojhā's *Rāmāyaṇa* (late 14th century) is the earliest great *mahākāvya* composed in Bengali. It is not a translation of the Sanskrit epic (*see* SANSKRIT LITERATURE) but an original work on the same theme, and for the Bengali it alone is the *Rāmāyaṇa*. It is alive today and is still sung at Rām festivals. In it the hero, Rām, is a Bengali, and his wife, Sītā, is the ideal of Bengali wifehood. The landscape and social conditions are those of Bengal. The versions of the *Mahābhārata*, the greatest of which is that of Kāśīrāmdās, also mirror the life of contemporary Bengal. The principal poets are: for the *Rāmāyaṇa:* Kṛttibās Ojhā and Kavicandra (18th century); for the *Mahābhārata:* Kavindra (d. 1525), Kāśīrāmdās (d. 1602), Kṛṣṇānanda Basu (17th century), and Kavicandra.

Vaiṣṇava Literature (*padāvalī*).—The presentation of the Rādhā-Kṛṣṇa *līlā* (divine play), initiated by Jayadeva, was continued in the 15th century by Baṛu Caṇḍīdās in *Śrīkṛṣṇakirtan*, a lyric sequence in 13 cantos. In this work, as in Jayadeva's, the emphasis is on the human rather than the religious aspects of the *līlā*. In the early 16th century, the teaching of Śrīcaitanya (*see* CHAITANYA) changed the character of the *padāvalī* by converting human love songs into fervent religious hymns, though the substance was unchanged and the sensuous imagery of human passion was retained. Śrīcaitanya was deified by his followers, and the fervour he created found expression in prolific literary activity, which continued into the 18th century. It became an accepted convention to preface groups of Rādhā-Kṛṣṇa hymns with others to Caitanya (Çhaitanya; *q.v.*). These were known as *gauraçandrikā*. The language of most of the *padāvalī* was not Bengali but Brajbuli, an artificial literary language of uncertain origin, though its linguistic affinities are to Maithili (a Bihari dialect; *see* BIHARI LANGUAGE) and Bengali.

The greatest of the *padkartās* or *mahājans*, as the Vaiṣṇava poets were called, are: Locandās; Jñāndās, who wrote in both Bengali and Brajbuli; Balarāmdās; Govindadās; and a poet or poets named Caṇḍīdās. They all belong to the 16th or early 17th century.

Muslim Poets.—The school of 17th-century Muslim Bengali poets in Arakan stands apart from the main streams of Bengali literature: their works are secular, and they took their subjects from other sources. The earliest, Daulat Kājī, wrote *Satī Mayanāmatī* and *Lorcandrānī* between 1622 and 1638. Both were left unfinished. The preeminent poet of this school was Ālaol. His works are: *Padmāvatī* (*c.* 1648), a version of a poem by the Hindī poet Jāyasī (*see* HINDĪ LITERATURE); *Saiyad Muluk; Baduijjamāl;* and *Hapta Paikar*. The last three, written between 1660 and 1669, are based on Perso-Arabian stories. Ālaol also completed the unfinished poems of Daulat Kājī.

The Modern Period.—*Prose.*—The literary use of prose was begun in Calcutta in 1800 by the missionary William Carey and his pandits, Rām Rām Basu and Mṛtyuñjay Bidyālaṅkār. After translating the Bible (publ. 1822), Carey organized the production of prose texts for use in Fort William College and in schools. Rām Rām Basu's *Pratāpāditycarit* (1801) was the first original prose work by a Bengali. The pioneers of prose served their apprenticeship in meeting the needs of the classroom. The second phase of prose was that of the newspaper, inaugurated by the Baptist missionary John Marshman in 1818 with publication of *Samācār Darpan*. Other papers followed: *Saṃbād Kaumudī* (1821), begun by Rām Mohun Roy (*q.v.*), who had already published some prose theological studies, and *Samācār Candrikā* (1822), begun by Bhabāṇīcaraṇ Bandyopādhāy. More than 30 papers were issued between 1822 and 1832, including Iśvarcandra Gupta's *Saṃbād Prabhākar*, which became the training ground for many important writers. Among later newspapers were *Tattvabodhinī Patrikā* (1843), begun by Debendranāth Ṭhākur and Akṣay Kumār Dutt (Datta), and *Baṅga Darśaṇ* (*Banga Darshan*) (1872) by Bankimcandra Caṭṭopādhyāy. (*See* NEWSPAPER: *Commonwealth of Nations.*) Prose reached full literary status with Akṣay Kumār Dutt (1820–69) and, more especially, with Iśvarcandra Bidyāsāgar (1820–91), who is regarded as the father of Bengali prose.

The Novel.—The novel as a literary form emerged in 1858 with *Ālāler Gharer Dulāl* by Pyārīcād Mitra. It is a social satire, as also is *Hutom Pēcār Naksā* (1862) by Kālīprasanna Siṃha. *Aitihāsik Upanyās* (1862), by Bhūdeb Mukhopādhyāy, was the first Bengali historical novel. In 1865 Bankim-candra Caṭṭopādhyāy (*see* CHATTERJI, BANKIM CHANDRA) burst upon Bengal with *Durgeśnandinī*, followed by others in close succession. A little later came Rabindranāth Tagore (*q.v.*). With these two the Bengali novel reached maturity. Outstanding among later writers are Śaratcandra Caṭṭopādhyāy and Bibhūtibhūṣaṇ Bandyopādhyāy. The latter's moving portrayal of village life in *Pather Pāncāli* (1917) is known outside India as the basis for a distinguished film of the same title, made in Bengal in the 1950s. But Śaratcandra comes nearest to the heart of the Bengali reader. His novels may have structural weaknesses, but his characters are live and convincing. "He writes as we speak," said one contemporary reader. The colloquial language (*Calit-Bhāṣā*), well handled by Rabindranāth, in Śaratcandra and Bibhūtibhuṣaṇ has become established as a literary medium.

Drama.—The Bengali theatre as a regular institution dates from 1872, when the national theatre was founded by Giriścandra Ghoṣ (1844–1911). The first original Bengali play, *Kulīnkulsarvasva,*

was written by Ramnarayan Tarkaratna in 1854. Within the next decade Madhusūdan Datta (Michael Madhu Sudan Dutt; *q.v.*) and Dīnabandhu Mitra wrote a number of plays, but they were not of notable quality, and their production was dependent on patronage. The national theatre was a professional theatre, dependent on popular support, and in it women were employed as actresses for the first time. Giriścandra Ghoṣ, the genius behind this enterprise, was, as well as being producer and actor, a playwright of no little talent, and a poet and musician. He wrote no fewer than 80 plays. In them he combined the techniques of European drama with those of the indigenous drama, the *yātrā*. After Ghoṣ came Dvijendralāl Rāy (1863–1913), a writer of popular but mediocre historical plays, and Rabindranāth.

Poetry.—Early 19th-century poetry was medieval in form and content, except that in the poems of Iśvarcandra Gupta there can be felt the stirrings of patriotic sentiment. The modern phase began in the 1860s, under the influence of English poetry. Its principal features were metrical innovations based on western models; adoption of new, often contemporary, subjects; and a tendency to hero-worship and patriotic enthusiasm. The pioneers in metrical innovation were Madhusūdan Datta, who introduced blank verse modeled on that of Milton, and Raṅgalāl Bandyopādhyāy (1826–77), who experimented with new lyric stanzas. Bihārilāl Cakrabartī (1835–94) trod a new path in his descriptions of natural scenery, reaching his highest powers in *Śāradāmaṅgal* (1876). The compositions of Hemcandra Bandyopādhyāy (1838–1903) include dramatic, narrative, and lyric poetry. He drew on Sanskrit authors, and on Shakespeare, Dante, and Madhusūdan. His metrical range includes medieval metres, blank verse after Madhusūdan, and various new lyrical forms. His principal works are two volumes of lyrics (1870 and 1905); *Bṛtrasaṃhār* (1877), an epic poem; a translation of *Romeo and Juliet;* and *Chāyāmayī* (1905), based on Dante. Hemcandra is well known for his patriotic poems, but like others, he suffers from comparison with his great contemporary, Rabindranāth.

See J. C. Ghosh, *Bengali Literature* (1948); Sukumar Sen, *History of Bengali Literature* (1960). (T. W. Cl.)

BENGASI (Banghazi), chief seaport and capital of the province of Cyrenaica (Barca), Libya, and joint capital, with Tripoli, of the country, lies southwest of the site of the ancient Euhesperides or Hesperides-Berenice. Situated 600 mi. E. of Tripoli by road, Bengasi covers about a mile of the coast line, facing west on a strip between the Gulf of Sidra (Khalij Surt) and a salt marsh, and extends ½ mi. toward the flat rocky hinterland. There are sandy beaches nearby. Pop. (1964) 136,641.

Founded by the Greeks of Cyrenaica under the name of Hesperides, the town received from Ptolemy III the additional name of Berenice in honour of his wife. The ruins of the ancient town, which became the chief place in the province after the 3rd century A.D., are now nearly buried in the sand. There are numerous rock-cut tombs of the Ptolemaic and Roman period, when there was a considerable Jewish colony. No traces exist of the buildings attributed to Justinian, who is said to have fortified it. In World War II Bengasi suffered considerably and after changing hands five times was finally captured by the British 8th army in Nov. 1942. The federal government moved there from Tripoli in Oct. 1957.

Bengasi, still bearing marks of war damage in the early 1960s, is nevertheless an attractive town overlooking the harbour, with its promenade dominated by modern buildings, including the Roman Catholic cathedral and the imposing Berenice hotel. The National University of Libya was opened in 1955.

In a predominantly pastoral and agricultural district, Bengasi's industries mainly supply local needs, but exports include hides and skins, wool, sponges and live sheep. A good east-west coast road runs through the town and short railways operate in the area. There is a steamship service with Italy. Benina airport, 10 mi. outside the town, is an important commercial airport. *See* also Cyrenaica. (P. W. I.; M. F. J.)

BENGEL, JOHANN ALBRECHT (1687–1752), German Lutheran pastor and theologian who produced the first critical edition of the Greek New Testament, was born at Winnenden, Württemberg, on June 24, 1687. After studying at the University of Tübingen he taught at the evangelical Klosterschule, Denkendorf (1713–1741), and then became general superintendent at Herbrechtingen (1741) and Alpirsbach (1749). He died at Stuttgart on Nov. 2, 1752.

A firm believer in the importance of a personal understanding and application to life of the Bible by the individual Christian, he was dissatisfied with the immense array of variant readings in John Mill's edition of the Greek New Testament (1707), which seemed to shake the reliability of the text. He therefore determined himself to edit the text on objective critical principles and thus have a secure basis for its exegesis. In his edition (1743), besides altering the *textus receptus* in certain places, he puts at the foot of each page those variants arranged according to their value which he thinks worth consideration, discusses each of them in an appendix and adds a treatise on the whole problem of variant readings. He concludes that the mere number of manuscripts supporting any one reading is of no value in itself, for the manuscripts must be grouped into families before the worth of each as a witness to the text can be determined. The first step in grouping the manuscripts is to determine which variant can be explained as derived from which other variant; a guiding principle is that the difficult reading is to be preferred to the easy one (*proclivi scriptioni praestat ardua*), the famous rule best known in the wording *difficilior lectio potior*. Bengel thus opened the way to a really methodical handling not only of the New Testament but of other texts as well. But he regarded his edition of the New Testament merely as the preparation for his *Gnomon novi testamenti* (1742; Eng. trans. 1857–58), a commentary in which he gives a careful word for word explanation of the Greek text in an unusually concise and penetrating way.

See K. Hermann, *J. A. Bengel* (1937). (W. G. Kü.)

BENGHAZI: *see* Bengasi.

BENGUELA, a city and district of Angola, west Africa. The city was founded in 1617 around St. Philip fortress and was the fulcrum of Portuguese expansion in Africa. It continued to grow (pop. [1960] 40,282) in spite of the competition of the neighbouring Lobito, one of the finest ports of the west African coast. Benguela is politically, commercially and industrially the coordinating centre for the inland activities. The most important buildings are the Government hall and the luxurious Mombaka hotel (1958). There is a lyceum and an industrial school.

The city is linked with Lobito by an asphalt road and by other roads with Sá da Bandeira, Nova Lisboa, Silva Porto and Luanda; and by rail with the Republic of the Congo and the Rhodesias.

Benguela District had a population in 1960 of 487,873, of whom 26,731 were Europeans and 7,299 mixed. It includes the four *concelhos* ("counties") of Benguela, Lobito, Ganda and Balombo. The area of the district is 15,042 sq.mi. The chief towns are Benguela, Lobito (*q.v.*), Catumbela, Norton de Matos and Mariano Machado. The principal products are sugar cane, oil-producing seeds, coffee, cotton, sisal, maize, broad beans, many kinds of vegetables and fruit, and timber. At Ganda is a coffee experimental station, and stock raising is assisted by a veterinary station. Industries include cement, sisal and oil processing, and metal works. A hydroelectric power station is at Biópio on the Catumbela river. (A. A. G. P.)

BEN-GURION, DAVID (1886–), one of the founders of the state of Israel and its first prime minister, was born at Plonsk in Poland on Oct. 16, 1886. Devoted from boyhood to Zionism and to socialism, he went to Palestine in 1906 as a labourer and set out to form a Labour party and also a body of guards for the defense of Jewish agricultural settlements there. Soon after the outbreak of World War I he was expelled from Palestine by the Turks and went to New York, where he married and where he organized a Zionist Labour party. He joined the Jewish legion, which was raised there in 1918, to be part of the British forces in Palestine. From 1918 he lived in Tel Aviv and was head of the Labour party (Mapai), which became the most powerful political and economic force. He also formed the General Federation of Jewish Labour (Histadruth). In the Zionist organization he carried on a struggle with Chaim Weizmann for supreme power, and

the frustration of Jewish hopes by the British government's policy from 1938 strengthened his hold on the young generation in Palestine. Convinced that the Jews must have a state, he organized the Haganah as a fighting force.

It was Ben-Gurion who, on May 14, 1948, at Tel Aviv, read the declaration of Israel's independence. In the new state he became prime minister as well as minister of defense, continuously retaining these two offices except for a period from Dec. 1953 till summer 1955. After each general election he had to form a coalition government, but Mapai was always the core, and Ben-Gurion was always the strong man of the state. His main aim was to bring to Israel all the Jews who were willing to come; and the "ingathering of the exiles" brought nearly 1,000,000 immigrants in the first decade. He attacked the "Anglo-Saxon Zionists" because only a few were prepared to move their homes to Israel. His role in the Suez conflict of 1956, when he mobilized Israel's forces and sent them into Sinai, strengthened his authority; and his visits in 1960 and 1961 to the United States, Great Britain and France marked his standing as a statesman. In those years his authority in Israel was impaired by an internal conflict over the secretary of the Histadruth. He was, however, prime minister of a new coalition government in 1961. *See* also ISRAEL: *History*.
(No. B.)

BENI (EL BENI), a department in the lowlands of northeastern Bolivia, was established in 1842 during the administration of Gen. José Ballivián. It is bounded northwest by the department of Pando, northeast by Brazil, south by the departments of Santa Cruz and Cochabamba and west by La Paz. Population (1959 est.) 135,518; area 82,457 sq.mi. Trinidad, the capital (pop. [1959 est.], 12,542), founded in 1556 by Tristán de Tejada and Juan de Salinas, is about 6 mi. from the Mamoré river. Partly forested, Beni is largely a plains region subject to widespread flooding from February to June. The Mamoré and Beni rivers leading to northern Bolivia and Brazil and their tributaries are the main channels of communication and transport. The Jesuits established *reducciones* or mission settlements in this region in the 17th and 18th centuries. They introduced cattle and horses which multiplied to extraordinary numbers on the Llanos de Mojos, and are still a major source of wealth. The collection of rubber, quinine and Brazil nuts are important forest industries. A wide range of agricultural products including rice, sugar cane, bananas, coffee, cacao, manioc, cotton and corn are grown in the area. Inadequate communication facilities, geographical isolation and underpopulation have impeded the successful development of this great frontier region. (J. L. TR.)

BENI 'AMER: *see* BEJA.

BÉNI MELLAL, a small town and capital of a province of the same name, of central Morocco, 121 mi. N.E. of Marrakesh on the road to Fès, lies at 2,034 ft. above sea level on the foothills of the Middle Atlas. Pop. (1960) 28,933. At the entrance to the town is the Kasba Bel Kush, built in the 17th century and restored in the 19th century. This little agricultural centre gained its importance from the development of the Tadla plain, achieved mainly by the construction of the barrage of Bin el Ouidane on the Wadi el Abid, which was opened in 1955.

Béni Mellal province (pop. [1960] 474,001) was formerly a dry plateau frequented only by shepherd tribes. The Tadla was transformed by irrigation, which, at full stretch, covers about 1,500 sq.mi. Though the peasants have retained the ownership of their land, cultivation is regulated by a government office. Experiments have been made in growing new crops, especially cotton, which has been successful. (A. AM.)

BENIN, the name of a city of the Western region of Nigeria, Africa, and of an old west African kingdom. The name was formerly applied to the whole Guinea coast from the Volta to the Rio del Rey and included the Slave Coast, the delta of the Niger and some country to the east. The part of the sea which washes the Slave Coast is still called the Bight of Benin.

Benin city lies on the Benin river, north of the swamps and creeks of the Niger delta in the dense tropical forest of the coastal plain, 260 ft. above sea level. Pop. (1960 est.) 61,745. It is the administrative centre of the midwest area of the Western region. The old walled town, which had occupied this site for centuries, was burned down in 1897 (see *History* below). Traces of the old wall and moat remain, but the new town is a close-packed pattern of houses and streets converging on the *oba's* ("king's") palace and the government offices. The palace is of historical interest and a juju ceremonial house, containing the *oba's* ceremonial robes of coral beads, still stands in the compound. A small museum houses items of historic value which survived the fire. In the main square is a statue of Emotan, a lady said to have offered herself for sacrifice to restore the prestige of her husband, the *oba*. Benin has long been known for its brasswork, some of which is said to date from the 13th century, and for its woodcarvings. Though the ancient artistry has been lost, traditional designs are still produced in both these crafts.

Benin has no railway but stands on the main highway from Lagos (323 mi.) via Ibadan to the east. A direct road from Lagos has reduced the distance to about 180 mi. The town's own port has been constructed at Koko on the Benin river. Benin is also a principal centre in Nigeria's internal airways network. The timber and rubber industries of western Nigeria centre on Benin, and rubber development includes improved collecting facilities and processing factories.

History.—Benin city was the capital of one of the most highly organized states of west Africa. The period of its greatest expansion appears to have been between the 14th and 17th centuries. Lagos was founded by a Benin army and continued to pay tribute to the *oba* of Benin until about the end of the 19th century. He ruled over Yoruba, Ibo, Itsekiri and Ijo (Ijaw) as well as the Edo-speaking peoples. The *oba* was reputed to be descended from Oduduwa, the founder of the Yoruba peoples, though the Binis, or Edos, a Negro people inhabiting Benin city and the surrounding area (*see* EDO), have always considered themselves to be a race apart; they are sharply differentiated linguistically from the Yoruba, Ibo and other neighbours, and are further distinguished by cultural and social characteristics. Akenzua II, who was the reigning *oba* in the 1950s, was the 35th king of the dynasty, of which the 15th was reigning about 1472 when Benin was first visited by a European, the Portuguese João Affonso d'Aveiro. Other Portuguese traders and missionaries followed. Dutch traders replaced the Portuguese for a time, and the first Englishman to visit Benin coast was Thomas Wyndham in 1553. Apart from ivory, palm oil and tailed pepper, the state profited much from the slave trade. In 1668 Olfert Dapper described the city as large and prosperous, and reported the *oba* as able to raise 20,000 armed men in a day and 100,000 if necessary. With the abolition of the slave trade its fortunes declined.

The *oba* was the supreme political, judicial, economic and spiritual head of his people. He and his ancestors were the object of state cults, which were the occasion of much of the human sacrifice that earned Benin the title of "the city of blood." It was, however, only in the 19th century that this title came into use; early travelers had reported the people of Benin as gentle and welcoming to strangers. The practice of human sacrifice was stamped out only after the burning of the city by the British in 1897, though in the 20th century it survived in the annual (non-human) sacrifices to the *oba's* head; *i.e.*, to his divinity as the reincarnation of his ancestors. On his well-being the health and prosperity of the nation is believed to depend. In 1885 the coast was placed under British protection and attempts were made to persuade the *oba* to enter into trade relations and to put a stop to human sacrifices. A treaty made in 1892 was not observed by the *oba*, and in Jan. 1897 an unarmed mission which set out for Benin was massacred. A punitive expedition the following month captured and partly burned the city, which was found to be reeking of human sacrifices. The *oba*, Overami, was deported, but on his death in 1914 his son was installed as Ewcka II; his son in turn became *oba* in 1933 as Akenzua II. By mid-20th century the *oba's* authority was restricted to the Benin division.

Benin city was described by early travelers as organized in two halves, "palace" and "town," and subdivided into about 50 wards, each under its own chiefs and elders, and affiliated to one of three palace societies. Each ward was inhabited by members

of a particular craft or function. Something of this organization has survived. *See* also NIGERIA: *History*.

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BENI RIVER, a river of Bolivia, 600 mi. long, formed by numerous confluents rising in the northern sector of the Cordillera Real near La Pax. The Beni flows east and northeast through the densely forested and plains country until it joins the Madre de Dios at Riberalta. It is navigable from Rurrenabaque for several hundred miles as far as the Esperanza rapids near its junction with the Mamoré. The rapids are 330 yd. long with a declivity of 20 ft.; the Beni there is nearly 1,000 yds. wide and 18 ft. deep. From Riberalta, after passing the rapids, the Beni joins the Mamoré at the town of Villa Bella and the two rivers then flow northward as the Madeira, constituting the frontier with Brazil until uniting with the Abuna. Seasonal variation of the water level of the Beni renders navigation uncertain. Only during the season of high water is steam navigation reliable. Generally, steamboats run freely on the Beni (and the Madre de Dios) from December to May. (J. L. TR.)

BENI SUEF: *see* BANI SUWAYF.

BENITOITE, a titanium mineral discovered in 1907 near the headwaters of the San Benito river, San Benito county, Calif., in veins with natrolite in green schist. Benitoite may be colourless or blue, the colour varying sometimes in different parts, and passing to a deep sapphire blue. The blue variety is cut as a gem stone and often resembles blue spinel, though its comparative softness distinguishes it from spinel and sapphire. It is a titanosilicate of barium ($BaTiSi_3O_9$), crystallizing in the trigonal system, with a hardness of 6.5 and specific gravity of 3.65.

BENJAMIN, a tribe of Israel that traced its pedigree back to Jacob and Rachel, hence closely allied, possibly subordinate, to the Joseph tribes. *See* TWELVE TRIBES OF ISRAEL.

BENJAMIN OF TUDELA (fl. 1159–1173), rabbi and traveler who between 1159 and 1173 traveled to the western borders of China from Saragossa. His *Itinerary* throws light on the position of Jews in the 12th century. The *Itinerary* was translated from the Hebrew into Latin by Arias Montanus in 1575. The best English translation (with critical Hebrew text) is by M. N. Adler, *The Itinerary of Benjamin of Tudela* (1907). (E. M. J. C.)

BENJAMIN, JUDAH PHILIP (1811–1884), Anglo-U.S. lawyer, secretary of state of the Confederate States of America during the American Civil War, was born a British subject at St. Thomas in the West Indies on Aug. 11, 1811. About 1813 his parents moved to Wilmington, N.C., and subsequently the family lived in Charleston, S.C. After some time spent at Yale college, Benjamin studied law in New Orleans, being admitted to the bar in 1832. In 1834 he and Thomas Slidell published a digest of decisions of the territorial and supreme court of Louisiana that for many years was the standard work on Louisiana law. Benjamin's practice was extremely successful in the field of commercial and insurance law, and he was one of the leaders of the U.S. bar. Pres. Millard Fillmore offered him a justiceship on the supreme court, which he declined. In 1852 he was elected a United States senator for Louisiana, and he quickly became a leader of the extremist southern faction in the pre-Civil War congressional debates. He withdrew from the senate in 1861 to join the government of the Confederacy, first as attorney general, then as secretary of war and finally as secretary of state (1862–65). After Appomattox he escaped from the coast of Florida and reached England as an exile.

At age 55 Benjamin was taken as a pupil into the chambers of Charles Pollock, son of Sir Frederick Pollock (*see* POLLOCK, family), lord chief baron of the exchequer, and through the influence of English judges who knew of his abilities he was called to the bar in June 1866. He quickly became one of the leaders of the English bar, becoming a queen's counsel in 1872. His treatise, *Law of Sale of Personal Property*, first published in 1868, was the principal textbook on its subject both in England and the United States for many years. Following his death, May 6, 1884, the *Times* of London declared that Benjamin's was "one of the most remarkable of modern careers," for "he carved out for himself by his own unaided exertions not one, but three . . . histories of great and well-earned distinction."

See Pierce Butler, *Judah P. Benjamin* (1907); Robert Douthat Meade, *Judah P. Benjamin* (1943). (A. DM.)

BENLOWES, EDWARD (1602–1676), English poet of the metaphysical school, was born on July 12, 1602, at Finchingfield, Essex, where he inherited large estates. He was educated at St. John's college, Cambridge, and Lincoln's Inn. Though his family was Catholic, he early became a vehement Protestant. During 1627–29 he made the grand tour, and then settled down to a life of religious meditation and the cultivation of the arts. He used his wealth to patronize poets, artists and musicians. He commissioned engravings to illustrate his own and his friends' poems and had his own rolling press, worked by a Dutch printer whom he had brought back from the Continent as his personal servant. Among works which he sponsored were Phineas Fletcher's *The Purple Island* (1633) and Francis Quarles's *Emblems* (1635). During the 1640s he gave himself to the composition of his long poem, *Theophila* (printed 1652), which describes the progress of the soul through the successive stages of humiliation, zeal and contemplation to a mystical communion with God. It has some fine rhapsodic passages but is noted for its extravagant conceits. His other extant poems, in Latin and English, are mostly short.

A decline in Benlowes' fortunes began with the Civil War. He suffered severe parliamentary taxation, and after taking part in the royalist rising in Essex in 1648 he was heavily fined. To clear off his debts and to provide a dowry of £6,000 for his niece Philippa he sold his estates in 1655. The costs of prolonged litigation completed his ruin. He spent his last years in Oxford, reading in the Bodleian library and still occasionally writing poetry, and died there in destitution, on Dec. 18, 1676.

Theophila and two shorter poems, of which *The Summary of Wisdom* (1657) is a *réchauffé* of passages from *Theophila*, are included in G. Saintsbury's *Minor Poets of the Caroline Period* (1905), vol. 1.

See H. Jenkins, *Edward Benlowes* (1952). (HD. J.)

BENN, SIR ERNEST JOHN PICKSTONE, 2ND BARONET (1875–1954), English publisher and author, one of the chief advocates of individual enterprise in an age when leading economists preached in support of collectivism and state planning, was born at Hackney, Middlesex, on June 25, 1875, the eldest son of Sir John Williams Benn. His father devoted himself to politics as a Liberal member of parliament and an original member and early chairman of the London County council. He left the management of his publishing business largely to his capable son, who thus found himself in charge almost before attaining his majority. Young Benn soon acquired the *Hardware Trade Journal* to add to his father's journal, the *Cabinet Maker*. His experiences selling advertisement space to manufacturers, coupled with his work in World War I at the ministries of munitions and reconstruction, served to form in his mind the views he subsequently expressed so forcefully in contributions to the press and in books. *The Confessions of a Capitalist*, *Account Rendered* and *The State the Enemy* were his best-known books.

Benn's publishing activities continued to grow, and spread from trade journals to books. He was a pioneer of paperbacks with the Sixpenny Poets and Sixpenny Library, two best-selling popular education series. His public work included the presidency of several national trade charities, and the foundation of the Boys Hostels association. He died at Oxted, Surrey on Jan. 17, 1954. (ED. G. B.)

BENNET, JOHN (*c.* 1575–?), English composer, chiefly of madrigals. Scarcely anything is known of Bennet's life, but the dedication of his *Madrigalls to Foure Voyces* (1599) suggests that he may have come from the border of Lancashire and Cheshire. Since the title page also describes this collection as "his first works" it may be presumed that he was born *c.* 1575. He contributed a madrigal, the well-known "All creatures now are merry minded," to Thomas Morley's *The Triumphes of Oriana* (1601), and five four-part settings of traditional tunes to

the undated psalter printed by William Barley; since Barley was one of those to whom Morley had assigned his patent to print music and Morley also contributed to this psalter, he and Bennet probably knew one another. This is also suggested by the style of Bennet's madrigals, which is light but highly finished in Morley's Italianate manner.

Bennet's music was also valued by the composer and compiler Thomas Ravenscroft, who reprinted two of the psalm-settings in his psalter of 1621, and also included six new compositions by him in his *Briefe Discourse* (1614). Two of these, as well as Bennet's 1599 collection and his single Oriana madrigal, are included in vol. xxiii of E. H. Fellowes's *The English Madrigal School* (1922). (J. J. N.)

BENNETT, (ENOCH) ARNOLD (1867–1931), English novelist, dramatist and journalist, whose best work describes life in "the Potteries," where he lived as a boy, was born at Hanley, Staffordshire, on May 27, 1867. The son of a solicitor, he left school at 16 and entered his father's office but in 1888 left the Potteries for London where, having published several stories and articles, in 1893 he became assistant editor and, in 1896, editor, of the magazine *Woman*. His first novel, *A Man From the North*, not autobiographical but closely related to his personal experiences, was published in 1898. Thenceforward until 1930 he wrote continuously, sometimes publishing more than 300,000 words a year, becoming comparable in common reputation with Bernard Shaw and H. G. Wells, a popular sage expressing opinions on almost every sort of question, and the highest-paid book reviewer of the day. From 1902 to 1913 he lived mainly in France, marrying in 1907 Marguerite Soulié, from whom he was legally separated 14 years later. In the last years of his life he lived with Dorothy Cheston, an actress, who bore him a daughter. "Of his last ten years one's final impression is of a man bound down under the tyranny of things, perpetually tired, often ill, striving despite his enormous success to make both ends meet." (Walter Allen, *Arnold Bennett*, Arthur Barker Ltd., 1948.) This was the period of Bennett's yacht and luxury flat, of his hobnobbing with the rich and famous, of his theatrical ventures and his weekly two columns in the *Evening Standard*. Yet to see his career as that of the simple provincial corrupted by success is inadequate. He always defied facile pigeonholing, and he maintained an unsentimental integrity to the end of his life. He died in London on March 27, 1931.

Arnold Bennett's novels are very unequal in value and it is hard to trace any consistent development in them. Throughout his literary career crude, trivial and frankly commercial writings jostle with books showing a sincere effort to portray truth. *Anna of the Five Towns* (1902), *The Old Wives' Tale* (1908), *Clayhanger* (1910) and *Riceyman Steps* (1923) are generally considered the finest of his novels; none of his plays has real distinction, despite the success of *Milestones* (1912), written with Edward Knoblock, and *The Great Adventure* (1913), a dramatization of his *Buried Alive* (1908). Much has been made of Bennett's debt to the French novel, especially to the naturalists, Zola in particular. Certainly his concern with presentation ("An artist must have a passion for technique, a deep love of form") owes something to the French, and his attempt to achieve objectivity reflects the aims of naturalism; yet such a novel as *Anna of the Five Towns* seems to be closer in manner to the realism of Balzac and Turgenev. In *Anna* and, more ambitiously, in his masterpiece *The Old Wives' Tale* and in the *Clayhanger* books, Bennett portrays with unequaled knowledge and mature compassion the life, especially the middle-class life, of the Potteries, the "five towns" of north Staffordshire. He is at once close to his subject matter, and detached, objective, critical in his handling of it. When he is closest to it, as in the opening section of *The Old Wives' Tale*, his touch is Dickensian, although in less secure moments he can be facetious. When he stands back a little, as in the moving close of *Anna* or in the entire conception of *Riceyman Steps* (the only one of his major novels not set in the five towns), his objectivity is tinged with a compassionate and unforced irony. The unresolved contradiction in his own life—between the provincial boy and the boulevardier, the socialist who is yet absorbed in maintaining a luxurious way of living, the conscientious artist who became the grand panjandrum of middle-brow culture—is, in his best moments, resolved in this blend of the objective and the ironical. But the contradiction impregnates his novels, like his life, with sadness. Too tough a writer to capitulate to easy sentimentality, his sense of the impossibility of reconciling ideals with reality gives his best work truth and dignity but also leads to a certain lack of confident vitality. Perhaps the keyword of his career, as man and artist, is, with all its ambiguity, the word realism.

The Journals of Arnold Bennett, 1896–1928 were edited by N. Flower in three volumes (1932–33).

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BENNETT, CHARLES EDWIN (1858–1921), U.S. classical scholar, whose *Latin Grammar* (1895) was the first successful attempt in the U.S. to adopt the method of the brief, scholarly German school grammar, was born April 6, 1858, in Providence, R.I. He graduated from Brown university in 1878, and also studied at Harvard and in Germany. After teaching in secondary schools in Florida, New York and Nebraska, he became professor of Latin at the University of Wisconsin in 1889, of classical philology at Brown university in 1891 and of Latin at Cornell university in 1892.

His syntactical studies are based on a statistical examination of Latin texts, and are marked by a fresh system of nomenclature. Of interest are his advocacy of quantitative reading of Latin verse, and his *Critique of Some Recent Subjunctive Theories* in *Cornell Studies in Classical Philology*, of which he was editor. His later publications include *Syntax of Early Latin* (1910–14); and *New Latin Composition* (1912). He died May 2, 1921, at Ithaca, N.Y.

BENNETT, JAMES GORDON (1795–1872), U.S. journalist, founder and editor of the *New York Herald*, who greatly influenced journalism in the United States, was born at Newmill, near Keith, Banffshire, Scot., in 1795. He was educated for the Roman Catholic priesthood in a seminary at Aberdeen, but in the spring of 1819 he emigrated to America. After earning a meagre living as teacher, proofreader and translator in Halifax, N.S., Boston, New York and Charleston, S.C., he settled in New York, where he projected a school, gave lectures on political economy and did subordinate work for the journals. During the next ten years he was employed on various papers, was the Washington, D.C., correspondent of the *New York Enquirer* and associate editor of the *Courier and Enquirer*, his articles attracting much attention. He founded the short-lived *Globe* in New York in 1832, and in 1833–34 was the chief editor and one of the proprietors of the *Pennsylvanian* at Philadelphia.

Starting with a capital of $500, he published on May 6, 1835, the first number of a four-page penny paper bearing the title of *New York Herald* and issuing from a cellar. The proprietor and editor also played the part of salesman. In his initial issue he outlined his policy: "We shall support no party—be the agent of no faction or coterie, and care nothing for any election, or any candidate from president down to constable"; and to this he consistently adhered. By his industry and sagacity, and by considering it the function of a newspaper, "not to instruct, but to startle," he made the paper a great commercial success. He devoted attention particularly to the gathering of news and was the first to introduce many of the methods of the modern U.S. reporter. He published on June 13, 1835, the first Wall street financial article to appear in any U.S. newspaper; printed a vivid and detailed account of the great fire of Dec. 1835 in New York; was the first, in 1838, to establish European correspondents; was the first, in 1846, to obtain the report in full by telegraph of a long political speech; maintained during the Civil War a staff of 63 war correspondents; was a leader in the use of illustrations; introduced a society department; and with the Helm Jewett case was the first in U.S. journalism to publish an account of a love-nest murder. Bennett continued to edit the *Herald* almost till his death on June 1, 1872. (*See* also NEWSPAPER: *The Penny Press.*)

His son, JAMES GORDON BENNETT (1841–1918), born May 10, 1841, and educated abroad and by private tutors, shared his father's burdens after 1866, and succeeded his father in the control of the *Herald*. He founded the *Evening Telegram*, established a daily edition of the *Herald* in London and later in Paris, financed Henry M. Stanley on his mission to find David Livingstone in central Africa, fitted out the "Jeannette" Polar expedition, and in 1883 organized (with John W. Mackay) the Commercial Cable company. An enthusiastic sportsman, he established trophies for international yacht and motor races. On May 14, 1918, he died in France, from where he had long directed the policies of the *Herald*.

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BENNETT, RICHARD BEDFORD BENNETT, VISCOUNT (1870–1947), Canadian statesman and prime minister, who was strongly nationalist in economics and largely responsible for the Ottawa economic conference in 1932 which resulted in a series of bilateral trade agreements between various commonwealth states. Born at Hopewell, N.B., July 3, 1870, he was graduated from Dalhousie university, Halifax, and in 1893 was admitted to the bar. In 1897 he migrated westward, serving in the legislative assemblies of the Northwest Territories and of Alberta.

In 1911 he entered the house of commons as member for Calgary, Alta. In 1916 he was director-general of national service and in 1921 minister of justice. In 1927 he became leader of the Conservative party, and in 1930 he was returned to office as prime minister. In Oct. 1935 he was heavily defeated by the Liberals led by Mackenzie King.

Bennett was created a viscount in 1941, a title which became extinct when he died unmarried, on June 27, 1947, at Mickleham, Surrey, Eng. (W. R. GR.)

BENNETT, SIR WILLIAM STERNDALE (1816–1875), English pianist, conductor and composer, a notable figure in the musical life of his time. Born at Sheffield, April 13, 1816, he became a chorister at King's college, Cambridge, and in 1826 entered the Royal Academy of Music where he studied composition under William Crotch and Cipriani Potter. While there he wrote several symphonies and piano concertos. In 1833 his first piano concerto greatly impressed Mendelssohn, who became a close friend.

In 1836 he played his third piano concerto and conducted his overture *The Naiads* at the Gewandhaus concerts in Leipzig where he was enthusiastically received by Schumann.

In 1842 he was appointed one of the directors of the Philharmonic society in London and in 1849 he founded the London Bach society, at which, in 1854, he gave the first performance in England of Bach's *St. Matthew Passion*, which began the movement for the performance of Bach's choral music in England.

He was appointed conductor of the Philharmonic society in 1856 and in the same year became professor of music at Cambridge. In 1866 he became principal of the Royal Academy of Music. He was knighted in 1871. He died in London on Feb. 1, 1875.

Bennett's work, consisting chiefly of concertos and solo pieces for the piano, enjoyed a wide popularity in England and Germany, and his cantata *The May Queen*, written, like so many of his works, for a festival (Leeds, 1858), and the quartet "God Is a Spirit," from the oratorio *The Woman of Samaria* (1867), are still sung by village and church choirs.

See J. R. S. Bennett, *The Life of W. S. Bennett* (1907).

BEN NEVIS, the highest mountain in the British Isles, is in Inverness-shire, Scot. It is 4,406 ft. above sea level, 4½ mi. E.S.E. of Fort William, the meridian of 5° W. passing through it. From Banavie on the Caledonian canal, it shows two great masses and though bulky is much less striking than many other Highland hills. Its summit is a plateau of about 100 ac. with a slight slope to the south and a sheer fall to the northeast of more than 1,500 ft. Snow lies in some corries all the year round. The rocks of its lower half are mainly porphyritic granites intruded into Highland schists and traversed in places by intrusive dikes. The summit, in contrast, consists of volcanic rocks some 2,000 ft. in depth, resting unconformably on the Highland schists; cauldron subsidence has been invoked to explain this feature. Its circumference at the base is about 24 mi. Ben Nevis is really the highest point of a dissected mountain block flanked on the west and south by the glen and water of Nevis, on the east by the river and glen of Treig, and on the north by the river and glen of Spean. A small hotel on the summit has long been closed and is in ruins, as is the meteorological observatory maintained there from 1881 to 1905 and afterward closed for lack of funds. A bridle road up the mountain, which leaves Glen Nevis at Achintee and has a gradient nowhere exceeding 1 in 5, was made for the use of workers at the observatory. (A. T. A. L.)

BENNIGSEN, LEVIN AUGUST (Russian LEONTI LEONTIEVICH), COUNT VON (1745–1826), Russian general prominent in the Napoleonic Wars, was born of a Hanoverian family in Brunswick on Feb. 10, 1745, and served in the Hanoverian army until 1764. In 1773 he entered the Russian service as a field officer. He fought against the Turks in 1774 and in 1778 and became colonel in 1787. He distinguished himself repeatedly in the Polish War of 1793–94 and in the Persian War of 1796. The part played by Bennigsen in the actual assassination of the emperor Paul I is not fully known, but he took a most active share in the formation and conduct of the conspiracy. The emperor Alexander I made him governor general of Lithuania in 1801 and a general of cavalry in 1802. In 1806 he was in command of one of the Russian armies operating against Napoleon and fought the battle of Pultusk. In the sanguinary but indecisive battle of Eylau (Feb. 8, 1807) he could claim to have inflicted the first reverse suffered by Napoleon, but six months later he met with crushing defeat in the battle of Friedland (June 14), the direct consequence of which was the treaty of Tilsit. He retired for some years, but in the campaign of 1812 he commanded the Russian centre at Borodino and defeated Joachim Murat at Tarutino. Because of a quarrel with M. I. Kutuzov, however, he was compelled to retire. After Kutuzov's death he was recalled and placed at the head of an army. Bennigsen led one of the columns that made the decisive attack on the last day of the battle of Leipzig (Oct. 16–19, 1813). On the same evening he was made a count by Alexander I and he afterward commanded the forces operating against L. N. Davout in northern Germany. He retired from active service in 1818 and settled on his Hanoverian estate of Banteln near Hildesheim. He died in Hanover on Dec. 3, 1826.

See FRIEDLAND; NAPOLEONIC WARS. (I. GY.)

BENNIGSEN, RUDOLF VON (1824–1902), for 30 years president of the German National Liberal party, was born at Lüneburg on July 10, 1824, the son of a major general in the Hanoverian army. After studying law, he entered the Hanoverian civil service in 1846 but resigned in 1856 on his election to the Hanoverian second chamber, in which he became the leader of the Liberal opposition. In 1859 together with Johann von Miquel, he founded the Nationalverein, becoming its president. The Nationalverein's aims were German unity under Prussian leadership and an all-German parliament. Bennigsen vainly tried to keep Hanover neutral in the Seven Weeks' War, but with Prussia's annexation of Hanover after the war he entered the diet of the North German confederation and the Prussian chamber of deputies, whose president he was from 1873 to 1879. When the Nationalverein was dissolved (1867), Bennigsen helped to found the National Liberal party which worked for German unity and a liberal constitutional development. He took part in the negotiations at Versailles in Dec. 1870 between the North German confederation and the states of southern Germany. Bismarck's attempt to bring him into the Prussian ministry in

1877 failed because the emperor William I disliked him and partly because Bennigsen insisted that two of his party colleagues be also appointed. Despite earlier co-operation, relations between Bismarck and the National Liberals became strained, especially when the party rejected Bismarck's entire protectionist policy in 1879. The parliamentary power of the National Liberals was however shattered when a right-wing protectionist group split away in 1879 and the radicals, of the so-called *Sezession*, in 1880. Bennigsen retired from politics in 1883, but returned in 1887 to enter the *Kartellreichstag*, in which the Conservatives combined with the National Liberals to pass the Septennat bill (for a seven-year army grant). William II appointed Bennigsen president of the province of Hanover in 1888. He resigned from this post and retired from public life in 1897. He died at Bennigsen, in Hanover, on Aug. 7, 1902.

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BENNINGTON, a township including the three villages of Old Bennington, Bennington and North Bennington, in the southwest corner of Vermont, U.S., between the Taconics and Green mountains; the seat of Bennington county. It was chartered in 1749, settled in 1761 and named for Benning Wentworth, the governor of New Hampshire who issued the grant. The settlers were led by Samuel Robinson, who had camped in the valley on the Walloomsac river on his return from the French and Indian War. The group immediately organized the First Congregational Church and, within the year, their first town meeting government in a form (with slight modification) still in existence. The settlers' first difficulties were with the absentee landlords of New York, who claimed rights to Bennington lands, but through successful resistance at the Breakenridge farm in North Bennington, the independence of Vermonters was soon established. These vigorous and independent settlers were already experienced fighters when, as Green Mountain Boys under the leadership of Ethan Allen and Seth Warner, they organized in Aug. 1777 to resist Gen. John Burgoyne and his Loyalists and Hessians on their march to capture the Bennington stores of arms and supplies. The patriots set forth from the Catamount tavern under Gen. John Stark and defeated the British at the battle of Bennington, Aug. 16, 1777, a battle which was a turning point in the American Revolution.

During the 19th century the town grew into a textile, pottery, wood products and paper centre. The inhabitants are mostly of English, Irish and French-Canadian extraction and engaged in manufacturing (furniture, textiles, batteries, lithography, transistors), agriculture (dairy products, apples, maple sugar, chickens and Vermont turkeys) or in tourist and service trades. Nearby ski areas (Bromley mountain and Mt. Snow), as well as deer hunting and trout fishing, attract many visitors, as does the spectacular fall foliage of maples and silver birches.

Extant colonial buildings include the Parson Dewey, Governor Tichenor and Governor Robinson houses, the Old First church and the Walloomsac inn, in continuous service since 1763.

The Historical museum contains the oldest stars and stripes flag in existence, fine collections of old Bennington pottery, early American furniture, glass, household wares and genealogical materials. A 304-ft.-high obelisk commemorates the battle of Bennington.

Bennington College for Women (founded 1932), enrolling almost 350 students annually, is known for its individually planned programs in the humanities and the sciences and for its winter nonresident term, when all students leave their campus studies for related practical work.

For comparative population figures *see* table in Vermont: *Population*. (C. O. Fo.)

BENNO, SAINT (d. *c.* 1106), bishop of Meissen, Ger., was a canon attached to the imperial collegiate church of Goslar when, in 1066, he was made bishop of Meissen. In the troubles between empire and papacy that followed, Benno took part against the emperor.

In 1085 he was deposed by the synod of Mainz, but after the death of Pope Gregory VII he submitted and on the recommendation of the imperialist pope Clement III was restored to his see, which he held until his death. His canonization (1523) drew from Martin Luther a violent brochure titled "Against the New Idol and the Old Devil About To Be Set Up at Meissen." Benno's feast day is June 16.

See H. Thurston and D. Attwater (eds.), *Butler's Lives of the Saints*, vol. ii (1956).

BENOIT, PETER LÉONARD LÉOPOLD (1834–1901), Belgian composer who established a Flemish school of choral music. Born on Aug. 17, 1834, at Harelbeke, near Courtrai, he entered the Brussels conservatory in 1851 and studied composition there under F. J. Fétis. He won the Grand Prix de Rome in 1857 and in 1858 traveled throughout Germany. After visiting Paris, where he was conductor at the Théâtre des Bouffes-Parisiens, he returned to Belgium and in 1864 produced at Antwerp a sacred tetralogy, consisting of a Christmas cantata, a Mass, a *Te Deum* and a Requiem. Two years later his oratorio *Lucifer* was given in Brussels.

Under the influence of poets Hendrik Conscience (*q.v.*) and Emanuel Hiel, Benoit became interested in the Flemish national movement and in 1867 founded at Antwerp and became director of the Flemish School of Music, which in 1898 became the Royal Flemish conservatory. He also wrote works reflecting Flemish national ideals, chief of which was his *Rubens-Cantate* (1877), evoking historical scenes at Antwerp. Other of his choral works were inspired by the scenery of his country.

Benoit's conception of a Flemish musical art was democratic, and most of his works were intended to be sung by the people. Though he played an important part in popularizing choral music in Flanders, few of his works were successful abroad. He died at Antwerp on March 8, 1901.

See C. van den Borren, *Peter Benoit* (1942); A. Corbet, *Peter Benoit* (1944).

BENOÎT DE SAINTE MAURE (from Ste. Maure, an ancient town in Touraine), 12th-century author of the Old French *Roman de Troie*. This poem, in 30,000 lines, in octosyllabic couplets, is based on late Hellenistic romances, *De excidio Troiae historia*, by Dares Phrygius (*q.v.*) and *Ephemeris belli Troiani* by Dictys Cretensis (*q.v.*), which purport to be eye-witness accounts of the events described by Homer. The main plot is a travesty of the Iliad: Hector slays Patroclus at the outset and is himself slain by Achilles in the course of a battle. A year later, Achilles falls in love with a Trojan princess, Polyxena, and retires to his tent until he is shamed into fighting by the successes of the Greeks; however, he is killed in an ambush while trying to visit Polyxena. Much is said of the amours of Briseida, the daughter of a renegade Trojan priest Calchas (herein lies the germ of Chaucer's *Troilus and Criseyde*). The Amazons come to the aid of the Trojans, but Troy falls because of the treasonable negotiations of Aeneas and Antenor. A prelude to the main story tells of Jason and the Argonauts and an earlier sack of Troy; in an epilogue are the stories of Orestes, Andromache and Ulysses. The whole is an immense baroque tapestry of Greek lore and fable. Benoît was superseded in the later middle ages by an imitator, Guido delle Colonne, who wrote the Latin *Historia destructionis Troiae* (1287), the source of many English "Troy-books."

It is possible to identify this poet with another Benoît (Beneeit) who flourished at the court of Henry II and wrote a verse history covering the same ground as the *Roman de Rou* of Wace (*q.v.*); but there are weighty arguments against the identification (*see* L. Constans, *Roman de Troie*, vol. vi, pp. 165–181). The relation of *Troie* to the other romances on Greco-Latin themes has led to much debate; it is now agreed that the romances *Troie* and *Éneas* are indebted to that of *Thèbes*.

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BENONI, a town of the Transvaal, Republic of South Africa, lies 20 mi. E. of Johannesburg at 5,600 ft. above sea level, covering two sides of a valley which borders four lakes. Pop. (1960) 135,467. Planned in 1903 by a mining leader, Sir George Farrar, as a gold mining town, it has developed into a modern industrial centre. At the north and northeast are European suburbs, the commercial area is in the centre and the industrial section to the south. To the east, beyond a strip of land for industrial development, is the large modern township of Daveyton for Africans. The main street is Prince's avenue, resembling a south European boulevard and bordered with palms and ornamental trees, on which stand the town hall, amid gardens, and office buildings, banks and shops. There are schools of all grades, commercial and technical colleges and a Carnegie library. Sports grounds and swimming baths are of international standard; Willowmoore Park stadium is the headquarters of the Eastern Transvaal Football association and caters for association and rugby football, hockey, cricket and other sports.

Electric trains run to Johannesburg; motor roads link the town with all parts of the Transvaal, and Jan Smuts airport is nearby. Benoni is part of the workshop of the republic; industrial exports include heavy-duty batteries, welding electrodes and engineering machinery.

BENSBERG, a town of Germany which after partition of the nation following World War II is in the *Land* (state) of North Rhine-Westphalia, Federal Republic of Germany. Pop. (1959 est.) 28,445. It is an administrative and shopping centre, but is chiefly a "dormitory" town; atomic reactors are manufactured and there is a leather industry. There is a baroque *Schloss* ("castle"; 1706–13) that belonged to duke John William of the house of Berg, and the ruins of an old *Schloss* (1250) that had belonged to the counts of the same family. There is a local museum and a Roman Catholic academy. Communications (train, streetcar and bus) are mainly with Cologne, 9 mi. distant. (Ha. C.)

BENSERADE, ISAAC DE (1612 or 1613–1691), French poet remembered for his sonnet on "Job," for his libretti and for his rondeaux. His family (whose name he originally spelled Bensserade) may have been Protestant when he was born, but he is known to have been baptized as a Catholic on Nov. 5, 1613. He began visiting the Hôtel de Rambouillet in Paris in 1634, but seems not to have been much esteemed there. After writing some tragedies (1634 ff.), he turned chiefly to polite and amorous verse, of which there are about 100 examples by him in collections published between 1640 and 1660. In the "Sonnets controversy" (1649) his sonnet on "Job" was upheld by the Jobelins against Vincent Voiture's sonnet to "Uranie," upheld by the Uranistes, to whom victory was eventually adjudged. From 1651 onward he wrote numerous libretti for court ballets, notable for witty allusions to current topics. Elected to the Académie Française in 1674, he was unjustly blamed for turning Ovid's *Metamorphoses* into rondeaux when in fact he had simply composed the 224 rondeaux printed as tailpieces to the splendid illustrations to Ovid published by Sébastien Le Clerc and François Chauveau (1676). He died in Paris on Oct. 20, 1691.

See C. I. Silin, *Benserade and His Ballets de Cour* (1940); A. Adam, *Histoire de la littérature française au XVIIe siècle*, vol. i and iii (1948–52). (Ae. A.)

BENSLEY, ROBERT (*c.* 1738–*c.* 1817), English actor praised by Charles Lamb in the *Essays of Elia*, played important parts at the Drury Lane, Covent Garden and Haymarket theatres from 1765 to 1796. His most successful role was that of Malvolio in *Twelfth Night*.

BENSON, EDWARD WHITE (1829–1896), archbishop of Canterbury, was born on July 14, 1829, at Birmingham. His father, a Yorkshireman and a manufacturing chemist, died in 1842, leaving his family impoverished. Educated at King Edward's school, Birmingham—where he was greatly influenced by the headmaster, James Prince Lee, whom he revered all his life—Benson went in 1848 to Trinity college, Cambridge, joining his intimate friends J. B. Lightfoot and B. F. Westcott (*qq.v.*), both pupils of Prince Lee. The close friendship and common spiritual ideals of these three great scholars (Benson won the senior Chancellor's medal in 1852 and became fellow of Trinity in 1853) richly benefited the Anglican church in the late 19th century.

From 1852 to 1858 Benson was an assistant master at Rugby and in 1859, the year in which he married his cousin Mary Sidgwick, he was appointed on the recommendation of Frederick Temple (then headmaster of Rugby) to the headmastership of the newly founded Wellington college. With astonishing creative power and forcefulness of personality, Benson succeeded in converting a poorly endowed institution for army officers' orphans into a great school. At Wellington, Benson began his study of Cyprian and also took the deepest interest in the building of the school chapel, the mosaics, carvings and windows of which testify to the important part he played in the revived interest in ecclesiastical symbolism and patristic studies.

In 1873 Benson became chancellor of Lincoln. He founded a theological college, conducted a successful mission and established night schools and university extension lectures. In Dec. 1876 Disraeli offered him the newly created see of Truro, and he was consecrated on April 25, 1877. Nonconformity was firmly entrenched there, but by brilliant diocesan organization and frequent pastoral tours and not least by winning the hearts of the Cornish people by his deep interest in their history and traditions, Benson virtually re-established the Anglican church in Cornwall. Truro cathedral is his most fitting monument, the realization of his dearest wish that the cathedral should be the active spiritual centre of a diocese.

In Dec. 1882 Benson accepted Gladstone's offer of the archbishopric of Canterbury on the death of Archbishop Archibald Campbell Tait (in part a recognition of his careful avoidance of party conflict), and was enthroned on March 29, 1883. He was by nature sanguine, believing that faith and unremitting industry could move mountains, and although he suffered occasional lapses into black depression (as when his eldest son, Martin, died in 1878) he fought relentlessly for what he believed to be right. He attended the house of lords regularly, pressing for the reform of church patronage (realized in the Benefices act, 1898) and for the Clergy Discipline act, 1892. In 1886 he created the House of Laymen, a consultative body to convocation. Benson firmly believed in the essential alliance of clergy and laity in defense of the establishment, launching the Central Church Committee for Church Defence and Instruction in 1893 and successfully organizing resistance to attempts to disestablish the Welsh church. He earned the unqualified praise of Dean R. W. Church and Bishop Westcott, among many others, for his masterly judgment in the bishop of Lincoln's case (1888–90), when against the advice of many friends he heard the charges, alleging unauthorized ritualism, brought by the Church association against Edward King, bishop of Lincoln. The bishop claimed that the archbishop sitting alone had no jurisdiction over his provincials, but this objection was overruled by the privy council. In his judgment, Benson revealed the depth of his learning on ecclesiastical antiquity and liturgy, ignoring previous rulings of the privy council and producing a lucid definition of liturgical practices sanctioned by usage. The Lincoln judgment (*q.v.*) contributed greatly to the ending of one of the most unedifying chapters of 19th-century church history, and was generally accepted by both high church and evangelical parties within the church.

Greater still was his work in encouraging missions and friendly relations with churches not in direct communion with Canterbury. He opened negotiations with the Russian church, re-established the Anglican bishopric in Jerusalem, achieved a peaceful settlement of the unhappy schism in Natal (*see* Colenso, John William) and founded a mission to the decayed Assyrian church (*see* Nestorians). On the other hand, Benson was suspicious of the negotiations between Leo XIII, the Abbé Portal and Lord Halifax on the question of Roman recognition of Anglican orders.

Benson combined a restless vitality with meticulous love of detail. In bearing, he was dignified and impressive. On Oct. 11, 1896, after an exhausting and successful tour of Ireland, he died from heart failure while staying with the Gladstones, during morning service at Hawarden parish church. His two main literary works were published posthumously: *Cyprian* (1897) and *The Apocalypse* (1900).

See his *Life* by A. C. Benson (1899); A. B. Donaldson, *The Bishopric of Truro* (1902); D. H. Newsome, *A History of Wellington College, 1859–1959* (1959).

Archbishop Benson's second son, ARTHUR CHRISTOPHER BENSON (1862–1925), teacher and writer, was born at Wellington on April 24, 1862. Educated at Eton and King's college, Cambridge, he was an assistant master at Eton (1885–1903), fellow of Magdalene college, Cambridge (1904), and master of Magdalene (1915–25). During his mastership, Magdalene expanded considerably. He was a kind and generous host and a liberal benefactor. He died on July 17, 1925, at Cambridge. He wrote prolifically, mainly collections of essays and biographical studies, written in a distinctive gentle and wistful style. His essays include *The Upton Letters* (1905), *From a College Window* (1906) and *The Leaves of the Tree* (1911). He also wrote the life of his father (1899) and of his brother Hugh (1915), and edited *The Correspondence of Queen Victoria 1837–1861* (1907) (with Lord Esher). He wrote the words of the anthem "Land of Hope and Glory."

See E. H. Ryle (ed.) *Arthur Christopher Benson,* (1925).

Archbishop Benson's third son, EDWARD FREDERIC BENSON (1867–1940), born at Wellington on July 24, 1867, and educated at Marlborough and King's college, Cambridge, was also a prolific writer. His main works were *Dodo* (1893), *As We Were* (1930) and *Final Edition* (1940). He died on Feb. 29, 1940.

Archbishop Benson's fourth son, ROBERT HUGH BENSON (1871–1914), became a Roman Catholic writer and apologist. Born at Wellington on Nov. 18, 1871, and educated at Eton and Trinity college, Cambridge, he was ordained in Anglican orders but became a Roman priest (1903) after five years in the Community of the Resurrection at Mirfield. From 1911 he was a papal chamberlain. He was impulsive and full of enthusiasms, an artist and craftsman. He died in Manchester on Oct. 17, 1914. His main works were *The Light Invisible* (1903), *By What Authority* (1904) and *The Papers of a Parish* (1907).

See his *Life* by C. C. Martindale (1916); A. C. Benson, *Hugh* (1915). (D. H. N.)

BENSON, SIR FRANK (ROBERT) (1858–1939), English actor-manager, was born at Alresford, Hampshire, on Nov. 4, 1858. While at New college he produced the first Oxford Greek play, *Agamemnon*. In 1882 he made his first professional appearance at the Lyceum theatre, London, under Henry Irving, playing the role of Paris in *Romeo and Juliet*. The next year he went into managership with a company of his own, taken over from Walter Bentley. In 1886 he married Gertrude Constance Featherstonhaugh (1860–1946), who acted in his company and continued to play leading parts with him. Besides appearing in London he toured regularly in Shakespeare, and went to Canada (1913) and South Africa (1921). His finest parts were Hamlet, Coriolanus, Richard II, Lear and Petruchio. By his organization of a regular touring company, and by his foundation of a dramatic school of acting in 1901, Benson exercised an important influence on the contemporary stage. From the first he devoted himself largely to the production of Shakespeare's plays. After 1888 he organized 26 of the annual Stratford-on-Avon Shakespearean festivals. He was knighted in 1916 in Drury Lane theatre. Benson died in London on Dec. 31, 1939.

See Benson's *My Memoirs* (1930).

BENSON, FRANK WESTON (1862–1951), U.S. painter and etcher, best known for his pictures of women and children and outdoor subjects, was born in Salem, Mass., March 24, 1862. He was a pupil of G. R. C. Boulanger and of Jules Lefebvre in Paris; won a silver medal at the Paris exhibition (1900); the Potter Palmer medal and prize, Chicago (1910); Logan prize, Chicago Society of Etchers (1918); William A. Clark prize and Corcoran gold medal (1919); and became a member of the Ten American Painters, and of the National Academy of Design, New York city. In addition to his reputation as a painter, he achieved success with his etchings and wash drawings of wild fowl. He was one of the decorators of the Library of Congress, Washington, D.C. Benson died at Salem on Nov. 14, 1951.

BENT, CHARLES (1799–1847), U.S. pioneer and trader whose name is associated with Bent's fort, a famous trading post built (1828–32) with his brother William on the Arkansas river near the present La Junta, Colo. He was born Nov. 11, 1799, at Charleston, Va. (now W. Va.). The family moved to St. Louis, Mo., in 1806 and Charles soon became interested in the fur trade. He eventually became one of the best-known traders in the west and in 1846 was appointed civil governor of New Mexico. He was killed at Taos on Jan. 19, 1847, during a Mexican and Pueblo Indian uprising against the U.S.

WILLIAM BENT (1809–1869), who is considered Colorado's first permanent white resident, managed the trading post for a number of years with two younger brothers. From an early age he participated in trapping expeditions of Charles and another trader, Ceran St. Vrain, in the Arkansas valley.

SILAS BENT (1820–1887), another brother, was an oceanographer and U.S. naval officer. He served under Commodore Matthew C. Perry on his expedition to Japan, 1852–54.

See Allen H. Bent, *The Bent Family in America* (1900).

BENT, JAMES THEODORE (1852–1897), English explorer and archaeologist, was born near Leeds, Yorkshire, on March 30, 1852. He was educated at Repton school and graduated in 1875 from Wadham college, Oxford. His travels among the Aegean Islands are described in *The Cyclades; or Life Among the Insular Greeks* (1885). In 1890 he traveled in southern Turkey in the Roman province of Cilicia, investigating the visible ruins of ancient cities, and published descriptions, plans and ancient inscriptions of these and other earlier explorations in Asia Minor in the *Journal of Hellenic Studies*. Bent led three expeditions to parts of Africa. He spent a year examining the great Zimbabwe ruins in South Africa, which he described in *The Ruined Cities of Mashonaland* (1892) (*see* ZIMBABWE). His book *The Sacred City of the Ethiopians* (1893) was the result of exploring Eretria and northern Abyssinia, where he visited Aksum and described Sabaean monuments and copied inscriptions. In 1895–96 he discovered an ancient gold mine in the Sudan. Bent also led five expeditions to Arabia. On Bahrein Island in 1889 he was only able to excavate two meagre tombs. In 1893–94 his expedition mapped part of the unexplored Hadhramaut area in southern Arabia, and in 1895 he visited Muscat and explored the Dhofar coast, making maps and briefly describing ancient cities in the area. One of these, Al Beleid, yielded, upon recent excavation, nothing definitely earlier than 1750. Evidence of ancient occupation has been found, however, near the site he rightly identified as Abyssapolis, the ancient frankincense and myrrh port. While in south Arabia again in 1896–97 Bent contracted malaria and died in London on May 5, 1897. Mrs. Bent, his constant companion and photographer of the expeditions, published their last travels in *Southern Arabia, Soudan and Sakotra (1900)*. Bent's descriptions of contemporary life, as well as his accounts of ancient ruins in Africa and Arabia, are still valuable, but certain of his theories, such as the Zimbabwe being of Semitic origin or Bahrein being the original home of the Phoenicians, have been found untenable. (J. C. RU.)

BENT GRASS, the common name for species of *Agrostis*, a large and widely distributed genus of the grass family. A few species are much used in pastures, especially redtop (*A. alba*), and in lawns, particularly certain of the stoloniferous species such as *A. palustris*, the creeping bent with its several strains known as Cocoos, Coos Bay, Metropolitan, Seaside, Seashore and Washington bent grasses that are used for lawns, golf greens and lawn bowling greens. Colonial bent (*A. tenuis*) is also widely used for the same purpose. *See* also GRASSES; LAWNS, CARE OF. (J. M. BL.)

BENTHAM, GEORGE (1800–1884), English botanist and plant cataloguer outstanding as a systematist, was born at Stoke

near Portsmouth on Sept. 22, 1800. His father, Sir Samuel Bentham (1757–1831), the only brother of Jeremy Bentham (*q.v.*), was a naval architect in the service of the empress Catherine II of Russia. The Bentham family spent much time on the continent, and after 1815 settled at Montpellier, France. There George read A. P. de Candolle's edition of J. B. Lamarck's *Flore française* and was much impressed with its analytical tables. He began forthwith to collect the materials for his first botanical work. *Catalogue des plantes indigènes des Pyrénées et du Bas Languedoc* (1826). From 1826–32 he acted as secretary to his uncle, Jeremy Bentham, and studied for the bar at Lincoln's Inn.

In 1854 he found the maintenance of a herbarium and library too great a tax on his means. He therefore offered them to the government on the understanding that they should form the foundation of such necessary aids to research in the Royal Botanic gardens at Kew. In 1858 his *Handbook of the British Flora* was published, and was reprinted several times (7th ed., 1924). The 5th and 6th editions were prepared by J. D. (later Sir Joseph) Hooker, and "Bentham and Hooker" remained one of the standard floras for students. The government, in 1857, sanctioned a scheme for the preparation of a series of floras of British colonies and possessions. Bentham began with the *Flora Hongkongensis* in 1861. This was followed by the *Flora Australiensis*, in seven volumes (1863–78). His greatest work was the *Genera Plantarum*, 3 vol. (1862–83) in collaboration with Sir Joseph Hooker. He seemed at last only to live for the completion of this monumental work. He died in London on Sept. 10, 1884.

During the period 1826–32, he wrote the *Outline of a New System of Logic, With a Critical Examination of Dr. Whateley's Elements of Logic* (1827) and a number of articles on various legal subjects. In his *Outline* the principle of the qualification of the predicate was explicitly stated for the first time.

BENTHAM, JEREMY (1748–1832), English utilitarian philosopher, economist and theoretical jurist, one of the principal influences on the reforming thought of the 19th century, both in his own country and abroad, was born on Feb. 15, 1748, in Red Lion street, Houndsditch, London, the son of an attorney. At the age of three the child is said to have read eagerly such works as Paul de Rapin's *History* and to have begun the study of Latin. Much of his childhood was spent happily at his two grandmothers' country houses. At Westminster school he obtained a reputation for Greek and Latin verse writing. In 1760 he went to Queen's college, Oxford, where his most important acquisition seems to have been a thorough acquaintance with Robert Sanderson's *Logic*. He took his degree in 1763 and, in November, entered Lincoln's Inn and took his seat as a student in the king's bench, where he listened with rapture to the judgments of Lord Mansfield. In Dec. 1763 he managed also to hear Blackstone's lectures at Oxford, but says that he immediately detected the fallacies which underlay the rounded periods of the future judge (*see* BLACKSTONE, SIR WILLIAM). He spent his time in making chemical experiments and in speculating upon legal abuses rather than in reading lawbooks. On being called to the bar he "found a cause or two at nurse for him, which he did his best to put to death," to the bitter disappointment of his father, who had confidently looked forward to seeing him become lord chancellor.

Bentham's first book, the *Fragment on Government*, appeared in 1776. The subtitle, "an Examination of what is delivered on the subject of Government in the Introduction to Sir William Blackstone's Commentaries," indicates the nature of the work. Bentham found the "grand and fundamental" fault of the *Commentaries* to be Blackstone's "antipathy to reform." Bentham's book, written in a clear and concise style different from that of his later works, may be said to mark the beginning of philosophic radicalism. It is also a very good essay on sovereignty. Lord Shelburne (afterward 1st marquess of Lansdowne) read the book and called upon its author in 1781 in his chambers at Lincoln's Inn. Afterward Bentham was a frequent guest at Bowood, where he met Miss Caroline Fox (daughter of the 2nd Lord Holland), to whom he later made a proposal of marriage. At this period Bentham's mind was much occupied with the work which was published by Étienne Dumont in French as *Théorie des peines et des récompenses*, 2 vol., in 1811, but which eventually appeared as *The Rationale of Reward* (1825) and *The Rationale of Punishment* (1830). In 1785 Bentham started, by way of Italy and Constantinople, on a visit to his brother, Samuel Bentham, a naval engineer in the Russian service; and it was in Russia that he wrote his *Defence of Usury* (published 1787). This, his first essay in economics, cast in the form of a series of letters from Russia, shows him as a disciple of Adam Smith, but one who insisted on the extreme logical application of Smith's principles. He argued that every man was the best judge of his own advantage, that it was desirable from the public point of view that he should seek it without hindrance and that there was no reason for limiting the application of this doctrine in the matter of lending money at interest. His later works on political economy followed the *laissez-faire* principle, though with modifications. In the *Manual of Political Economy* (partial Fr. ed. by Dumont in the *Bibliothèque britannique*, 1798; Eng. text in vol. iii of Bentham's *Works*) he gives a list of what the state should and what it should not do, the second list being much longer than the first.

Disappointed, after his return to England in 1788, in the hope of making a political career, he settled down to discovering the principles of legislation. The great work on which he had been engaged for many years, *An Introduction to the Principles of Morals and Legislation*, was published in 1789. In this book he defines the principle of utility as "that property in any object whereby it tends to produce pleasure, good or happiness, or to prevent the happening of mischief, pain, evil or unhappiness to the party whose interest is considered." Mankind, he said, was governed by two sovereign motives, pain and pleasure; and the principle of utility recognized this subjection. The object of all legislation must be the "greatest happiness of the greatest number." He deduced from the principle of utility that, since all punishment involves pain and is therefore evil, it ought only to be admitted "so far as it promises to exclude some greater evil." (*See* UTILITARIANISM.)

The fame of the *Principles* spread widely and rapidly. Bentham was made a French citizen in 1792; and his advice was respectfully received in most of the states of Europe and America, with many of the leading men of which he maintained an active correspondence; one of the most curious of these exchanges was with Mohammed Ali. In 1817 he became a bencher of Lincoln's Inn. It was his ambition to be allowed to prepare a code of laws for his own or some foreign country. The codification of law was one of his chief preoccupations, but he seems to have underestimated both the intrinsic difficulties of the task and the need for diversity of institutions adapted to the tradition and civilization of different countries. Bentham however must be reckoned among the pioneers of prison reform. It is true that the particular scheme that he worked out was bizarre and spoiled by the elaborate detail which he loved. "Morals reformed, health preserved, industry invigorated, instruction diffused" and other similar desiderata would, he thought, be the result if his scheme for a model prison, the "Panopticon," were to be adopted; and for many years he tried to induce the government to adopt it. His endeavours, however, came to nothing (*see* PRISON); and though he received £23,000 in compensation in 1813, he lost all faith in the reforming zeal of politicians and officials.

In 1823 he helped to found the *Westminster Review* (1824 ff.) to spread the principles of philosophic radicalism. Bentham had been brought up a Tory, but his experience over the "Panopticon" scheme served to make a democrat of him. As far back as 1809 he had written a tract, *A Catechism of Parliamentary Reform*, which advocated annual elections, equal electoral districts, a wide suffrage and the secret ballot, but it was not published until 1817. He drafted a series of resolutions on reform, based on this tract, which were moved in the house of commons in 1818. A volume of his *Constitutional Code*, which he did not live to complete, was published in 1830.

Bentham died in Queen's Square place on June 6, 1832, in his 85th year. In accordance with his directions, his body was dissected in the presence of his friends. The skeleton was then reconstructed, supplied with a wax head to replace the original

(which had been mummified), dressed in Bentham's own clothes and set upright in a glass-fronted case. Both this effigy and the head are preserved in University college, London.

Bentham's life was a happy one. He gathered around him a group of congenial friends and pupils, such as James and John Stuart Mill, John and Sarah Austin and John Bowring, with whom he could discuss the problems upon which he was engaged and by whom several of his books were practically rewritten from the mass of rough though orderly memoranda which the master had himself prepared. Thus the *Rationale of Judicial Evidence*, 5 vol. (1827), was written out by J. S. Mill, and the *Book of Fallacies* (1824) by Peregrine Bingham. The services of Étienne Dumont in recasting as well as translating the works of Bentham were still more important. It is often difficult to distinguish what part of the work is Bentham's and what is due to his assistants. (X.)

Bentham was much less a philosopher than a critic of law and of judicial and political institutions. Unfortunately, he was not aware of his limitations. He tried to define what he thought were the basic concepts of ethics; and he also elaborated a method for calculating amounts of happiness, the "felicific calculus." Most of his definitions are oversimple or ambiguous or both together, and his calculus, as even his warmest admirers have admitted, cannot be used. It is in principle absurd and not just impractical, for not even an omniscient God could make the calculations imagined by Bentham. It is doubtful whether happiness can be defined in terms of pleasure and the absence of pain. As a moralist and psychologist, Bentham is crude and inadequate; his arguments, though sometimes elaborate, rest too often on ambiguous premises. He had a passion for making definitions and but little talent for the exact analysis of abstract ideas. He seems to have believed both that man is completely selfish and that everyone ought to promote the greatest happiness, no matter whose. Not even the formula of which he made so much, "the greatest happiness of the greatest number," has a definite meaning. The opening chapters of *An Introduction to the Principles of Morals and Legislation*, in which Bentham seeks to explain the ideas fundamental to his philosophy, are remarkably confused. Fortunately, they are more confused than confusing. They spring from simple fallacies easily detected. It must be said in Bentham's favour that he tried to be clear and precise; he did not hide the poverty of his arguments in a fog of rhetoric. He was maladroit but no mystifier.

As a critic of institutions Bentham was admirable. In his *Rationale of Judicial Evidence* he describes the methods that a court should use to get at the truth as quickly as possible; and in the *Essay on Political Tactics* (partial Eng. text, 1791; full text in *Works*, vol. ii) he describes what he considers the most effective forms of debate for a legislative assembly—an account largely based on the procedure of the house of commons. In these works and in others Bentham is concerned to discover what makes for efficiency. Though he defines efficiency in terms of happiness, his reader need not do so; or, if he does, he need not think of happiness as Bentham did. Bentham's assumptions about what makes for happiness are often quite ordinary and sensible; the reader can accept them and still insist that happiness is not to be defined in terms of pleasure and is not to be measured. Whatever is excellent, ingenious and original in Bentham—and there is a great deal of it—need not depend on the "felicific calculus" and "the greatest happiness of the greatest number."

See also Index references under "Bentham, Jeremy" in the Index volume.

BIBLIOGRAPHY.—A collected edition of Bentham's *Works*, with an introduction by J. Hill Burton, selections from his correspondence and a biography, was published by John Bowring (1838–43). This does not include the *Deontology*, which, much rewritten, had already been published in 1834. *See* also *Jeremy Bentham's Economic Writings*, ed. by W. Stark, 3 vol. (1952–54). Translations of the *Works* or of separate treatises have appeared in most European languages. Masses of Bentham's manuscripts are preserved at University college, London (*see* T. Whittaker, *Report on the Bentham Manuscripts at University College, 1892*); also in the British Museum (*see* E. Nys, *Etudes de droit international et de droit politique*, 2nd series, pp. 291–333, 1901). *See* further L. Stephen, *The English Utilitarians*, i (1900); A. C. Doyle, *Jeremy Bentham: Selected Bibliography* (1899); O. Kraus, *Zur Theorie des Wertes: eine Bentham-Studie* (1901); C. M. Atkinson, *Jeremy Bentham: His Life and Work* (1905); H. G. Lundin, "Influence of J. Bentham on English Democratic Development," University of Iowa *Studies*, vol. vii (1920); C. Phillipson, *Three Criminal Law Reformers* (1923); E. Halévy, *The Growth of Philosophic Radicalism*, Eng. trans., new ed. (1949). (J. Pz.)

BENTHOS, a Greek word meaning "depth of the sea" and hence used in biology to denote all the sedentary, crawling and burrowing bottom-dwelling organisms of the sea, representing most of the plant and animal phyla, ranging from the lighted, water-soaked beach to the darkened, greatest depths. The term is used in contradistinction to the drifting plankton (*q.v.*) and actively swimming nekton. *See* MARINE BIOLOGY.

BENTINCK, LORD WILLIAM GEORGE FREDERICK CAVENDISH, better known as LORD GEORGE BENTINCK (1802–1848), British politician, who became leader of the protectionist opponents of Sir Robert Peel, was the second surviving son of the 4th duke of Portland by Henrietta, sister of Lady Canning, and was born on Feb. 27, 1802. He served in the army for several years, and entered parliament in 1828 for King's Lynn, which he represented for 20 years. A celebrated sportsman, he was the last member of the house of commons to wear a pink hunting coat there; and he exercised great authority at race meetings. Until within three years of his death he was little known out of the sporting world.

He belonged originally to the moderate Whig party, and voted in favour of Catholic emancipation, as also for the Reform bill, though he opposed some of its principal details. Soon after, however, he joined the ranks of the opposition, with whom he sided up to 1846. When, in that year, Sir Robert Peel openly declared in favour of free trade, the advocates of the corn laws, then without a respectable leader, discovered that Lord George Bentinck was the only man of position and family round whom the several sections of the opposition could be brought to rally. He soon gave convincing evidence of powers so formidable that the protectionist party under his leadership was at once stiffened into real importance. Toward Peel, in particular, his hostility was uncompromising. Believing that that statesman and his colleagues had, as he put it, "hounded to the death his illustrious relative," George Canning, he combined with his political opposition a degree of personal animosity that gave additional force to his invective.

He abandoned his connection with the turf, disposed of his magnificent string of race horses (including the next Derby winner) and devoted his whole energies to the laborious duties of a parliamentary leader. Apart from the question of the corn laws, however, his politics were decidedly independent. In opposition to the rest of his party, for instance, and to please his chief adviser Disraeli, he supported the bill for removing Jewish disabilities. The result was that in Dec. 1847 he resigned the protectionist leadership, though he still remained active in politics. But his positive abilities as a constructive statesman were not to be tested, for he died suddenly at Welbeck, Sept. 21, 1848. Disraeli published a biography of Lord George Bentinck in 1852.

(M. R. D. F.)

BENTINCK, LORD WILLIAM HENRY CAVENDISH- (1774–1839), British soldier and administrator, whose many radical innovations when governor general (1827–35) made him one of the founders of modern India, was born on Sept. 14, 1774, the second son of the 3rd duke of Portland. An ardent Whig, like his father, Lord William was much influenced by Jeremy Bentham and James Mill; though he found reading irksome he was intelligent and industrious, with a flair for action. By many he was considered impetuous, but age ripened his judgment without diminishing his ardour to make possible the achievements of his governor generalship.

Entering the army in 1791, he was present at Marengo and served in the Peninsular War, commanding a division under the duke of Wellington who disapproved of him and thought him headstrong. He was appointed governor of Madras in 1803 at the age of 29, but the Vellore mutiny (1806), for which he was held responsible, led to his recall, along with the commander in chief in 1807. Bentinck deeply resented this action as unjust and never rested until he had achieved reparation. In 1811 he went

to Sicily as British envoy to the court of Naples and became the virtual governor of the island. In a brief intervention in Genoa in 1814 he embarrassed the British government by reviving the former republican constitution of 1797 on his own initiative. His recall in 1815 marked the Tory government's loss of confidence in him and he remained unemployed for 12 years.

After an unsuccessful attempt in 1823 he was appointed governor general of Bengal during George Canning's brief premiership in 1827. Age had brought discretion and his rule amply belied the misgivings caused by his earlier activities. His task was eased by the new approach, with which he sympathized, then developing toward the government of India. After a difficult two years when Wellington was prime minister and the young Lord Ellenborough was trying to replace Bentinck, he found himself supported by the reform ministry of Lord Grey (1830–34) as well as by the directors of the British East India company. In these circumstances he was able to carry through a series of measures which introduced a new era into Indian government.

Bentinck's most pressing business was to economize. The first Burmese War had strained the company's finances and it was urgently necessary to restore them before the approaching parliamentary discussion of the renewal of the company's charter. By economies and good management he turned an annual deficit of £1,000,000 into a surplus of £1,500,000. The economies included, on the company's direct orders, the abolition of double batta, an allowance for field service paid to troops in the Bengal presidency. This measure, which Bentinck privately denounced, was bitterly resented and won him lasting unpopularity in military circles. The fruit of all this work was the renewal of the company's government by the Charter act of 1833 whereby he became the first governor general of India.

Bentinck next dealt with judicial and revenue reform. In the judicial department he admitted Indians to two grades of judgeships. This was the first stage in the admission of Indians to important branches of the government. Land and revenue administration was still confused. Bentinck set out on a great northern tour (1830–33) which resulted in launching of the revenue settlement of R. M. Bird, which became a model for the north.

But Bentinck's greatest work was social and intellectual reform. In effect he introduced the west to India, not only in its personnel but in its institutions and spirit. He prohibited suttee, the Hindu custom of burning of widows on the funeral pyres of their husbands, and suppressed thuggee, the practice of ritual murder by robber gangs. With T. B. Macaulay's support he made English the language of government business and the higher courts instead of Persian. Government-aided education was to be on western lines and the medium of instruction English. These measures had profound effects. Other reforms included the abolition of internal transit duties and of flogging in the army and the introduction of experiments in tea cultivation, steam transport and coal and iron production.

In foreign policy Bentinck was cautious, and in his relations with the Indian states he followed the traditional policy of nonintervention. By ignoring the internal condition of Indian states when there was time for improvement the British were forced eventually to take drastic action, and Bentinck himself had to take over the administration of Mysore in 1831. Bentinck retired in 1835, refused a peerage and entered the house of commons. He died in Paris on June 17, 1839.

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BENTIVOGLIO, an Italian family dominant in the city of Bologna during the second half of the 15th century. A native family, long prominent in the politics of the city, their first premature attempt to rule occurred in 1401, when Giovanni I Bentivoglio was proclaimed lord; but in the following year he was defeated in war with the Visconti, overthrown and murdered. Next, in 1420, Anton Galeazzo Bentivoglio seized power, but was compelled to yield Bologna on terms to its papal overlord. Despite these reverses and the active opposition of other ambitious families, notably the Ghisilieri and Canetoli, the Bentivoglio succeeded by the middle of the century in establishing a popular and secure pre-eminence in the city, under the leadership first of Annibale (1443–45) and then of Sante (1446–62) and Giovanni II (1462–1506). This domestic ascendancy they helped to strengthen by wisely calculated alliances with greater powers, which brought them added wealth, land and titles. At home they recognized papal supremacy and had it defined in a concordat (1447) that remained in force until the 18th century. They also chose, like the Medici of Florence, to govern anonymously as "first citizens" of a small ruling group, with a decisive share of public offices and a part of the public revenues. The Bentivoglio maintained a lavish court frequented by many artists and writers and did much to beautify Bologna. But the licentiousness of Giovanni II and his sons and the violence with which they put down disaffected families, the Malvezzi in 1488 and the Marescotti in 1501, in time destroyed their popularity. So, when they were driven from Bologna in 1506 by Pope Julius II and his French allies, all subsequent attempts to return were frustrated.

See G. Gozzadini, *Memorie per la vita di Giovanni II Bentivoglio* (1839); C. M. Ady, *The Bentivoglio of Bologna* (1937). (P. J. J.)

BENTIVOGLIO, GUIDO (1579–1644), Italian cardinal, diplomat and historian, was born at Ferrara on Oct. 4, 1579. After studying law at Padua, he became one of Pope Clement VIII's privy chamberlains. Pope Paul V sent him as nuncio to Flanders (1607–15) and to France (1616–21) and created him cardinal (Jan. 1621). On the death of Pope Urban VIII, whose close friend he had been, Bentivoglio was one of the ten cardinals counted as eligible for the papacy, but he died suddenly on Sept. 7, 1644, eight days before the end of the conclave. His *Relazioni in tempo delle sue nunziature* (1629; partial Eng. trans. by Henry, earl of Monmouth, *Historical Relations of the United Provinces and Flanders*, 1652), his *Della guerra di Fiandra* (1632–39; Eng. trans. by Monmouth, *The Compleat History of the Warrs of Flanders*, 1654) and his diplomatic letters to the papal secretariat of state (ed. by L. De Steffani, *La Nunziatura di Francia del cardinale Guido Bentivoglio*, 4 vol., 1863–70, and by R. Belvederi, *Guido Bentivoglio diplomatico*, 1947–) give precise and objective accounts of affairs in the countries that he visited.

Bentivoglio's *Opere storiche* were edited with a life by L. Barotti (1806–07), and his *Memorie e lettere* were edited by C. Panigada (1934).

BENTLEY, RICHARD (1662–1742), one of the greatest figures in the history of classical scholarship, was born on Jan. 27, 1662, at Oulton, near Wakefield, Yorkshire. He was educated at Wakefield grammar school and St. John's college, Cambridge. In 1683, after a year as master of Spalding school, he became tutor to the second son of Edward Stillingfleet, dean of St. Paul's, and in 1689 accompanied his pupil to Oxford. There he made the acquaintance of John Mill, who asked him to look through the proof sheets of the Oxford edition of the chronicler John Malalas. The request gave rise to Bentley's *Epistula ad Millium* (1691), a short treatise in which his skill in textual emendation and his knowledge of ancient metre were strikingly displayed.

Bentley had taken deacon's orders in 1690. In 1692, and again in 1694, he was appointed Boyle lecturer. In the first series of lectures (the second was not published) he argued against atheism, using the theories of Isaac Newton to prove the existence of an intelligent creator. In 1694 he became keeper of the royal library and fellow of the Royal society.

Bentley contributed a collection of the fragments of Callimachus to J. G. Graevius's edition (1697), and in 1699 appeared his *Dissertation upon the Epistles of Phalaris*. This arose from the controversy on the relative merits of the ancients and the moderns. A laudatory reference to Phalaris in Sir William Temple's *Essay on Ancient and Modern Learning* gave rise to an edition of the epistles by Charles Boyle of Christ Church, Oxford. As a result of a request from William Wotton, a champion of the moderns, Bentley attacked the genuineness of the epistles in an essay contributed to Wotton's *Reflections on Ancient and Modern Learning* (1697). Boyle and his Oxford friends combined to produce a reply, which in turn resulted in a much enlarged *Disser-*

tation by Bentley, in which he brought all his learning and critical powers to bear in proof of the spuriousness of the epistles.

In 1700 Bentley was chosen master of Trinity college, Cambridge. His tenure of the office was marked by friction and litigation. He inaugurated reforms in usages and discipline, made improvements in the buildings and encouraged learning both in the college and in the university. But his domineering temper and his contempt for the feelings and rights of the fellows drove them in 1710, after ineffectual resistance within the college, to appeal to the general visitor of the college, the bishop of Ely. Only the bishop's death in 1714 prevented Bentley's ejection from the mastership. In the course of the long-drawn-out quarrel Bentley was deprived of his degrees by the university in 1718, but these were restored to him in 1724. In 1733 he was again brought to trial before the bishop of Ely and was sentenced to deprivation of the mastership, but the college statutes required the sentence to be executed by the vice-master, who refused to act. From a feud which lasted about 30 years Bentley emerged victorious. In addition to his mastership he held the regius professorship of divinity from 1717.

At Trinity college he continued his classical studies. He published a critical appendix to John Davies's edition of Cicero's *Tusculan Disputations* (1709) and contributed notes on two plays of Aristophanes to Ludolf Küster's edition of 1710; in the same year appeared his emendations of the fragments of Menander and Philemon. His edition of Horace, written in haste at a critical period of the quarrel at Trinity and published in 1711, shows his ingenuity and argumentative powers, but few of the many emendations proposed in it became accepted. In his edition of Terence, published in 1726, together with the fables of Aesop and the *Sententiae* of Publilius Syrus, he threw new light on Terentian metre. In old age (1739) he published an edition of Manilius in which, along with characteristic faults, he displayed his brilliant gifts in emending and interpreting a difficult author. He left notes on other classical authors, such as Nicander, Plautus, Lucretius and Lucan, which were published after his death. Though in his later years he concerned himself mainly with Latin authors, he planned an edition of Homer which, though never brought to fruition, had an important result in that he discovered the significance for the text of the lost letter *digamma*.

Another project which was never carried out was an edition of the New Testament, *Proposals* for which were issued in 1720. In these he explained his intention of publishing a text based on the oldest Greek and Latin manuscripts, and restoring "the true exemplar of Origen, which was the standard to the most learned of the Fathers, at the time of the Council of Nice and two centuries after." He had previously (1713), in his *Remarks* on Anthony Collins's *Discourse of Free Thinking*, defended the critical study of the Bible and denied that the existence of textual variants weakened its authority. Some of Bentley's New Testament material was published by A. A. Ellis in *Bentleii Critica Sacra* (1862).

In 1732 he made an unfortunate excursion into English criticism in his edition of *Paradise Lost*. In this he put forward numerous unjustified emendations, assuming that Milton employed both an amanuensis and an editor, who were responsible for the clerical errors, alterations and interpolations which Bentley professed to detect.

He had married in 1701 Joanna, daughter of Sir John Bernard. She died in 1740, leaving a son and two daughters. Bentley himself died at Cambridge on July 14, 1742.

As one of the great figures of classical scholarship Bentley combined wide learning with critical acuteness. Gifted with a powerful and logical mind, he was able to do much to restore the ancient texts and to point the way to new developments in scholarship. At the same time his masterful temperament, his self-confidence and his impatience led him to misuse his gifts. He was at his best when dealing with a badly corrupted text, less happy with an author like Horace whose text is well preserved. In textual criticism his work was followed up by the English Greek scholars of the 18th and early 19th centuries; in his dissertation on Phalaris he pointed the way to the historical and literary criticism of the 19th century.

The Works of Richard Bentley were edited by A. Dyce in 3 vol. (1836–38, incomplete) and *The Correspondence* was edited by C. Wordsworth in 2 vol. (1842).

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BENTON, THOMAS HART (1782–1858), U.S. political leader and writer, was born March 14, 1782, near Hillsborough, N.C. His father, a successful lawyer, planter, slaveholder and land speculator, died when Thomas was eight. Thomas was deeply affected by his mother's grief and by her charge that he, the eldest son, must assume his father's place. In Jan. 1799, Benton entered the University of North Carolina, Chapel Hill. Finding himself poor compared to his tidewater patrician roommates, he stole money from them, and was publicly disgraced and expelled. These early traumatic events, together with Roman ideals of achievement prompted by early reading in his father's library, produced in Benton strong drives of ambition. At the age of 30 he proclaimed his determination of "doing something worthy of being written," or "writing something worthy of being done." Despite his strong ambition, he also developed inward gentleness and personal charm.

After 1801, when his family moved to a near-wilderness tract south of Nashville, Tenn., Benton was subject to western influences. Admitted to the bar in 1806, he learned the problems of western farmers from circuit riding and land-title cases. Absorbing the Jeffersonian political premises of the region, he entered public controversy in 1808 with vigorous newspaper articles demanding state court reform in the interest of "farming men," and pressed his plan with substantial success in the state senate the next year. An ardent patriot in the War of 1812, he was a colonel of volunteers under Andrew Jackson, but never realized his dreams of military glory. In 1815 he resumed law practice in the frontier village of St. Louis, where his vast energy and strong intellect quickly brought him eminence.

Tall, handsome, with a massive head thrust forward on muscular shoulders as if to express his resolute drives, edgy sense of honour, and courage, Benton engaged in typical western quarrels. One was a disorderly shooting affray at Nashville (1813) in which he and his brother Jesse nearly killed Andrew Jackson, the original aggressor; another, a pair of formal duels at St. Louis (1817) with a fellow lawyer, Charles Lucas, the challenger, who died in a return engagement Benton demanded. But Benton also made warm friends, and the chastening effect of Lucas's death moderated his pugnacity. In 1821 Benton married Elizabeth McDowell of Cherry Grove, near Lexington, Va., who also brought out his gentle, sympathetic side, as did their four daughters, one of whom (Jessie Ann) married the explorer John Charles Frémont. Two sons died in their youth.

As editor of the *St. Louis Enquirer* in 1818–1820, Benton struck a keynote for his ensuing career. He wrote slashing, well-informed, comprehensive articles in the style that later marked his political speeches. "It is time," he proclaimed, "that western men had some share in the destinies of this Republic." He attacked the national administration for "surrendering" American rights in Texas and the Pacific northwest, which he envisioned as a farming community and as a base for "Asiatic commerce." He proposed western development through federal roads and canals, and protection to the fur trade; urged a "gold and silver" currency to replace unsound bank note issues; and demanded statehood for the Missouri territory without restriction on slavery. Such a mixture of agrarian, commercial and slaveholding appeals brought Benton to the national senate in 1821. In Washington he was influenced by the purist-Jeffersonians John Taylor, Nathaniel Macon and John Randolph. He moved from paying political debts to Missouri's fur-trading, mining, and commercial groups, and from early support of Henry Clay's "American System" of protective tariffs and federal roads and canals for capitalist development, to agrarian, popular-democratic views. Building a new power base in Missouri among small-farmers and

small-traders, he fought repeatedly in 1824 and after for distribution of public lands to settlers at reduced prices or as homestead "donations," and for popular presidential elections. In 1825 he turned to Jackson (with whom he had become reconciled) as his choice for president.

Seeing burgeoning enterprise and bank-credit speculation in conflict with Arcadia, Benton marshalled radical Democrats against the Bank of the United States. He initiated the legislative battle (1831); fought Clay, Daniel Webster, and powerful Whig and established-business opposition to sustain Jackson's veto of recharter (1832); and supported Jackson's removal of government funds from the bank (1833). He also opposed conservative Democrats who sought to extend state banks and their unstable note issues—"I did not join in putting down the Bank of the United States to put up a wilderness of local banks. . . . I did not strike Caesar to make Anthony master of Rome." To serve "the farmer, the artisan, the market man, the day laborer," Benton sponsored coinage acts (1834) to promote "hard money" currency in place of bank note credit; urged gradual suppression of bank notes under twenty dollars; prompted Jackson's specie order (1836) requiring gold or silver in payment for public lands; and worked with Pres. Martin Van Buren for a federal "Independent Treasury" (1840) to perform the public functions of the national bank. Like most Jacksonians, he favoured tariff reduction and opposed federal expenditures for local internal improvements. As an unflagging advocate of agrarian principles and a hard-money crusader, Benton won immense popularity and the sobriquet "Old Bullion." He was frequently proposed for president but never sought the office.

Through the 1830s, Benton, a small slaveholder himself, was generally pro-southern and proslavery, though he rejected John C. Calhoun's doctrine (1832) of state nullification of federal law. When national expansion in the 1840s brought a southern demand for slavery extension, however, Benton regarded it as "aggression" and as a menace to his freeholder's Arcadia and to the union. He opposed immediate annexation of slaveholding Texas and warned against "unjust" war with Mexico (1844), but supported war when it came (1846–48) and acquisition of Mexican territory to the Pacific. He urged American occupation of the Pacific northwest, working with Pres. James K. Polk for a compromise boundary at 49° north latitude instead of the extreme claim of 54° 40′. Maintaining that the new territories were free soil by nature and by Mexican law, Benton opposed as unnecessary the slavery-restrictionist Wilmot proviso, along with Calhoun's slavery-extension resolutions of 1847, as "two halves of a pair of shears" to sever the nation. He pressed for admission of California as a free state, and supported the Whig president, Zachary Taylor, against Clay's Compromise of 1850, which he considered an excessive concession to the south. Such unyielding stands, eventuating in opposition to slavery as an institution, lost Benton the pre-eminent party leadership he had previously enjoyed, and brought his defeat for re-election in slaveholding Missouri in 1851, after a senatorial tenure of 30 years. Elected to the house of representatives, he attacked the Kansas-Nebraska bill (1854) as "a bulging attempt to smuggle slavery into the Territory." Unlike many other antislavery Democrats, he rejected the new Republican party and opposed his own son-in-law, John C. Frémont, as the Republican presidential nominee in 1856. He was, however, sharply critical of proslavery domination in the Democratic administrations of Pierce and Buchanan.

His writings combined political and literary interests. His imposing memoir-history of his senate decades, *Thirty Years View* (2 vol., 1854, 1856), was eloquent with agrarian and Jacksonian-democratic faith, opposition to slavery extension, and concern for the imperiled union. Despite the agony of a fatal cancer, he produced a learned, polemical *Examination* (1858) of the supreme court's Dred Scott decision that congress had no power to prohibit slavery in the territories. His 16-volume *Abridgment of the Debates of Congress* through 1850 is still useful. After a long illness, Benton died in Washington, April 10, 1858, and was buried at St. Louis next to his wife, who had died three years before.

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BENTON, THOMAS HART (1889–), U.S. painter, the most articulate and controversial of the proponents of native American art known as the Regionalists (Benton, Grant Wood and John Steuart Curry). Born on April 15, 1889, at Neosho, Mo., of a family long distinguished in Missouri politics, Benton was educated at the Art Institute of Chicago (1906–07) and the Académie Julien, Paris (1908–11). Though active in his early years (1906) as a cartoonist for the *Joplin* (Missouri) *American*, he began his career as a professional artist in New York in 1912, served as a draftsman in the U.S. navy during World War I, taught at the Art Students league and then (1935) settled permanently in Kansas City, Mo. where he taught at the Kansas City Art institute until 1941.

Benton's position as an artist was determined not only by his own strong creative temperament, but by the genuinely patriotic character of his midwestern family background, his Paris experience, and the critical period of social and political upheaval of the depression and war years. His was a passion for the historic roots of the rich and varied character of his country, which he learned so well through extensive travel and study.

The record of his development is best seen in the murals for the University of Kansas City (early 1920s), the New School for Social Research (1931) and the Whitney Museum of American Art (1932) in New York city, the Indiana state building for the Chicago World's Fair (1933), the Missouri state capitol in Jefferson City (1935), the Harzfeld store in Kansas City (1946), the Power Authority of New York at Massena and Niagara Falls (1959), and the Truman library in Independence, Mo. (1959). In 1933 he was awarded the gold medal of the Architectural League of New York for his work in mural painting. Like his murals, Benton's easel paintings have caused considerable controversy, but eventually have been acquired by the major museums and collections throughout the nation. His ideas, experiences and controversies are recorded in his autobiographical *An Artist in America* (1937, revised edition 1951) as well as in numerous articles, particularly in the *University of Kansas City Review*.

See Thomas Craven, *Thomas Hart Benton* (1939). (L. E. S.)

BENTON, WILLIAM (1900–), U.S. businessman, educator and statesman, from 1943 publisher of *Encyclopædia Britannica*, was born on April 1, 1900, in Minneapolis, Minn., and moved as a boy with his widowed mother to Montana, where he led a pioneer life on one of the last tracts of homestead land in the United States. After a year at Carleton college, he went to Yale university, from which he graduated in 1921. In a break with family tradition, he entered the advertising business, instead of education or the ministry. With Chester Bowles he founded the agency of Benton and Bowles in 1929, and by 1935, in spite of the economic depression, had made it one of the six largest firms of its kind in the world. His imagination and boldness appeared in everything he did in advertising. Many of the techniques now traditional in that business, particularly in broadcasting, originated with him. Some of them have had such an effect on American culture that he has more than once apologized for thinking of them.

At 35 Benton sold his interest in the agency and in 1937 went to The University of Chicago to become vice-president of the university, where Robert M. Hutchins, a Yale classmate, was president. There he took leadership in making The University of Chicago Round Table the most distinguished forum in the country. He interested himself in the development of sound motion pictures for higher education. He was one of the young administrative officers who gave the university unparalleled vitality at that epoch in its history. While an officer of the university in 1942, he helped organize, with Paul G. Hoffman, the committee for economic development. As founding vice-chairman of its board of trustees and of its research committee, he helped develop its program of scholarly research that made it one of the most influential groups of businessmen in the country. Also as an officer of the university

he dedicated himself to the task of acquiring *Encyclopædia Britannica* as a gift to the university, and, when the trustees of the university hesitated, he put up his own money to supply the working capital. This decided the issue: the university accepted the gift and committed the management and the common stock to Benton, retaining a preferred stock interest and a royalty contract.

In 1945 Benton resigned from the university to become assistant secretary of state under Pres. Harry S. Truman. He organized the first major U.S. program for peacetime international information and educational exchanges. Thus he began the Voice of America broadcasts, including broadcasting in Russian to the U.S.S.R., established the United States information offices, and promoted international visits of professors and students. He also organized and led U.S. participation in the United Nations Educational, Scientific and Cultural organization (UNESCO). On behalf of the state department, he sponsored such legislation as the Smith-Mundt act and the Fulbright act establishing international educational exchange programs, and the Foreign Service act of 1946 to improve the organization and administration of the service. He resigned in 1947 and in 1949 accepted an appointment as United States senator from Connecticut. In 1950 he was elected to serve two years of an unexpired term.

In the senate he became a champion of freedom and justice throughout the world, defending the United Nations and fighting for civil liberties and civil rights. At the height of Senator Joseph R. McCarthy's power, Senator Benton led the attack on McCarthyism, with a courage unmatched by that of any other politician of the time. He introduced a resolution calling for McCarthy's expulsion from the senate and McCarthy's conduct in relation to this resolution later led to his formal condemnation by the senate.

After leaving the senate, Benton divided his energies between his numerous educational and public interests (he is a trustee of several universities) and the affairs of Encyclopaedia Britannica, Inc. He often combined the two, as when he wrote "The Voice of the Kremlin," the first comprehensive account of Russian education to appear in America, for the *1956 Britannica Book of the Year,* "The Voice of Latin America," the story of his travels to Latin America with Adlai Stevenson, for the 1961 issue, and "The Teachers and the Taught in the U.S.S.R.," a continuation of his analysis of the Soviet educational system, for the 1965 edition.

The first two of these articles were adapted into books, *This Is the Challenge* (1958) and *The Voice of Latin America* (1961). He has also contributed more than 100 articles to major magazines. Under his direction Encyclopaedia Britannica, Inc., acquired Encyclopaedia Britannica Films in 1943, published *Great Books of The Western World* in 1952 and the Spanish-language *Enciclopedia Barsa* in 1957, and purchased *Compton's Pictured Encyclopedia* in 1961 and the G. & C. Merriam Co., dictionary publishers, in 1964. In 1963 Pres. John F. Kennedy appointed him U.S. representative to UNESCO with the rank of ambassador. (Ro. M. H.)

BENTON HARBOR, a city of Berrien county, Mich., U.S., near Lake Michigan at the mouth of the St. Joseph river. Benton Harbor was originally an inland extension of its older neighbour, St. Joseph, but in the period 1860–62, as a result of disagreements with the parent city over bridging the river, the town assumed a separate identity as Bronson's Harbor. In 1869 it was incorporated under its present name. Benton Harbor is a marketing and processing centre for peaches, grapes, apples, plums, cherries and berries. Manufactures include automotive parts, construction machinery, castings, pumps, electronic equipment, plastics and other products. In 1903, Benjamin ("King Ben") Franklin Purnell established an Adventist colony of the Israelite House of David at Benton Harbor. For comparative population figures *see* table in MICHIGAN: *Population.* (E. O. E.)

BENTONITE is a rock composed of clay minerals formed by the alteration of minute glass particles that once composed volcanic ash. The name was derived from the Ft. Benton series of Cretaceous rocks in Wyoming where it was first found. Two types of bentonite are recognized, and the uses of each depend on specific physical properties. Sodium bentonites, like those of Wyoming and South Dakota, adsorb large quantities of water, swell many times their original volume and give permanent suspensions of jell-like masses. These have been used to seal dams, as drilling muds, in portland cements and concrete, in bonding foundry sands, asbestos and mineral wool, in ceramics, in paper manufacture, in emulsions, in insecticides, in soaps, in pharmaceuticals, in paints and for clarifying water, juices and liquors and as a water softener to remove calcium from hard water. Calcium bentonites are nonswelling and break down to a finely granular aggregate that is widely used as an adsorbent clay. (*See* FULLER'S EARTH.)

Bentonite deposits range in age from Ordovician to Tertiary, or from about 400,000,000 to 1,000,000 years. In the United States the principal production has been from South Dakota, Wyoming, Texas, California and Mississippi. Bentonite is found also in Canada, Peru, England, Germany, Italy and New Zealand, and has been reported from Argentina, France, Poland, Russia, Rumania, China, Japan, Mexico and South Africa. The formation of bentonite involves the alteration of volcanic glass to clay minerals and is connected with the instability of volcanic glass that has less than 68% silica; this requires hydration and a loss of alkalies, bases and possibly silica with the preservation of the textures of the original volcanic glass. The minerals of bentonite are chiefly crystalline clay minerals belonging to the montmorillonite group, which are hydrous aluminum silicates containing iron, magnesium and other elements, but a few tiny grains of original volcanic rock minerals may be present. In the montmorillonite group aluminum substitutes for silicon and some iron or magnesium substitutes for aluminum in the crystal structure. The substitution of an element of high valence for one of lower valence leaves the crystal structure or lattice out of balance and this is compensated by interlayer, exchangeable ions, permitting base exchange. The dominant exchangeable bases are sodium and calcium and these give rise to the two types of bentonites previously mentioned. *See* also CLAY AND CLAY MINERALS. (V. T. A.)

BENUE, a river in west Africa, the greatest of the tributaries of the Niger (*q.v.*). It rises in Cameroun at an altitude of about 3,000 ft. and in the first 150 mi. descends more than 2,000 ft., with many falls and rapids. However, the remainder of its course is largely uninterrupted, making it the only major African river so free. During periods of flooding its waters are linked by way of its tributary, the Mayo-Kebbi, through the Tuburi marshes with those of the Logone which flows to Lake Chad (*q.v.*). Capture of this stream by the Benue is a distinct possibility and when fully effected would take about two-fifths of the water supplying Lake Chad. Below the Mayo-Kebbi the Benue is navigable all the year round by boats drawing less then 2½ ft. of water and by larger boats for more restricted periods. Power-driven craft towing barges alongside can navigate to Makurdi, Nigeria, from June to November, to Yola from July to early October, and to Garoua, Cameroun, in Aug. and Sept. The journey upstream from the Niger delta to Garoua takes 17 days and the return journey 11 days. In this way a considerable volume of imports (particularly petroleum) reaches the territory and cotton and peanuts are exported from the Chad region. Between Yola and Makurdi the Benue is joined by the Gongola, an important tributary from the north which rises on the Jos plateau, Nigeria, and flows northeast and then south for a distance of 300 mi., being navigable for about half its course when in flood. There is a sand bar across the Benue at its confluence with the Niger, giving only 2 ft. of water when the flow is at its minimum. The river fleet moving upstream from the delta is frequently held up at Lokoja, Nigeria, waiting for a sufficient depth of water, and must return at the end of the navigation season before the level of water falls too low. Investigations have been made with a view to improving navigation. Total length of the Benue is 673 mi.

Heinrich Barth (*q.v.*) reached the upper Benue at Yola in 1851 and in 1854 W. B. Baikie (*q.v.*) in the "Pleiad" sailed 400 mi. up the river from its confluence with the Niger. Its basin was explored more thoroughly in 1882–84 by E. R. Flegel (*q.v.*), who reached N'Gaoundéré. Further journeys were made by Maj. Claude Macdonald (1889) and by E. Lenfant (1903), who succeeded in crossing the Tuburi marshes and navigating through to the Logone.

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BENZ, CARL (1844–1929), German engineer who designed and built the first commercially successful motor car, was born at Karlsruhe on Nov. 26, 1844. In 1879 he started at Mannheim a small factory for the production of his stationary two-stroke gas engines. After improvements, such as the use of high-tension electric ignition in place of flame ignition, these Benz engines gained a sound reputation at home and abroad. He built his three-wheeled prototype motor car in 1885, and equipped it with a new design of four-stroke gasoline engine, which developed 1½ h.p. at 200 r.p.m. and gave the car a speed of 10 m.p.h. The important model III of 1887–88 was developed from this prototype and four were built and sold commercially. The only remaining example is now in the Science museum, London. Improved models appeared, in particular the 3-h.p. "Comfortable" model, of which 4,000 were produced between 1897 and 1900. Benz died at Ladenburg on April 3, 1929. (C. F. Ca.)

BENZALDEHYDE (oil of bitter almonds) was first isolated in 1803 and was the subject of an important investigation by Justus von Liebig (*q.v.*) in 1837. It occurs naturally in the form of the glycoside amygdalin, which is present in bitter almonds, cherries, peaches and the leaves of the cherry laurel and is obtained from this substance by hydrolysis with dilute acids. (*See* Glycosides, Natural.) It occurs free in bitter almonds, being formed by an enzyme decomposition of amygdalin. It may also be prepared by oxidizing benzyl alcohol (*q.v.*) with concentrated nitric acid; by distilling a mixture of calcium benzoate and calcium formate; by the two Gattermann syntheses (*see* Aldehydes and Ketones) and by the action of chromium oxychloride on toluene dissolved in carbon bisulfide (A. Étard, 1884). It is the simplest of the aromatic aldehydes, having the formula $C_6H_5.CHO$.

Technically, it is prepared from toluene, by converting it into benzyl chloride, which is then heated with lead nitrate, $C_6H_5CH_2Cl + Pb(NO_3)_2 = 2NO_2 + PbCl.OH + C_6H_5.CHO$, or, by converting it into benzylidene chloride (benzal chloride), which is heated with aqueous calcium hydroxide under pressure:

$$C_6H_5CHCl_2 + Ca(OH)_2 = CaCl_2 + C_6H_5CHO + H_2O$$

The direct oxidation of toluene with various metallic oxides (manganese dioxide, ceric oxide, peroxides of nickel and cobalt) in the presence of acid produces benzaldehyde free from chlorinated derivatives. Benzaldehyde, a colourless liquid smelling of bitter almonds, boils at 179.1° C., is only slightly soluble in water, but is readily volatile in steam. It possesses all the characteristic properties of an aldehyde, being readily oxidized to benzoic acid, reducing solutions of silver salts, forming addition products with hydrogen, hydrocyanic acid and sodium bisulfite, and giving an oxime and a hydrazone. On the other hand, it differs from the aliphatic aldehydes in many respects; it does not form an addition product with ammonia but condenses to hydrobenzamide, $(C_6H_5.CH)_3N_2$; on shaking with alcoholic potassium hydroxide it undergoes simultaneous oxidation and reduction, giving potassium benzoate and benzyl alcohol (S. Cannizzaro, 1881); and on warming with alcoholic potassium cyanide it condenses to benzoin.

During the oxidation of benzaldehyde to benzoic acid when exposed to air it has been observed that as much oxygen is rendered "active" as is used up by the substance undergoing oxidation; thus if benzaldehyde is left for some time in contact with air, water and indigosulfonic acid, just as much oxygen is used up in oxidizing the indigo compound as in oxidizing the aldehyde. A. von Baeyer and V. Villiger (1900) showed that a peracid $C_6H_5.CO.O.OH$, formed as an intermediate product, oxidizes the indigo compound, being itself reduced to benzoic acid. They have showed that this peroxide is soluble in benzaldehyde with production of benzoic acid, and it must be assumed that the oxidation of benzaldehyde proceeds as shown in the equations:

$$C_6H_5.CHO + O_2 = C_6H_5.CO.O.OH$$
$$C_6H_5.CO.O.OH + C_6H_5.CHO = 2C_6H_5.COOH$$

The oxime of benzaldehyde, $(C_6H_5.CH:N.OH)$, formed by the addition of hydroxylamine to the aldehyde, undergoes isomeric change when hydrogen chloride is passed into its ethereal solution, a second modification being produced. The former (known as the α or *syn*-benzaldoxime) melts at 34°–35° C.; the latter (β or *anti*-benzaldoxime) melts at 130° C. and is slowly transformed into the α form. The difference between the two forms was explained by A. Hantzsch and A. Werner (1890) on the assumption of a different spatial arrangement. (*See* Stereochemistry.) Because of the readiness with which it condenses with various compounds, benzaldehyde is an important synthetic reagent. With aniline it forms benzylidineaniline, $C_6H_5.CH:N.C_6H_5$, and with acetone, benzylidineacetone, $C_6H_5.CH:CH.CO.CH_3$. Heated with anhydrous sodium acetate and acetic anhydride it gives cinnamic acid; with dimethylaniline and anhydrous zinc chloride it forms leuco-malachite green, $C_6H_5.CH[C_6H_4N(CH_3)_2]_2$; and with dimethylaniline and concentrated hydrochloric acid it gives dimethylaminobenzhydrol, $C_6H_5.CH(OH)C_6H_4N(CH_3)_2$. (*See* Dyes.) Its addition compound with hydrocyanic acid gives mandelic acid, $C_6H_5.CH(OH).COOH$, on hydrolysis.

BENZEDRINE: *see* Amphetamine.

BENZENE, a hydrocarbon, was discovered by Michael Faraday in 1825 when he investigated the nature of an oil found in the receptacles of the compressed illuminating gas made from whale oil. Because of the high ratio of carbon to hydrogen, Faraday called the hydrocarbon "bicarburet of hydrogen." E. M. Péligot and E. Mitscherlich prepared it in 1833 and 1834, respectively, by distilling benzoic acid in the presence of lime. Mitscherlich named it benzin, but J. von Liebig suggested the change to benzol. The form "benzene" was used by A. W. Hofmann, who in 1845 demonstrated the presence of the hydrocarbon in coal tar. "Benzene" is the term used by U.S. and English chemists, while "benzol" (U.S.) and "benzole" (Great Britain) are the common designations for the commercial products which contain the hydrocarbon benzene as the chief constituent.

The commercial recovery of benzene began in 1849 when C. B. Mansfield separated it from the solvent naphtha fraction of coal tar. It was first sold as a fuel for illuminating purposes, as a solvent for rubber, and later as a dye intermediate. Rapid expansion of the dye industry made it necessary to augment the supply by recovering it from coal gas. Since in the process of coking coal at high temperatures more than 90% of the benzene formed is found in the gas and less than 10% in the tar, coke-oven gas became the most important source of benzene. The recovery starts with the removal of the light oil from the gas. This contains, in addition to benzene, the methylated homologues, toluene and xylene, and other organic substances. It represents about one volume per cent of the gas. Removing light oil from gas is usually effected by scrubbing it with a high-boiling oil or by adsorption on activated carbon. It is subsequently freed from the condensing medium by steam stripping. At this stage the product is known as crude light oil. With or without a preliminary fractional distillation it is treated with a small volume of sulfuric acid, followed by water and caustic washes. It is finally subjected to a fractional distillation from which the various grades of benzol are recovered. They are sufficiently pure for most markets but still contain traces of thiophene and nonaromatic hydrocarbons. The former can be removed by a treatment with fuming sulfuric acid, and the latter by crystallization of the benzene.

As late as 1940 the supply of benzene available from the coal carbonization industry was more than sufficient to supply the needs of the chemical industry and most of it was disposed as blending agent in motor fuels. Because of the rapidly expanding production of styrene, used in synthetic rubber and plastics, phenol, also used in plastics, and of the synthetic fibre nylon, a shortage had developed by 1950. At that time the petroleum industry began to augment supplies by the catalytic aromatization of suitable naphtha

fractions. Benzene is also needed for the manufacture of aniline, synthetic detergents, maleic anhydride and insecticides such as DDT, and for solvent purposes.

Benzene, C_6H_6, is a colourless, limpid liquid, having a characteristic odour. It boils at 80.1° C. and solidifies at 5.5° C. At 25° C. its density is 0.874 and its refractive index 1.498. It is very slightly soluble in water, more soluble in alcohol, and completely miscible with ether, acetic acid and carbon disulfide. It is an excellent solvent for rubber, gums, fats and many resins.

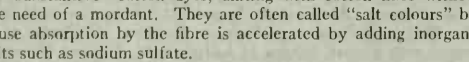
Since benzene is the parent compound of the enormous number of substances belonging to the aromatic or benzenoid series, its structure has been extensively investigated. In 1865 F. A. Kekulé postulated the benzene ring formula which, in spite of deficiencies, has retained its usefulness. It consists of a hexagon in which the carbon atoms form the six corners, alternate pairs of carbon atoms are connected by double bonds and one hydrogen atom is linked to each of the carbon atoms. There are two objections to this formula: (1) benzene does not show the reaction properties associated with the normal double bond; (2) the number of known isomeric disubstituted benzenes is smaller than that predicted by the formula. Kekulé, aware of these failings, postulated an oscillation of the double bond from one side of the carbon atom to the other, thereby giving the benzene ring the symmetry demanded by the known number of disubstituted benzene isomers. By applying the theory of resonance, L. Pauling (1933) gave this hypothesis a more precise interpretation. Applying the concepts of quantum mechanics, he arrived at a hybrid or mesomeric state for the benzene molecule resulting from the resonance of the two structures which Kekulé assumed to be in dynamic equilibrium. This hybrid state gives the carbon-to-carbon bond in the benzene ring a position intermediate between the normal double bond and the single bond, and explains the abnormally low reactivity of benzene. X-ray data support this view: the distance between the carbon atoms of a normal double bond is 1.34 Å; that of a single bond, 1.54; and that of a benzene bond, 1.39.

Benzene reacts with sulfuric acid to give mono-, di- and trisulfonic acids; with nitric acid to give the mono-, di- and trinitro benzenes. When benzene is treated with chlorine or bromine, addition to the benzene molecule with or without substitution of hydrogen takes place. In direct sunlight three molecules of chlorine add directly to form hexachlorocyclohexane; in the presence of iron chloride or aluminum chloride, chloro- and dichlorobenzene are formed. Benzene is remarkably resistant to oxidation. By passing benzene vapour and air over vanadium oxide at 450° C. parabenzoquinone and maleic anhydride are formed. Reduction of benzene to cyclohexane takes place in the presence of reduced nickel at 180° C. under elevated hydrogen pressure. Passed through a red-hot tube, benzene vapour yields diphenyl, diphenylbenzenes, acetylene and hydrogen.

See also Index references under "Benzene" in the Index volume. (E. W. V.; X.)

BENZIDINE, an aromatic organic chemical of value in the dyestuff industry. The dyes derived from benzidine are of importance because, unlike other classes of azo dyes, they are "direct" or "substantive" cotton dyes, uniting with cotton fibre without the need of a mordant. They are often called "salt colours" because absorption by the fibre is accelerated by adding inorganic salts such as sodium sulfate.

Preparation.—Benzidine, 4,4′-diaminodiphenyl (*see* formula I, below), is easily prepared by reducing nitrobenzene in an alkaline medium to hydrazobenzene (formula II) and treating the latter with a strong acid. In the laboratory, zinc dust or electrolytic reduction is used. For the second stage hydrochloric acid is employed, the benzidine being often precipitated as its sparingly soluble sulfate by adding sodium sulfate to the solution.



I II

The Benzidine Transformation.—The change from II to I shown above is the simplest case of a molecular rearrangement which takes place in all compounds of the hydrazobenzene type. With hydrazobenzene itself there are four products of the rearrangement of which benzidine is formed in the largest amount.

These are all the possible ways in which two units C_6N_2NH— can unite with ortho-para coupling, with the exception of 2,2′-diaminodiphenyl (*o*-benzidine) which would be the product of ortho-ortho coupling. This latter type is, however, formed in the corresponding naphthalene series, often in good yield. A substituent in the para position in the ring, such as —Cl, $-CO_2H$, $-SO_3H$, is often ejected in the change, whereas others such as $-OCH_3$ and $-NH_2$ are not displaced, so that the product is the only possible one, the *o*-semidine.

It is definitely established that the first step in the transformation is not the production of semidine, as was at one time supposed. Moreover, evidence that there is no dissociation of hydrazobenzene into free radicals or ions comes from experiments in which two differently substituted hydrazobenzenes in the same solution give the same benzidines that are produced in the separate rearrangements of each hydrazobenzene. This was confirmed by experiments using radiocarbon as a "tracer." The arrangement is catalyzed by hydrogen ions, in proportion to the square of their concentration.

As the transformation is known to be intramolecular, it must be concluded that the fragments resulting from the rupture of the —NH-NH— linkage in hydrazobenzene are restrained from separating before the *p-p′* (or *p-o′*, etc.) bonds are set up. Mechanisms in terms of classical structures hitherto proposed have not dealt satisfactorily with the stereochemical problems involved.

(T. W. J. T.; D. L. Hɪᴄ.; X.)

BENZOIC ACID, an organic chemical important as a preservative, antiseptic and the starting point in the manufacture of a large group of chemicals used in medicines, food preservatives, cosmetics, dyes, plastics and insect repellents.

Although benzoic acid is produced synthetically for commercial purposes, it exists widely in plants, including fruits such as cranberries and prunes and in resins such as gum benzoin, from which it obtains its name. Because benzoic acid is found extensively in plants used as foods, the urine of all herbivorous animals, including man, contains hippuric acid, a derivative of benzoic acid.

Benzoic acid, also sometimes called benzenecarboxylic acid or phenylformic acid, has been known for many years, being first described in the second half of the 16th century. It was recognized early for two reasons. It constitutes about 20% of gum benzoin, a common resin, and sublimes below 100° C. For centuries the chief source of benzoic acid was gum benzoin. During the first half of the 19th century the acid was prepared in Germany by the hydrolysis of hippuric acid obtained from the urine of cows and horses. About 1860 it was prepared synthetically for the first time from compounds derived from coal tar.

Benzoic acid, whose formula is C_6H_5COOH, and its derivatives played an important part in the development of organic chemistry. Its composition was determined in 1832 by Friedrich Wöhler and Justus von Liebig, who showed that in many of its transformations into other chemicals the benzoyl group, C_6H_5CO, remained intact, thus extending to organic chemistry the idea of radicals that had been applied a short time before to inorganic reactions. Eilhardt Mitscherlich in 1833 reported that distillation of benzoic acid with lime gave a hydrocarbon, C_6H_6, which he called benzin but which Liebig changed to benzol, identical with the hydrocarbon isolated by Michael Faraday in 1825 from the products of the thermal decomposition of fats and now known as benzene.

Benzoic acid, the simplest of the carboxylic acids of the aromatic (cyclic) series of organic compounds, is a fairly strong antiseptic and also has diuretic and antipyretic properties that led during the last half of the 19th century to extensive investigation of its use in medicine. However, it is little used in modern therapeutics except in the form of tincture of gum benzoin and in skin salves to treat fungus infections. During the early investigations, however, it was found to be practically nontoxic, probably because of the ease with which it is detoxified, chiefly in the kidneys, by combination with the amino acid glycine to form hippuric acid, which is eliminated in the urine. This detoxification appears to be limited only by the ability of the liver to produce glycine, and doses of 10

to 25 g. of sodium benzoate in one day can be tolerated by some persons, although in others large doses may produce nausea. It is considered safe to ingest continuously up to 0.5 g. daily in a concentration of 0.1%.

Because benzoic acid prevents or inhibits the growth of yeasts and molds and in the concentrations used is odourless, tasteless and nontoxic, its most important use is as a food preservative. The free acid is from five to ten times more effective than the sodium salt, but the latter usually is used because its high solubility in water (1 g. in 2 ml.) permits easier mixing. With acidic foods such as fruit juices and condiments, the free acid is liberated and is the effective agent. It also retards rancidity and darkening and is used in oleomargarine, sea foods, pharmaceuticals, cosmetics, soap and adhesives. Although the quantity added is usually only 0.1%, the volume of these products consumed requires a sizable production.

The number of ways in which benzoic acid has been obtained are too numerous to mention. In the commercial process most generally used in the United States and Great Britain after 1930, crude phthalic anhydride and about 5% of a catalyst consisting of equal parts of chromium and sodium phthalates is heated to 220° C. and steam is introduced. The steam hydrolyzes the anhydride to phthalic acid, which decarboxylates to benzoic acid.

$$C_6H_4(CO)_2O + H_2O \rightarrow C_6H_4(COOH)_2$$
$$C_6H_4(COOH)_2 \rightarrow C_6H_5COOH + CO_2$$

In Germany this process competes with (1) vapour phase decarboxylation of phthalic acid over a zinc oxide catalyst at 450°, (2) air oxidation of toluene using a cobalt-manganese catalyst at 190° and (3) oxidation of toluene with aqueous sodium dichromate solution at 250°–300° and regeneration of the dichromate with sodium hydroxide and air at the same temperature.

Some benzoic acid also is produced as a by-product of the production of phthalic anhydride and benzaldehyde. Other processes that have been used commercially are the decarboxylation of sodium acid phthalate in aqueous solution, the oxidation of toluene with nitric acid and the hydrolysis of benzotrichloride from the chlorination of toluene.

Benzoic acid has been obtained with a purity of 99.998% and a melting point of 122.375° ± 0.001° C. Although the boiling point is 250° C., it sublimes below 100° and is readily volatile with steam. In its solid state, benzoic acid exists as white, crystalline needles. Its solubility is only 0.34 g. per 100 g. of water at 25° C., but it is considerably more soluble in most organic liquids. It is a weak acid ($K_A = 6.6 \times 10^{-5}$) although slightly stronger than acetic acid ($K_A = 1.75 \times 10^{-5}$).

The most important derivatives of benzoic acid include the following compounds:

Sodium benzoate, C_6H_5COONa, is prepared by dissolving benzoic acid in an aqueous solution of sodium carbonate until the solution is neutral, then clarifying the solution, evaporating to dryness and grinding the residue.

Benzoyl chloride, C_6H_5COCl, the acid chloride of benzoic acid, can be prepared by the action of phosphorus pentachloride on benzoic acid but is made commercially by the chlorination of benzaldehyde, by the partial hydrolysis of benzotrichloride or by the action of hydrogen chloride on phthalic anhydride in the presence of a decarboxylating catalyst. The last process gives a product free of nucleus-halogenated compounds. Benzoyl chloride is a liquid, b.p. 197° C., has a characteristic odour and is strongly lachrymatory. It is used as a benzoylating agent, especially for the production of benzoic anhydride and benzoyl peroxide.

Benzoic anhydride, $(C_6H_5CO)_2O$, is an odourless solid, m.p. 42° C., b.p. 360° C. It is made by the reaction of acetic anhydride with benzoic acid in the presence of phosphoric acid, or by heating benzoic acid with benzoyl chloride and removing at reduced pressure the hydrogen chloride formed. The anhydride is used for the same purposes as benzoyl chloride but has the advantage that its use does not require equipment resistant to corrosion by hydrogen chloride.

Benzonitrile, C_6H_5CN, b.p. 191° C., is a good solvent for many resins and plastics. It is prepared by fusing sodium benzenesulfonate with sodium cyanide.

Benzyl benzoate, $C_6H_5COOCH_2C_6H_5$, is a liquid, b.p. 324° C., that occurs naturally in Peru and tolu balsams. It has antispasmodic properties and is a chigger repellent. It is also a powerful miticide and is used in the treatment of scabies. During World War II it was used on a large scale to eradicate disease-carrying ticks and mites from South Pacific islands. It can be made by the esterification of benzoic acid with benzyl alcohol but usually is prepared by the catalytic action of a small amount of aluminum ethoxide on benzaldehyde. During World War II it was made also from sodium benzoate and benzyl chloride in the presence of 1% of triethylamine.

Benzoyl peroxide, $(C_6H_5CO)_2O_2$, is a solid that melts at 110° C. It is used extensively as a bleaching agent for edible oils and fats and for flour, because the end product of the reaction, benzoic acid, is harmless and need not be removed. Benzoyl peroxide decomposes into free benzoyloxy radicals which lose carbon dioxide to give free phenyl radicals. Hence benzoyl peroxide is used widely to initiate the polymerization of unsaturated compounds that yield important plastics. It is made by the reaction of benzoyl chloride with an aqueous solution of sodium peroxide or an alkaline solution of hydrogen peroxide.

***o*-Aminobenzoic acid** (anthranilic acid), *o*-$NH_2C_6H_4COOH$, is made by the action of sodium hypochlorite on a solution of sodium phthalamate, prepared from phthalimide. It is used as a dye intermediate and formerly was important for the production of indigo. The methyl ester is used in perfumery and in artificial grape flavours. The menthyl ester is used in sun-screening lotions.

***p*-Aminobenzoic acid,** *p*-$NH_2C_6H_4COOH$, is prepared by the reduction of *p*-nitrobenzoic acid. It plays an important biological role and makes up part of the molecule of folic acid, which brings about the remission of several forms of anemia. Numerous esters of *p*-aminobenzoic acid are important local anesthetics. The ethyl ester (anesthesin or benzocaine) and the *n*-butyl ester (butesin) are valuable surface anesthetics. The hydrochloride of the β-diethylaminoethyl ester (novocaine or procaine) is the most widely accepted chemical for local and spinal anesthesia.

***o*-Hydroxybenzoic acid** (*see* SALICYLIC ACID).

***p*-Hydroxybenzoic acid,** *p*-HOC_6H_4COOH, is more effective than benzoic acid as an antiseptic. Its methyl, ethyl, propyl and butyl esters are used widely in cosmetics and in preparations for treating infections of the skin caused by fungi.

***o*-Hydroxy-*p*-aminobenzoic acid** (*p*-aminosalicylic acid, PAS), *o*-HO-*p*-$H_2NC_6H_3COOH$, became the most successful of the several substituted benzoic acids found to have tuberculostatic action.

***p*-Nitrobenzoic acid,** $O_2NC_6H_4COOH$, is an intermediate for the preparation of *p*-aminobenzoic acid and its derivatives. It is made by the oxidation of *p*-nitrotoluene.

See CHEMISTRY: *Organic Chemistry.*

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BENZOPHENONE is the simplest ketone in the aromatic series. It is structurally a diphenyl ketone, having the formula $C_6H_5.CO.C_6H_5$. Tetramethyldiamino-benzophenone or Michler's ketone, $CO[C_6H_4N(CH_3)_2]_2$, is of technical importance in the manufacture of synthetic dyes. Benzophenone is a dimorphous substance, existing in two crystalline forms, one melting at 26° C. and the other at 48° C. (T. Zincke, 1871). It boils at 306.1° C. It may be prepared by condensing benzene with benzoyl chloride in the presence of anhydrous aluminum chloride. It is reduced by sodium amalgam to benzhydrol or diphenylcarbinol, $C_6H_5.CH(OH)C_6H_5$; a stronger reducing agent such as hydriodic acid in the presence of amorphous phosphorus converts it into diphenylmethane, $(C_6H_5)_2.CH_2$. With hydroxylamine it forms an oxime, which exists in one form only; if, however, one of the phenyl groups in the oxime be substituted in any way, then two stereoiso-

meric oximes are produced. *See* ALDEHYDES AND KETONES; OXIMES; STEREOCHEMISTRY. (G. W. WD.)

BEN-ZVI, ISAAC (1884–1963), Israeli statesman, second president of the State of Israel, was born on Dec. 6, 1884, at Poltava, Ukraine. He studied at Kiev university, went to Palestine in 1907 and continued his law studies at the Imperial Ottoman university in Istanbul (1912–14). In 1908 he was one of the founders of Hashomer (the Jewish self-defense organization) and also of the first Hebrew secondary school in Jerusalem. Exiled from Palestine by the Turks in 1915, he went to the United States, where, together with David Ben-Gurion, he established the Hehalutz (Pioneer) movement and the Jewish legion, with which he returned to Palestine after the expulsion of the Turks by the British. One of the founders of the Vaad Leumi (National Council of Palestine Jews) in 1929, he served as its chairman from 1931 to 1944 and later as its president. On May 14, 1948, as a member of the provisional state council, he signed the declaration of independence of Israel. He was elected to the *knesset* ("national assembly") in 1949 and in 1951 as a member of the Israeli Labour party (Mapai). On Chaim Weizmann's death Ben-Zvi was elected president by the *knesset* on Dec. 8, 1952, and invested two days later. He was re-elected for a second term on Oct. 28, 1957, and for a third term on Oct. 30, 1962. He died on April 23, 1963.

BENZYL ALCOHOL (PHENYL CARBINOL) occurs combined with benzoic acid in Peru balsam, with cinnamic acid in tolu balsam, with acetic acid in essential oil of jasmine and also in storax. It is a colourless liquid with a faint aromatic smell, boiling at 206° C. and having the composition $C_6H_5.CH_2OH$. It may be synthetically prepared by the reduction of benzoyl chloride; by the action of nitrous acid on benzylamine; by boiling benzyl chloride with an aqueous solution of potassium carbonate, or by the so-called "Cannizzaro" reaction (1881) in which benzaldehyde is shaken up with potassium hydroxide, one half of the aldehyde being oxidized to benzoic acid, and the other half reduced to the alcohol. On oxidation with nitric acid it is converted into benzaldehyde while chromic acid oxidizes it to benzoic acid. If reduced by hydriodic acid and phosphorus at 140° C. it gives rise to toluene; toluene and benzoic acid result from its distillation with concentrated alcoholic potassium hydroxide.

BEOTHUK, American Indian tribe of hunters and collectors, resident chiefly on the Newfoundland coast where salmon and shellfish could be obtained to eke out the supply of deer. Their skill as canoemen was commented upon by several early writers, but they were equally at home in the woods. The scanty material culture was characterized by the use of wood for household utensils; stone implements were well made; snowshoes were of a peculiar type, and red ochre was extensively employed for painting the body, a habit which probably gave rise to the term "Red" Indian. The Beothuk were gradually forced into the interior of the island by European fishermen and settlers; reduced in numbers, their doom was sealed when, in the 18th century, Micmac hunters, equipped with firearms, began to swarm over from the mainland. A few survivors may have escaped to Labrador, but the last known Beothuk died in 1829.

See J. P. Howley, *The Beothucks or Red Indians* (1915).

BEOWULF, the finest and most considerable heroic poem in Old English, has survived in a single manuscript, which, to judge by the handwriting of its two scribes, must have been written *c.* 1000. It is in a volume of the Cottonian collection, now in the British museum, London, known as Vitellius A XV. It first aroused scholarly interest in 1705, when Humphrey Wanley described and quoted from it in his catalogue of manuscripts, but in 1731 it was damaged by fire, and has since deteriorated. However, two copies were completed by 1787 for the Icelander Grimur Jonsson Thorkelin; the first, Thorkelin A, by a professional copyist, and the second, Thorkelin B, by Thorkelin himself. These two transcripts are indispensable to modern scholars since much of the manuscript which has now vanished was then visible. Thorkelin's transcript was the basis of the first printed edition (1815). The name of the hero, Beowulf, whose exploits and character provide the connecting theme of the work, is accepted as the title of the poem, which in the manuscript is untitled.

Content of the Poem.—A summary of the events in the poem gives some impression of its scope though nothing of the total effect, which is gained by the superb harmonizing of the theme with the poetic method.

The royal house of Denmark, once renowned for its power through the northern world, is now shamed by the attacks of an anthropomorphous monster, Grendel, who nightly carries off men from King Hroðgar's great hall Heorot, until no Danish warrior dare remain there after dark. Beowulf, a young noble of the Geatas (a people who lived in southern Sweden) sails to Denmark with 14 companions to offer his help. He is welcomed by King Hroðgar (Hrothgar) who, after a banquet where the hero's character and achievements are explored, entrusts the hall to his charge. Grendel comes, and devours one of Beowulf's companions, but in a tremendous battle Beowulf, unarmed, mortally wounds the monster by tearing off his arm.

The next day all is rejoicing in Heorot, and Beowulf is feted and honoured with gifts, but that same night, when Beowulf and his Geatas sleep elsewhere, Grendel's death is avenged by his mother, who carries off from the hall one of Hroðgar's most eminent retainers. Beowulf offers to seek her out in her home at the bottom of a lonely mere in the hills. Fully armed the hero dives into the mere and the monster drags him into her home where Grendel lies dead. Beowulf is nearly worsted when his sword fails against her, but he is saved by noticing a giant sword hanging on the wall with which he manages to kill her. The hilt of this sword and Grendel's head he takes as trophies back to Heorot.

Enriched with honour and princely gifts Beowulf sails home and tells the story of his exploits to his uncle King Hygelac who rewards him with lands and an honoured position in his kingdom. Beowulf serves the king and his son Heardred until Heardred is killed in battle against the Swedes. Then by popular consent Beowulf becomes king and reigns wisely, maintaining peace and justice for 50 years. The events of his reign are quickly passed over but the poet describes his last battle in detail.

A dragon, roused by a theft from the treasure it has guarded for 300 years, ravages the land and to save his people Beowulf goes out to kill it. This fight is much slower than the two of Beowulf's youth. Memories of the hero's past achievements and speeches which sum up the experiences of his life give the prelude to the fight a dreamlike quality, but when the dragon is eventually roused its appearance is so terrible that the aged king's 11 followers flee and leave him to struggle, mortally wounded, in the dragon's grip. Only his young kinsman Wiglaf comes to his aid and together they kill the monster. Before Beowulf dies, Wiglaf shows him part of the treasure that he has won for his people. However, Wiglaf, who succeeds to the kingship, and also conducts Beowulf's magnificent funeral, decrees that the people shall not benefit from the ill-fated treasure and prophesies disaster for the Geatish nation who so failed their king.

Beowulf is cremated and his ashes, with the dragon's treasure, are buried in a great mound. The poem ends with the Geatish warriors' lament for their king: "the kindest and gentlest of men, the most considerate to his people, and most eager for glory."

Nature of the Poem.—We do not know whether a historical Beowulf ever existed, but if he did his deeds were certainly not those of the hero of the poem. As critics have shown, exploits such as the tearing off of the monster's arm and the underwater fight can be paralleled in ancient stories as far apart as Ireland and Mexico. Nevertheless his story gains in effect by being set in a historical background of 6th-century Scandinavia, peopled by figures that we, like the original audience, know to have existed. The Old English audiences liked their stories to be "adorned with truth" and the detailed reminiscences in *Beowulf* of the wars between the Swedes and the Geatas, the ancient rivalries of the Danes and the Heaðobards, and of Hygelac's ill-fated attack on the Rhineland, satisfied this desire.

References to such wars and to characters from traditional heroic stories, the retrospective allusions to Beowulf's achievements, and the long speeches which take up 1,300 lines, have been considered irrelevant hindrances to the advance of the story by

critics who have attempted to apply classical standards of narrative structure to the poem. The main story, also, has not escaped stricture both because of the seemingly imperfect balance of the three combats and because the hero is shown solely as a monster killer. However, on the whole modern critics have tended to applaud the poet's achievement. The poem's division into two narrative blocks (the second beginning with Beowulf's recapitulation of his exploits in Denmark) could be explained by the exigencies of oral delivery, but artistically the balance between the combats of the hero's youth and age, with their skilfully differentiated tone and subtle narrative links, justifies itself.

The evidence of English place names testifies to the reality of Beowulf's monsters to the Anglo-Saxon audience, and archaeology provides some evidence that the man-against-beast combat was a well-known theme in pagan Germanic times. However, in tracing the descent of the Grendel tribe from Cain, the poet gives the struggle a further dimension: Grendel and his mother are not entirely symbolic, but like the dragon—otherwise a different type of antagonist, as befits the slayer of the hero—they are irredeemably destructive and malignant to mankind.

Against the poem's background of feuds, divided loyalties and self-seeking ambition Beowulf's "noble, disinterested deeds for the good of the human race" (D. Whitelock, *The Audience of Beowulf*, Oxford University Press, 1951) shine the more brightly, although he is neither a symbol nor a superman but a human being whose achievements are necessarily incomplete.

The formal technique of the *Beowulf* poet largely conforms to traditional Germanic practice. The metrical unit is that of all Old English poetry, a line divided into two halves of equal weight linked by alliteration. The five basic stress patterns can be emphasized by the alliteration and coincide with the stress in sense. Much of the vocabulary of *Beowulf* must have had a long poetic descent, but the poetic diction as a whole is richer in both quantity and quality than that of other Old English poems. This is shown most clearly in the stylistic devices of contrast and variation, and these are used even in the total narrative structure of the poem where the hero's character and achievements are built up in a series of contrasting references, and apparent identities in the human situation are shown to cover subtle and often ironically dramatic differences, as in the way Hroðgar and Beowulf face the troubles that beset them in their old age. One of the most polished examples of subsidiary narrative variation is seen in the account of Grendel's approach to Heorot (li. 705–27): here by repetition and variation the poet conveys not only the monster's menacing advance and his state of mind but gives an increasingly clear impression of him, from the first introduction as a *sceadugenga* ("walker in the shadows"), to the more substantial fiend whose eyes shine fearsomely in the darkness as he finally bursts into the hall.

It is in the creation of compounds like *"sceadugenga,"* known only in *Beowulf*, that the poet is most original and characteristic. Such appellations, which highlight one aspect of the subject's being, he uses most freely to achieve particularly solemn and elevated effects, for example in the account of Scyld's ship burial (li. 47–52):

> Þa gyt hie him asetton segen g(yl) denne
> heah ofer heafod, leton holm beran,
> geafon on garsecg; him wæs geomor sefa,
> murnende mod. Men ne cunnon
> secgan to soðe, selerædende,
> hæleð under heofenum, hwa Þæm hlæste onfeng.

(Then last they set a golden banner high over his head, let the sea carry him off, gave him to the stormy ocean; they were sad at heart, oppressed in spirit. No man can truly say, neither the retainers in the hall nor the heroes under the heavens, who received that cargo.)

Here the sharp picture of the golden banner is followed by the repetition of Scyld's committal to the sea varied in two traditional terms, but the sea plays an active, then a passive role, and this is mirrored in the stress patterns. The variation in diction and metre to express the feelings of the grieving followers, and the qualification of men into two traditional groups, are typical examples of the poet's effective marriage of style and content.

Dating of the Poem.—When exactly the poem as we know it first came into being and where, is still impossible to decide. It seems clear that the work, with its lengthy descriptions of fighting and armour, political events, court life and the social and moral problems of the layman, was intended for the entertainment of a secular audience. However Christianity has so deeply penetrated the language, metaphor and thought of the poem that we must assume an audience with some tradition of Christianity and most probably Christian poetry behind it. The poet naturally presupposes also a wide knowledge of traditional heroic stories but he penetrates below the surface of such stories and their conventional situations, sympathetically considering the sufferings of innocent participants, the impermanence of success and happiness, and the courage of the heroes who had to live without the consolation of Christianity. We do not know if the author of *Beowulf* was the first to provide this sort of treatment of the traditional past since the poem is unique of its type, but it is normally assumed today that such poetry could hardly have evolved before the 8th century. At that time, however, the courts of several of the English kingdoms could have provided a sympathetic audience, although there are features in the language of the poem that point to an Anglian origin.

It has sometimes been assumed that archaeological evidence can date the poem more exactly by providing dated parallels for the material conditions of aristocratic life the poet describes. Unfortunately the evidence is still incomplete. Most of the illustrative material comes from grave goods buried in the pagan manner with the dead, and as this custom had ceased by the end of the 7th century the material conditions of the 8th century are little known. It is impossible therefore to know how far the poet modernized his story and how far he drew on traditional descriptions from earlier heroic poetry. It seems likely that certain descriptions, for example of the battle equipment of the heroes of the past, became appropriate by long usage but it must also be remembered that such equipment was much prized by the earliest English and handed down as heirlooms. A poet with a historical sense could describe such heirlooms accurately when, like the author of *Beowulf*, he specifically mentions that a certain piece was ancient.

The rich 7th-century ship burial discovered in 1939 at Sutton Hoo, Suffolk, with its wealth of imported silverware, its weapons and armour adorned with gold and jewels, has shown that the *Beowulf* poet's descriptions of the equipment and lavish burials of kings was neither exaggerated nor dependent on pre-English traditions. Moreover Sutton Hoo, showing as it does close links with Swedish art and customs, helps to explain why traditional stories from Scandinavia should have been current among the English.

There is a curious mixture of heathen and Christian elements in the burial (*see* R. L. S. Bruce-Mitford, "The Sutton Hoo Ship Burial," in *Proceedings of the Suffolk Institute of Archaeology*, vol. xxv, pt. 1, 1949) and there was no trace at Sutton Hoo (or in *Beowulf*) of the human or animal sacrifices which were a feature of fully pagan burial rites. It is not certain however whether the poet only knew traditions of such transitional-type funerals or whether he edited fully heathen accounts for himself.

Sutton Hoo does not tell us the date of *Beowulf*, but does at least provide the closest parallels yet known for conditions described in the poem. Likewise, the excavation of the first Anglo-Saxon royal buildings, at Yeavering in Northumberland, is an eloquent illustration of how the great wooden halls such as Heorot must have appeared to the original audience. Archaeological evidence can considerably enrich a study of the poem. It provides proof of the tastes, the external splendour, the delight in craftsmanship, of a society for which *Beowulf* is otherwise our solitary witness.

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BÉRAIN, JEAN, the Elder (1637–1711), French draftsman, designer, painter and engraver of ornament, was called the oracle of taste of his time in all matters of decoration. He was born on Oct. 28, 1637, at Saint Mihiel. In 1674 he was appointed designer to King Louis XIV, in succession to Henri Gissey, whose pupil he is believed to have been. After the death of Charles Le Brun he was commissioned to compose and supervise the whole of the exterior decoration of the king's ships. Although possessed of no great originality, he was skilful in adapting the work of his predecessors. He designed costumes and decorations for opera, court festivals and public solemnities. His work inspired the ornamentation of rooms and furniture, and exercised enormous influence all over Europe. His numerous designs were for the most part engraved under his own superintendence; a collection of them was published in Paris in 1711. He died in Paris on Jan. 24, 1711.

His son, Jean Bérain the Younger (1678–1726), best known as an engraver, was his father's pupil, and exercised the same official functions after his death. Claude Bérain, brother of the elder Jean, was still living in 1726. He was engraver to the king, and executed a good number of plates of ornament and arabesque of various kinds.

BÉRANGER, PIERRE JEAN DE (1780–1857), French song writer of much wit who became immensely popular in the early 19th century, was born in Paris, Aug. 19, 1780. Neglected by his father, he spent most of his youth working in an inn and sleeping in a garret, but found his true vocation when he first visited Le Rocher de Cancale, a tavern frequented by song writers. Thanks to Lucien Bonaparte, Napoleon's brother, who secured him a small pension, he was made a clerk at the university, composing in his spare time sentimental, ribald and satirical verses such as "Le Roi d'Yvetot" (*c.* 1813), a song about a king as easygoing and pleasure-loving as Napoleon was ambitious and despotic, which made him famous before he had published anything. After the fall of the empire (1815) and the restoration of the Bourbon kings he pleased his public by glorifying the era of Napoleon and the deeds of the emperor's veteran troops (as in "Le Vieux Drapeau") and by ridiculing the monarchy and the reactionary clergy. Collections of his work (1821 and 1828) earned him spells of imprisonment, first for three and then for nine months. His fame was increased by this persecution and he used it during the revolution of 1830 to further the cause of the bourgeois king Louis Philippe. A plain man and a liberal, he was praised by writers (Chateaubriand, Alphonse de Lamartine, Félicité de Lamennais and Jules Michelet, *qq.v.*) and politicians like Thiers who tried to cash in on his popularity. He affected modesty, saying that he owed his reputation only to the old tunes to which he set his lyrics. He acquired publicity by pretending to run away from it. After the revolution of 1848 he was elected a deputy but resigned because he said making parliamentary speeches was not his business and thereafter apparently lived in retirement with Judith Frère, who had been his companion for many years, though he would still reappear and catch the public eye on favourable occasions. He died in Paris, July 16, 1857, and Napoleon III, seizing an opportunity to make propaganda for himself, ordered a magnificent funeral in his honour. A poet and humorist, who had played an important part in politics, he had conducted his life with great skill.

His poems appeared in England and the United States in many translations, of which W. Young's *Songs of Béranger* (1878) was probably the best known. Charles Dickens once said to Ernest Legouvé, the dramatist, "Do you know which French writer is most popular with our enlightened working-class? Béranger."

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BERAR, a tract of rich cotton country in eastern Maharashtra, India, extends for about 200 mi. from west to east along the line of the Purna river. It lies 700–1,600 ft. above sea level and is bounded north by the Gawilgarh hills and south by the Ajanta and Satmala ranges. In India's political history the name was given to a province of varying extent, but from the mid-19th to mid-20th century it comprehended specifically the districts of Akola, Amravati, Buldana and Yeotmal (*qq.v.*). In the 1950s "Berar" tended in local popular usage to be replaced by the ancient name "Vidarbha" although this refers to a larger area also embracing the Nagpur plain and other territory to the east.

After the incursions of Muslim armies at the end of the 13th century A.D. Berar or Birar emerged as a distinct political entity; subsequently it was in turn a part of several Muslim kingdoms until, on the breakup of the Mogul empire it fell to the nizam of Hyderabad (*q.v.*). In 1853 it was assigned to the British. A perpetual lease was negotiated in 1902 and the Berar "Assigned Districts" attached as a division to the Central Provinces. When the commissioner's divisions of the newly created province of Madhya Pradesh (*q.v.*) were abolished in 1948 Berar lost its administrative significance.

BERAT, a town of southern Albania on the Osum-Seman river and capital of the district of the same name. The population in 1955 was 14,374, of whom nearly seven-eighths were Muslims and the rest Orthodox. The town is situated on steep hills, through which the Osum has cut its way, and the picturesque, white, terraced houses are crowned by the ruined old citadel. There are several mosques and many old churches. The surrounding valley is fertile. About 7½ mi. to the north is the productive oil field of Stalin (Kuçove), near which is a large modern airfield. To the east towers Tomorr (7,929 ft.), the highest peak in southern Albania.

Berat has a long and romantic history as a strategic point between Illyria and Epirus, and as the scene of many battles. Once probably the ancient Greek Antipatria, it became the Byzantine Pulcheriopolis; rebuilt in the 13th century by Michael Comnenus, despot of Epirus, it was renamed Beligrad (corrupted to Berat) in the 14th century by Stephen Dushan's Serbs and refortified by Ali Pasha in the 19th century. The Turkish bridge was built in 1780. (D. R. O.-H.)

BERBER, a word of uncertain origin designating the indigenous Caucasoid peoples of north Africa who call themselves, in most cases, some variant of the word *imazighen*.

Language.—First recorded as tribal names in Old Kingdom Egyptian inscriptions, Berber languages are spoken by over 10,000,000 persons discontinuously distributed from the Siwa oasis, Egypt, to the Atlantic and from the Niger river to the Mediterranean. Berber is related to ancient Egyptian, Semitic, the Cushitic languages of the eastern Horn of Africa, and, as classified by the linguist J. H. Greenberg, to languages spoken by Negroes near Lake Chad. It is divided into Masmuda, Senhaja, and Zenata and subdivided into regional languages and local dialects. Sex and number are expressed in Berber by both prefixes and suffixes: *e.g.*, Rifian *afunes* = "bull"; *ifunesen* = "bulls"; *thafunesth* = "cow"; *tifunesen* = "cows." Lexically it contains a few possibly Caucaso-Mediterranean, more Latin, and many Arabic roots, while French and Spanish words were incorporated into several Berber vocabularies. The Tuaregs, nomadic Berbers of the Sahara, write love poems in Tifinaq, an ancient Berber alphabet, but otherwise, literate Berbers write both Arabic and Berber in Arabic script. Many also learn French, Spanish, or both.

History.—Well into Roman times many Berbers were still Neolithic farmers, using polished stone cutting tools. From this epoch may have been transmitted widespread traditions of an invasion of Berber ancestors from the western Sahara, replacing

earlier peoples, and a prehistoric war between the Ghomara (Masmuda) and the Senhaja, won by the latter. Greeks and Phoenicians established trading posts at strategic coastal points, and the Phoenicians founded Carthage, destroyed by the Romans, who then colonized Tunisia, eastern Algeria, and western Morocco so effectively that many of the indigenous Berbers became Latin-speaking Christians, like St. Augustine. Meanwhile, Jewish colonists had penetrated the interior, trading widely and introducing metalworking. From them are descended the Berber-speaking mountain Jews. After the first Arab invasion, in the 7th century A.D., Christianity was replaced by Islam and Latin by Arabic in the Romanized areas, while Berbers elsewhere were evangelized by Muslim missionaries, and cities such as Fez and Kairuan were founded. In the 12th century a second wave of Arabs invaded north Africa. These were Bedouin, who turned the orchards and gardens of the coastal plains into grazing lands. Since then Arabs and Berbers mixed extensively and in some tribes exchanged languages. Although most Berbers live in mountains, others share the plains and deserts with Arabs and Europeans. More than half the Muslims of Morocco speak Berber; the ratio diminishes eastward through Algeria and Tunisia to Libya, and on to Siwa, Egypt.

Subgroups.—The principal Berber-speaking peoples in Morocco are the Rifis (*q.v.*) of the eastern Mediterranean coast, Beraber of the Middle Atlas, Shluh of the Great Atlas and Sous valley, and the Zenata of the eastern plains; in Algeria, the Kabyles of the Djurdjura mountains, the Shawiya of the Aurès mountains, numerous oasis populations such as the Mzabites of Ghardaïa, and the Tuareg of the open Sahara; in Tunisia, the Jerbans (Djerba islanders); in Libya, the villagers of Jabal Nefusa; and in Egypt, the Siwans. Although not racially identical all are more or less Mediterranean with variable stature, slender to medium build, Caucasoid facial features and hair, form, and, in most tribes, brunet pigmentation. Stocky builds and blondism are most frequent among mountain tribes, particularly Rifis, and Negroid features among members of scheduled castes—blacksmiths, butchers, well diggers, market attendants and musicians.

Material Culture.—Although most Berbers are sedentary farmers, some tribes cultivate the lowlands in winter and graze their flocks in mountain meadows in summer, while others are year-round pastoral nomads dependent for vegetable foodstuffs on serfs and slaves dwelling in desert plateaus and oases. There are also Berber cities, like Taroudant and Ghardaïa. In Arab and European cities of north Africa certain Berber groups monopolize the corner-grocery trade: Soussis in Morocco, Mzabites in Algeria and Jerbans in Tunisia.

The sedentary agricultural Berbers grow wheat and barley in open fields and irrigated terraces and fruits and vegetables near the river bottoms. Steep slopes, cultivated with the hoe, are covered with vineyards and patches of beans and rye. Fruits and nuts are dried for export and winter consumption, and olive oil, their principal cooking fat, is extracted in communal mills and presses. Women grind grain at home in rotary hand mills, or take it to a communal turbine water mill. Berbers raise much livestock: cattle, sheep, goats, asses, horses, mules and camels, as well as dogs, cats and poultry, the proportions depending on the terrain and climate. Oxen are used for plowing, asses and mules for drawing water, turning machinery, and carrying pack loads; camels for draught and riding; and horses for riding. The first wheeled vehicle commonly used by Berbers in modern times was the automobile.

Most home industries, like pottery making and weaving, are women's work, while full-time crafts are performed by Jews and Negroes outside the Berber social structure. Considered immune in tribal wars, the craftsmen are able to keep up a constant flow of vitally needed products to all tribes and villages, even those under siege. Some blacksmiths are established in villages, while others make the rounds of weekly markets, so ingeniously spaced and scheduled that a villager may walk from home to a market and back every day of the week except Friday, the Muslim sabbath. In the markets are imported hardware and machine-loomed textiles, candles, matches, tea and sugar, and local foods and manufactured products. Professional butchers, who are sometimes blacksmiths as well, work in a secluded section near the livestock market. Outcaste criers shout announcements, and professional weighers facilitate sales. In a special house or under a tree sit the tribal notables, who run the market, exchange information and drink mint tea.

Berber housing varies with climate, degree of mobility and building materials. The sedentary farmers build stone houses with gabled or flat roofs, depending on rainfall. Most houses are single storied and set around a court. The seasonally nomadic tribes erect multistoried castles of pounded earth for defense and storage, and live in black goathair tents when at pasture. Oasis dwellers and urbanites construct large masonry buildings, and the Tuareg live in leather tents.

Social and Political Structure.—Aside from language, Berbers differ from Arabs in four easily recognized ways. (1) Whereas Arabs govern their conduct by the *shariya* or written religious law, Berbers follow their own ancient *kanuns* or oral traditionals, at least as different from the *shariya* as the Napoleonic code is from English law. (2) Whereas Arabs prefer marriage between the children of two brothers, Berbers forbid it and favour the union between cross cousins—a mother's brother's daughter and a father's sister's son. (3) The position of women is higher among Berbers. They go unveiled, meet guests, sell their own products in the market and keep the money, help arrange betrothals and manage the details of weddings. Many are also literate. (4) Arab government tends to be personal and authoritarian, while Berber government usually is more communal or representative. The simplest Berber political structure, found in independent villages in Algeria and the Great Atlas, is the *jama'a* (*djemaa*), a meeting of all reputable grown men in the village square. Such villages are divided into rival moieties that give the meeting structure and provide links with other villages having the same moieties. Among the Rifis a complex representative system evolved, permitting the growth of a nation in time of stress and falling apart when the pressure subsides. Among part-time nomads the need for organization and policing during migration necessitates the election of an annual summer chief, who assigns places in the procession over the steep mountain passes and allots pastures. Among fully nomadic Berbers a constant need of structure gave rise to a permanent chieftainship with a council. Among them the class system is a complex arrangement by which nobles of a warrior caste protect both camel-breeding serfs and agricultural slaves, while guiding, protecting or raiding caravans.

Religious Structure.—All Berber groups harbour one or more ritual castes, said to be descendants of the Prophet or of saints who go about as fearlessly as the blacksmiths at the other end of the scale, immune to harm because of their holiness. They negotiate truces, educate the young and cure the sick by faith healing; they are buried in shrines, often beside great rocks or trees, where their powers are sought out as cures for sterility or special categories of diseases.

Except for Mzabites and Jerbans, who are Khawarij (Kharejites), most Berbers consider themselves Sunnis, usually of the Malikite rite. With notable exceptions as in the Middle Atlas region, circumcision, prayers and fasts are faithfully observed. Sufi brotherhoods in which members of local chapters attain a state of ecstasy through the performance of formal dancing, breathing and chanting rhythms, are popular with some Berbers but frowned upon by others. Certain groups celebrate a very secret annual ritual in which the most sacred Muslim beliefs and practices are ridiculed.

See AURES; KABYLES; NUBA, THE; SAHARA; TUAREG; and articles on various countries; *see* also Index references under "Berber" in the Index volume.

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BERBERA, a port of the Somali republic and capital (until 1941) of the former British Somaliland protectorate, Africa, lies on the Gulf of Aden. It has a stable population of about 7,500, most of whom are Somali of the Habar Awal clan, and is the headquarters of Berbera district. A local government council was instituted in 1953. A good water supply comes by pipeline from hot springs, which are of some antiquity, at Dubar to the south. With improved port facilities trade, mainly with Aden, has increased since World War II.

The coast around Berbera was known in classical times and to the early Arab geographers, the first of whom to give a brief description of the town was Ibn Sa'id (d. 1286). The original site of the town was probably a little to the east; and Berbera was one of the Muslim settlements in the medieval state of Adal. It was sacked by the Portuguese in 1518 and in the 17th century became a dependency of the sharifs of Mokha. In 1875 Berbera was occupied by the Egyptians, and when they withdrew at the time of the Mahdist rebellion in the Sudan it was occupied by Britain in 1885.

Travelers in the 19th century generally described the town as a poverty-stricken collection of huts with a population in the hot months of about 7,500. From October to March, however, during the northeast monsoon, when nomadic stockbreeders came down to the coast and the port was open to vessels from Arabia, the Persian gulf and India, bringing dates, cloth, rice, metals, etc., to be traded for slaves, livestock, ghee, hides and skins, and gums, the population swelled to as many as 40,000. (I. M. L.)

BERBICE, a river of British Guiana, South America. It rises in the Kanuku mountains and flows 370 mi. through dense forest to the coastal plain. It enters the Atlantic at New Amsterdam, where its flow is obstructed by shallows. Its basin is restricted by the proximity of its larger neighbours, the Essequibo and Courantyne rivers, and its only tributary of consequence is the Canje creek. It is navigable 100 mi. inland by small vessels; there are many rapids higher up.

The Dutch colony of Berbice was settled in 1627 and separated from Surinam in 1732. It joined Demerara and Essequibo in 1831 to form British Guiana. The county, or region, of Berbice has no modern political significance. (G. Ln.)

BERCEO, GONZALO DE (*c.* 1195–*c.* 1268), the earliest known Castilian poet, was born at Berceo, in what is now the province of Logroño. Records show that in 1220 he was a deacon and in 1237 a secular priest attached to the Benedictine monastery of San Millán de la Cogolla. He was still alive in 1264. His poetical works on devotional subjects include *Milagros de Nuestra Señora, Loores de Nuestra Señora, Vida de Santo Domingo de Silos, El Sacrificio de la Misa* and *Vida de Santa Oria.* He belonged to a school of erudite poetry known as the *mester de clerecía* and used the *cuaderna vía,* which consisted of single-rhyme quatrains, each line having 14 syllables. His *Milagros* probably came from the same source as the *Miracles de la Sainte Vierge* of his French contemporary Gautier de Coincy. Berceo is faithful to his sources, both scriptural and medieval, but adds details, full of charm and life, which sometimes allude to his own mood and surroundings. His poems were discovered in the 18th century and were praised by later Spanish authors including Rubén Darío and Antonio Machado.

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BERCEUSE, the French word for "lullaby," is used in music as the title of a character piece, usually for piano. As a title the *berceuse* does not imply a set musical form. The most famous example is the *Berceuse,* Op. 57, by Chopin, which takes the form of lacy figurations played by the right hand against a sequence of chords continuously repeated in the bass. Other *berceuses* are by Benjamin Godard, from the opera *Jocelyn;* Liszt, originally entitled *Träumerei;* Saint-Saëns, for piano duet; and Ravel, for violin and piano.

BERCHEM (Berghem), **NICOLAES** (Claes) **PIETERSZ** (1620–1683), Dutch painter and etcher, whose works were in great demand among his contemporaries, was born at Haarlem. He received instruction from his father (Pieter Claesz van Haarlem) and from the painters Jan van Goyen, Jan Baptist Weenix, Jan Wils and Pieter de Grebber. He studied in Italy, and most of his numerous landscapes are southern landscapes in bright sunshine. His finest pictures are at the Amsterdam museum and at the Hermitage, Leningrad. There are examples in London, Vienna, Berlin and elsewhere.

Berchem died on Feb. 18, 1683, in Amsterdam.

BERCHEM, a southern suburb of Antwerp, Belg., is one of the seven satellite communes, which, since the beginning of the 20th century, witnessed considerable development in the outskirts of the old maritime city. Pop. (1955 est.) 46,834. Most of the commune was inside the second ring of fortifications around Antwerp, but now that these have been abandoned Berchem is expanding into the country beyond. Most of the working inhabitants are employed in the port of Antwerp, in nearby photographic and shipbuilding industries and in a telephone manufacturing plant. (R. M. An.)

BERCHTA (Perchta), a minor Teutonic goddess known from beliefs and customs in south Germany. She leads a band of spirits combining beneficent and evil qualities, and is concerned particularly with spinning and plowing. Her day, celebrated by the offering of meals, coincides with the Christian feast of the Epiphany (Jan. 6). (K. C. K.)

BERCHTESGADEN, a town and resort area in southeastern Bavaria, Germany, surrounded on three sides by Austrian territory, lies in a deep valley on the northern side of the Alps on a small stream, the Berchtesgadener Ache, 145 km. (90 mi.) E.S.E. of Munich but only about 12 mi. S. of Salzburg, Aus. Pop. (1959 est.) 4,739. The Marktplatz is the centre of the little town and close by is the Stiftskirche (church) with two spires, on the site of a 12th-century basilica. The castle, originally the home of the provosts of Berchtesgaden and later the summer residence of the kings of Bavaria, now houses a museum. At Obersalzberg, 500 m. (1,640 ft.) above the town, were the chalets of Hitler (the Berghof), Göring, Bormann and other Nazi leaders, with air raid shelters, barracks and various installations. These were destroyed in an Allied air attack in April 1945. In 1952 the ruins were leveled to the ground and trees planted on the site. A paved road winds up the mountain to a tunnel entrance leading to an elevator (the tunnel and shaft cut in solid rock) up to a glass-walled tea house on the very top of the mountain, once Hitler's private retreat, the "Eagle's Nest."

The main industry of Berchtesgaden is the tourist trade. There is mountain climbing and skiing and the neighbourhood is scenic. Salt mines, which can be visited, form one of the oldest and most important industries; others include wood carving, brewing, the manufacture of stockings and buttons, the painting of china and agriculture.

Berchtesgaden grew up around the community of Augustinian monks called Chorherrenstift, which was founded about 1111 by Count Berengar I of Sulzbach. The opening of the salt mines began many centuries of bitter rivalry with Salzburg and Hallein. From 1300 Berchtesgaden was ruled by provosts and in 1491 the emperor Maximilian I gave the provost Ulrich Pernauer the title of *Reichsfürst* ("Prince of the Reich"). For a short time in 1704, during the War of the Spanish Succession, the town was occupied by Austrian troops and in 1803 it was annexed to Austria. In 1809–10 it was directly ruled by the French. From 1810 to 1918 it was part of the Bavarian kingdom; then it was part of Germany. Entered by Allied forces in World War II on May 5, 1945, it was a major resort and recreation area during the occupation. It became part of the Federal Republic of Germany in 1949.

BERCHTOLD, LEOPOLD, Graf (1863–1942), Austro-Hungarian foreign minister whose ultimatum to Serbia led to the outbreak of World War I, was born in Vienna on April 18, 1863. A wealthy landowner in Bohemia and Moravia, he became one of the richest men in Austria by his marriage to Ferdinandine von Nagy Karolyi in 1893. Having entered the diplomatic service

(1893), he was sent to Paris in 1894 and to London in 1899. In 1906 he was made ambassador at St. Petersburg, where his charm, elegance and discretion won him many important connections. On Feb. 19, 1912, after the death of A. Aehrenthal, he was appointed foreign minister, against his will. Berchtold's standing with Russia had already been compromised by Aehrenthal's agreement with A. P. Izvolski, the Russian foreign minister, concerning the annexation of Bosnia-Hercegovina, later denounced by Izvolski. As foreign minister, Berchtöld soon fell under the influence of Conrad von Hötzendorf, chief of the general staff, and his period in office saw a succession of ominous mistakes. In 1912 he hindered Italy's attempts to strengthen the Triple alliance. At the beginning of the first Balkan War he damaged Austria's prestige by an unrealistic attempt to maintain the *status quo*, and after the war his influence prevented Serbia from gaining a corridor to the sea and forced the Montenegrins to withdraw from Shkoder (Scutari) in favour of the new state of Albania. His unsuccessful intervention on Bulgaria's behalf brought about closer relations between Rumania and Russia. Berchtold's vacillating policy converted the old tensions between Austria and Serbia into hatred and further led to the anonymously sponsored propaganda campaign, which led to the murder of the archduke Francis Ferdinand at Sarajevo on June 28, 1914. Urged by Conrad von Hötzendorf, Berchtold was determined on war with Serbia and, on July 21, 1914, decided on an ultimatum whose text should ensure its rejection. Germany was informed but not Italy, since Berchtold feared that Italy would inform Russia and thus hasten its mobilization. At the same time he calmed the fears of the emperor concerning Russia's reaction and misled the general staff with a similar optimism. When Italy demanded territorial concessions in return for neutrality, Berchtold resigned, on Jan. 13, 1915, and accepted high office at court. He died at Peresznye castle, near Csepreg in Hungary, on Nov. 21, 1942.

With an unenviable heritage as foreign minister, Berchtold cannot be entirely blamed for the disastrous outcome of his period in office, but his unpublished memoirs nevertheless reveal a frightening superficiality. Uncertain, even when not mistaken, he let others persuade him into following unrealistic policies.

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BERDICHEV, a town of Zhitomir *oblast* (province) of the Ukrainian Soviet Socialist Republic, U.S.S.R., is a railway junction on the Zhitomir-Vinnitsa and Rovno-Kazatin lines. The town suffered heavily in World War II and its population in 1959 of 53,206 was still below the 1939 level of 62,000 when more than half its population was Jewish. Founded in 1482, Berdichev was Polish from 1569 to the partition of 1793. Up to the Russian Revolution it was an important trading centre for the right-bank Ukraine. Its importance is industrial, with two engineering works, a woolen mill, a sugar refinery and a tannery. (R. A. F.)

BERDYAEV, NIKOLAI ALEKSANDROVICH (1874–1948), Russian religious thinker, one of the foremost representatives of "Christian existentialism," was born in Kiev in 1874. He was attracted early by Marxism, although he was critical of its materialist doctrine, for which he originally desired to substitute an idealism derived from Kant, Fichte and, especially, the neo-Kantians. In 1899 he was sentenced to three years' exile in northern Russia on a political charge. Released, he visited Germany and then took up residence in St. Petersburg (1904), where he participated in the widespread religious and cultural revival taking place in Russia at that time.

After another visit to western Europe in 1907, he went to live in Moscow, where he made his most important contribution to the revival. He became a loyal if rather nonconformist member of the Orthodox Church. Brought to trial in 1914 because of an article attacking the Holy Synod, he escaped sentence when the case was dropped on the outbreak of the Russian Revolution. He was later appointed professor of philosophy at Moscow university, but had trouble with the police and eventually, in 1922, was expelled from the U.S.S.R., together with a number of other Russian intellectuals. After a period in Berlin, he established a religious-philosophical academy in Paris in 1924. He died at his home in the Parisian suburb of Clamart on March 23, 1948.

In manner Berdyaev was more of a prophet than a systematic philosopher, even though he expressed his prophecies in books devoted to the traditional problems of philosophy. Besides a considerable philosophical gift of an intuitive kind and a genuine sensitivity to the moods of his time, he had a controversial zest, evidence of which is provided in his contributions to his periodical *Put'* ("The Way"; Paris, 1925 ff.). Truth, in Berdyaev's view, was not attained by means of knowledge mirroring objects, but through penetration of our environment by a creative act. It is "a light which breaks through from the transcendent world of spirit" into the beclouded, "objectified" world, where everything is outside everything else. The greatness of man is his share in this world of spirit and his divine capacity to create; his tragedy, collective and individual, resides in the "objectification," debasement and eventual loss of the creative impulse. As the gulf between creative ideas and their embodiment widens, regeneration begins again from within man. Berdyaev believed that "the contradictions of modern history" portend such a time of new "divine-human creation." The writers and thinkers whom Berdyaev acknowledged as his masters are Jakob Boehme, Maine de Biran, Kant, Franz von Baader, Nietzsche, Dostoevski and V. S. Soloviev.

In the context of Russian cultural developments Berdyaev aspired to a synthesis of Westernism and Slavophilism. He never completely repudiated his Marxist antecedents, although his socialism and his critique of capitalism were qualified by a conviction that on a certain level the difference between them is insignificant and that socialism can be "the greatest *bourgeois* triumph." Here as elsewhere he was mainly concerned with the defense of the human person against bondage to things, to "fictitious economic and political values," to abstractions and to the fatalism of history. In regard to Soviet Russia he had a divided mind. He condemned "the crimes and violence of the Soviet order"; yet, unlike most of his compatriots in emigration, he not only did not consider the Communist regime to be an alien occupation, but claimed to detect the undertones of true messianism in post-revolutionary Russia.

The most important works by Berdyaev in English translation are *Freedom and the Spirit* (1935), *The Destiny of Man* (1937), *The Origin of Russian Communism* (1938), *Dream and Reality: an Essay in Autobiography* (1950) and *The Beginning and the End* (1952).

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BERDYANSK (from 1939 to 1958 called OSIPENKO), a town and port in Zaporozhye *oblast* of the Ukrainian Soviet Socialist Republic, U.S.S.R., stands on the Berdyansk gulf (Berdyanski Zaliv) of the sea of Azov, to the west of the long, curling Berdyansk spit (Berdyanskaya Kosa), 100 mi. S.E. of Zaporozhye town. Pop. (1959) 65,249. It is linked by railway, via Pologi, to the Dnieper and the Donets Basin (*q.v.*), or Donbas, industrial areas and iron ore from Kerch forms a major import. Founded in 1827, the town has engineering industries producing agricultural and transport machinery and cables, oil refining (using petroleum from Tuapse and Batumi) and flour milling. Fishing is carried on, with a fish factory located on the spit. (R. A. F.)

BERENGAR OF FRIULI (d. 924), king of Italy from 888 and emperor from 915, was the second son of Eberhard, margrave of Friuli, and Gisela, daughter of the emperor Louis I the Pious. After the fall of the emperor Charles III the Fat, Berengar was elected king of Italy (at Pavia, 888) and founded that line of princes of the 9th–11th centuries who in popular Italian histories are ranked quite incorrectly as national kings. Berengar acknowledged the overlordship of the East Frankish king Arnulf (*q.v.*),

as his own position in Italy was contested by Guy of Spoleto (d. 894). Early in 889, however, he was defeated by Guy and had to withdraw to northeastern Italy. In 896 he agreed on a partition of Italy with Lambert, Guy's son and successor; and with the death of Lambert (898) Berengar was recognized throughout the kingdom. In 899 he suffered a defeat on the Brenta river in battle against the invading Magyars. In 900 Louis of Provence (*see* LOUIS III the Blind), invited by the Italian nobles, contested Berengar's position in Italy. Driven out in 902, Louis made a renewed attack against Pavia and Verona in 905 but was captured and blinded by Berengar. Nevertheless Berengar's authority, even after his coronation as emperor by Pope John X in 915, remained weak. The Italian magnates called in Rudolf II of Burgundy against Berengar in 922, and at Fiorenzuola (near Piacenza) Berengar, despite an alliance with the Magyars, was defeated (923). He was murdered by one of his own men at Verona on April 7, 924.

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BERENGAR (BERENGER or BERENGARIUS) **OF TOURS** (*c.* 999–1088), medieval theologian, a participant, on the losing side, in the great struggle between theologians affirming the symbolic presence of Christ in the Eucharist and those supporting the doctrine of conversion (transubstantiation), was born at Tours, in France, and educated in the famous school of Fulbert of Chartres. Later, as director of the cathedral school of his native city, he taught with such success as to attract pupils from all parts of France, and powerfully contributed to the diffusion of interest in the study of logic and metaphysics, and to the introduction of the dialectic development of theology. The earliest of his writings of which record remains is an *Exhortatory Discourse* to the hermits of his district, written at their own request and for their spiritual edification. It shows a clear discernment of the dangers of the ascetic life, and a deep insight into the significance of the Augustinian doctrine of grace.

Sometime before 1040 Berengar was made archdeacon of Angers. It was shortly after this that rumours began to spread of his heretical views regarding the sacrament of the Eucharist. Transubstantiation, he held, was contrary to reason, unwarranted by Scripture, and inconsistent with the teaching of men like Ambrose, Jerome and Augustine. He did not conceal this conviction from his scholars and friends, and through them the report spread widely that he denied the common doctrine respecting the Eucharist. His old school companion, Adelmann, archdeacon of Liège, wrote to him letters of expostulation in 1046 and 1048; and Bishop Hugo of Langres wrote (about 1049) a refutation of the views Berengar had expressed to him in conversation. Berengar was not affected by their exhortations. Hearing that Lanfranc, the most celebrated theologian of his day, strongly approved the doctrine of Paschasius Radbertus—who in 831, in the first systematic treatise on the Eucharist, had asserted that the bread and wine are changed into the body and blood of Christ that was born of Mary—he wrote to him a letter expressing his surprise and urging him to reconsider the question. Lanfranc, who was then in Rome (1050), brought the letter to the notice of Leo IX with the result that Berengar was excommunicated and ordered to appear before the council of Vercelli, which was to be held later in the year. Before it assembled he was cast into prison. At the council of Tours (1054) he found a protector in the papal legate, the famous Hildebrand, who, satisfied with the fact that Berengar did not deny the real presence of Christ in the sacramental elements, succeeded in persuading the assembly to be content, with a general confession from him that the bread and wine, after consecration, were truly the body and blood of the Lord, without requiring him to define how. At the council of Rome (1059) Berengar signed a formula of faith defining the real presence in an extremely realistic manner; but on returning to France he continued to attack the doctrine of transubstantiation, apparently without objection from either his civil or ecclesiastical superiors. Finally, Hildebrand, now Pope Gregory VII, summoned him to Rome, and, in the council of 1078, tried once more to obtain a declaration of his orthodoxy by means of a confession of faith drawn up in general terms; but in the council of the following year Berengar was forced to acknowledge a change of the bread into the body of Christ that was born of the Virgin Mary, and that the change was not merely by sign and virtue of the sacrament but in the own nature and truth of substance. He was kindly dismissed by the pope not long after, with a letter recommending him to the protection of the bishops of Tours and Angers, and another pronouncing anathema on all who should do him any injury or call him a heretic. Berengar again recalled his confession but, at the council of Bordeaux (1080), made a final retraction. He passed the rest of his life in retirement and prayer on the island of St. Côme, near Tours, where he died in 1088. He left behind him a number of followers.

The position of Berengar in the Eucharist controversy rested on his theory that dialectic was *par excellence* the instrument for discovering truth, a theory that concerned the whole question of the relation between faith and reason and that meant that reason was to be the criterion in matters of faith. His objections to transubstantiation were chiefly metaphysical. Accidents, he argued, cannot exist without their substance, even by the power of God, and therefore, if the accidents of bread are present on the altar, their substance, and not that of the body of Christ, will be there. Besides, if Christ is present, and bread alone is seen, there is deception, for Christ, who is God, represents himself other than he actually is. Again, if Christ is in heaven, as the Scriptures say, he cannot be on earth or on many altars, since nobody can be in different places at the same time. Moreover, we know that the body of Christ after the resurrection became incorruptible; therefore, it cannot be broken with the teeth or daily recreated. This reasoning Berengar supports by the Bible and the church fathers.

He seems, however, to have admitted the real presence in the Eucharist, for he allowed that after the consecration the elements undergo a *conversio*, not inasmuch as they lose the *esse* that they have, but in the sense of acquiring something else, that something being the real and invisible body of Christ, which constitutes the *res sacramenti*.

The position of Berengar was not entirely new, for in the 9th century, Ratramnus (*q.v.*), a monk of Corbie, had rejected the substantial change in the elements as affirmed by Radbertus, and Eriugena had regarded the Eucharist as a memorial. As far as the church was concerned, the debates with Berengar led to a clearer exposition of the nature of the change in the sacrament, and an enrichment of the terminology applicable to Eucharistic dogma.

See A. J. Macdonald, *Berengar and the Reform of Sacramental Doctrine* (1930); D. Stone, *A History of the Doctrine of the Holy Eucharist*, vol. i, pp. 244–259 (1909).

BERENGARIO DA CARPI, JACOPO (1470–1530), Italian physician and anatomist who first described the valves of the heart, was born in Carpi, near Modena. He made other original contributions in his studies and careful descriptions of the sphenoid sinuses, vermiform appendix, uterus, brain and other organs.

Besides being a professor at Bologna (1502–22), he was a successful medical practitioner and became well-known for his treatment of syphilis with mercurial ointment. Berengario da Carpi was praised by Gabriel Fallopius (1523–62) for his contributions to the science of anatomy. He was one of the first, however, to break with tradition by illustrating medical works with drawings from nature instead of schematic drawings and arbitrary features. His works, which were illustrated with artistic drawings, include *Isgogae breves perlucidae et uberrimae in anatomiam carporis humani ad suorum scholasticorum preces editae, cum aliquot figuris anatomicis* (1514); *De fractura calvarae s. cranii* (1518); and *Commentaria . . . super antomia Mundini* (1521).

He died in Ferrara in 1530.

BÉRENGER, ALPHONSE MARIE (1785–1866), French magistrate and parliamentarian, distinguished for his role in the reform of law and of legal procedure, was born at Valence on May 31, 1785. Appointed judge in Grenoble in 1808, he had a successful career in the magistracy during the first empire. Having

been representative for Drôme during the Hundred Days, he retired to private life at the second Restoration. In 1818 he published his famous work *De la justice criminelle en France*, attacking the special courts of the Restoration and demanding the institution of trial by jury. Returning to politics, he was elected deputy for Valence in 1827 and kept this mandate for 12 years. After the July revolution of 1830 he was a member of the parliamentary commission for the trial of Charles X's ministers and secured the decision that the death penalty should not be imposed. As a member of the court of cassation from 1831, he took part in all juridical discussions, notably in the revision of the criminal code and in securing for juries the right to find extenuating circumstances in crimes. Appointed peer of France in 1839, he gave up all political activities nine years later, though he remained as counselor and then as president of one of the chambers of the court of cassation until 1860. He served as president of the high court of Bourges, judging political trials during the second republic. In his most important work, *De la répression pénale, comparaison du système pénitentiaire en France et en Angleterre* (1853), he defended his humanitarian principles in the administration of justice. He died in Paris on March 9, 1866. (JE. V.)

BERENGUER, DÁMASO (1873–1953), Spanish general, was prime minister for most of the short interval between the end of Primo de Rivera's dictatorship and the establishment of the second republic. He was born in Cuba on Aug. 4, 1873, entered the army in 1889, and fought in Cuba and north Africa, where his services secured his promotion to general in 1909. As minister of war (1918) he was so successful that in 1919 he was put in charge of the high commission in Morocco. There his capture of Xauen in 1920 gained him the title conde de Xauen, but he was involved in the Anual disaster (1921) and was court-martialed and placed on the reserve list (June 1924). Less than a month later he was amnestied and in 1926 Alfonso XIII appointed him head of his military household. The king nominated Berenguer to succeed Primo de Rivera on Jan. 28, 1930, his intention being that the new government should prepare for a return to constitutional rule on the one hand, while safeguarding the interests of the monarchy on the other. These aims quickly proved incompatible; the country became increasingly politically unstable and a military rising took place at Jaca in Dec. 1930. Berenguer resigned on Feb. 14, 1931. After being minister of war in the short-lived government of his successor, Admiral J. B. Aznar, he was imprisoned during most of the existence of the second republic. In 1946 he published a defense of his administration: *Crisis del reinado de Alfonso XIII. De la Dictadura a la República.* He died in Madrid on May 19, 1953.

BERENICE (BERNICE), the Macedonian form of the Greek *Pherenice* ("bearer of victory"), the name (1) of several princesses of the Ptolemaic house (*see* PTOLEMIES) and (2) of two Jewish princesses of the Idumean dynasty.

Ptolemies.—Four of the Ptolemaic princesses of the name deserve mention.

BERENICE (fl. late 4th century B.C.), possibly a relation of Antipater (*q.v.*), went to Egypt about 321 B.C. as a lady-in-waiting to Antipater's daughter Eurydice, the bride of Ptolemy I, son of Lagus, who later made himself king in Egypt. Supplanting Eurydice, she married Ptolemy in 316 and bore him a daughter, Arsinoë (*q.v.*), and a son, Ptolemy II Philadelphus, who obtained the succession over the heads of Eurydice's children. By an earlier marriage she was the mother of Magas, king of Cyrene.

BERENICE (d. 246 B.C.), daughter of Ptolemy II Philadelphus and Arsinoë I, was married *c.* 252 B.C., in furtherance of a political agreement, to the Seleucid king Antiochus II Theos, who repudiated his former wife Laodice and her descendants in favour of the new queen. In the civil war that broke out within the Seleucid realm after the deaths of Antiochus II and Ptolemy II she and her infant son were put to death by Laodice's party (246) before Ptolemy III could come to their assistance.

BERENICE (d. 221 B.C.), daughter of Magas of Cyrene and so a granddaughter of the first Berenice (*see* above), brought Cyrene back to its alliance with Egypt by marrying Ptolemy III (247). When her husband undertook an expedition to Syria to rescue his sister (the second Berenice, above), his consort dedicated a lock of her hair in a temple of Aphrodite for his safe return. The hair having disappeared from its place, the astronomer Conon of Samos explained that it had been placed among the stars, and the name Coma Berenices ("hair of Berenice") was then given to the constellation still known by this name. The leading poet of the day, Callimachus of Cyrene, wrote a poem on this subject, which was translated into Latin two centuries later by Catullus. On the accession of her son Ptolemy IV, Berenice was poisoned on the orders of the courtier Sosibius, presumably with the king's connivance (221).

BERENICE (d. 55 B.C.) was the eldest daughter of Ptolemy Auletes and the elder sister of the famous Cleopatra. In 58 B.C. the people of Alexandria recognized her as queen during her father's absence in Rome. In 56 she married Archelaus, a Cappadocian prince, and the two ruled as sovereigns until the following year, when a Roman army under the proconsul of Syria, Aulus Gabinius, restored her father to the throne. Berenice was thereupon put to death by her father.

Idumeans.—BERENICE (fl. late 1st century B.C.), the daughter of Herod I's sister Salome, was married first (*c.* 17 B.C.) to her cousin Aristobulus, the son of Herod and Mariamne. She bore him three sons, Herod of Chalcis, Herod Agrippa I (*q.v.*) and Aristobulus, and two daughters, Herodias and Mariamne. She later married Theudion, brother of Herod I's wife Doris.

BERENICE (*c.* A.D. 28–after A.D. 79) was the eldest daughter of Herod Agrippa I. After the death of her second husband, Herod of Chalcis, in 48 she lived for several years—save for an interval of short-lived marriage with Polemo of Cilicia—in the house of her brother Herod Agrippa II (*q.v.*). Scandal spoke of an incestuous relationship. They were seen frequently together in public; *e.g.*, at Caesarea Palestinae, when they greeted the new procurator of Judaea, Porcius Festus. On that occasion she sat on the tribunal before which St. Paul appeared (*c.* 60). In 66 Berenice and her brother tried in vain to check the impending Jewish rebellion; during the rebellion they remained loyal to Rome. In 69, on her own initiative, Berenice pledged the support of her brother's kingdom to the Roman emperor Vespasian. Although she was about 12 years his senior, Titus, Vespasian's elder son, fell deeply in love with her, and she became his mistress. In 75 she visited Rome with her brother. It was believed that Titus wished to marry her, but public anger at the prospect became so strong that he sent her out of Italy. (R. H. SI.)

BERENSON, BERNARD (1865–1959), U.S. art critic, whose writings, particularly those on Italian renaissance art, are at once popular and authoritative, was born in Vilna, Lithuania, on June 26, 1865. He was raised in Boston, Mass., and was educated at Harvard university, graduating in 1887. His first book, *The Venetian Painters of the Renaissance*, was published in 1894. A discriminating eye, an exceptional memory, perceptive intelligence and humanistic learning were brought to focus in his writings in a lucid, concise style. For a time he was an adviser to Lord Duveen and his opinion was often sought in the purchase of paintings. Many masterpieces now in U.S. museums were bought upon his recommendation. Although he retained his U.S. citizenship, he was a resident of Italy during most of his life. He passed World War II in sequestration in Tuscany, and his diary of this period, *Rumor and Reflection* was published in 1952. He died on Oct. 6, 1959, at his villa, I Tatti, at Settignano, near Florence. He bequeathed the villa, with its distinguished art collection and magnificent library (his proudest creation) to Harvard university, and it is administered as a Center for Italian Renaissance Culture. Among his major works are *Aesthetics and History, Drawings of the Florentine Painters* and the monumental *The Italian Painters of the Renaissance.*

See W. Mostyn-Owen, *Bibliografia di Bernard Berenson* (1955).

BERESFORD, CHARLES WILLIAM DE LA POER BERESFORD, 1ST BARON (1846–1919), British admiral, who was one of the best known sailors and most popular figures of his time, was born at Philipstown, King's county, on Feb. 10, 1846, the second son of the 4th marquess of Waterford.

Lord Charles, as he was generally known, entered the navy

in 1859 and had a distinguished career, his commands including the royal yacht "Osborne." At the bombardment of Alexandria (1882) he took the gunboat "Condor" close inshore, silenced the guns of Ft. Marabout, then landed to restore order in the town. For this service he was promoted captain. Two years later he commanded the naval brigade in Lord Wolseley's expedition for the relief of Khartoum, taking part in the battles of Abu Klea and Metemma. Promoted to flag rank in 1897, he commanded the Channel squadron (1903–05), Mediterranean fleet (1905–07) and Channel fleet (1907–09), becoming a full admiral in 1906. He retired in 1909.

His political career as a member of parliament ran parallel with his naval career, and while on half pay he devoted himself to arousing public interest in the development of sea power. He was Conservative M.P. for Waterford (1874–89), East Marylebone (1885–89), York (1897–1900), Woolwich (1902–03), and finally for Portsmouth (1910–16), then went to the house of lords as Baron Beresford, of Metemmeh and Curraghmore (Jan. 1916). He was made 4th sea lord in 1886, but resigned in Jan. 1888 as a protest against the government's naval program which he thought was inadequate. His criticisms however enlisted a large measure of public support for the Naval Defence act of 1889.

While commander in chief of the principal fleets, he was often in disagreement with the reforms and autocratic methods of Sir John Fisher (afterward Lord Fisher), the 1st sea lord, and as soon as he hauled down his flag attacked the whole policy of the admiralty in a letter to the prime minister who put it before a cabinet committee. Its report mainly supported the admiralty, but some of Beresford's recommendations were implemented later, notably the introduction of a naval general staff. The broad view he took of naval problems is apparent in his book *The Betrayal* (1912) and his *Memories* (1914).

Beresford died suddenly on a visit to Scotland on Sept. 6, 1919, and his peerage became extinct. (W. S. Ch.)

BERESFORD, JOHN (1738–1805), Irish statesman, who was a leader of the party which wanted to preserve the political monopoly of the Protestant aristocracy in Ireland, was born in Dublin on March 14, 1738, son of Sir Marcus Beresford (afterward earl of Tyrone) and of Catherine, Baroness de la Poer in her own right. John Beresford was educated at Trinity college, Dublin, studied law as a preparation for a political career and entered the Irish parliament in 1761 as member for Waterford, remaining its representative throughout his career. He was made a privy councilor in 1768, and was appointed a commissioner of revenue in 1770, becoming first commissioner in 1780. He had considerable administrative ability and introduced useful reforms in the machinery of taxation. He was also the author of several architectural improvements in Dublin including the new custom house by James Gandon. He was made a member of the English privy council in 1786. Beresford had become the head of one of the powerful Irish political groups. He controlled a vast patronage, and used it to increase his family influence, until the Beresford connection gained a dominant position in Irish politics. Beresford himself was even once described as "king of Ireland." He was a supporter of William Pitt, favouring Pitt's proposed commercial treaty of 1784; it was over this issue that he first came into conflict with Henry Grattan and the reformers, because they thought the propositions did not go far enough in giving Ireland commercial independence.

The English government was inclined to a policy of concession, hoping in particular that by extending political liberties to Roman Catholics, they would widen and strengthen the aristocratic support of their government in Ireland. Beresford used his considerable influence to resist reform, in order to preserve the power of his class of Protestant landowners. Earl Fitzwilliam was appointed viceroy in 1795 and, determined to carry out a policy of conciliation, dismissed Beresford from office, although his pay was continued and all the office holders in his family retained their positions. Fitzwilliam thought he had Pitt's support for his action, but Beresford's influence was so great that he was instrumental in securing Fitzwilliam's recall (March 1795), and was reinstated under Earl Camden (*q.v.*), Fitzwilliam's successor. A policy of repression was begun which had Beresford's full approval. He also approved Pitt's proposal for union, and was closely involved in planning the details of the fiscal and financial relations between England and Ireland. After the Act of Union he continued to represent Waterford in the imperial parliament, and remained in office until 1802. He died near Londonderry on Nov. 5, 1805. *See* Ireland: *History.*

See W. Beresford (ed.), *Correspondence of the Right Hon. John Beresford* (1854).

BERESFORD, WILLIAM CARR BERESFORD, Viscount (1768–1854), British general and Portuguese marshal, who served in the French Revolution and the Napoleonic Wars and won his greatest distinction in the Peninsular War (*q.v.*). He was born on Oct. 2, 1768, and entered the army in 1785, distinguishing himself at Toulon (1793) and commanding the 88th Connaught rangers from 1795. He served under Sir David Baird in the expeditions to Egypt (1801) and to the Cape of Good Hope (1806), and Baird allowed him to sail from South Africa on Sir Home Popham's squadron as brigadier general commanding 1,200 troops in an unauthorized raid on the Spanish colonial city of Buenos Aires (Spain at that time being an ally of France). Beresford captured the town easily, but local forces compelled him to capitulate after hard fighting on Aug. 12, 1806, and imprisoned him for six months. He escaped and at the end of 1807 was sent to occupy and govern Madeira in the name of the king of Portugal. On recall to the British army in Portugal, he was commandant at Lisbon, but marched with Sir John Moore to Spain and was conspicuous at Corunna. In Feb. 1809 Sir Arthur Wellesley (later duke of Wellington) chose Beresford for the reorganization of the Portuguese army, in which he was given the rank of marshal. In the spring of 1811 Gen. R. Hill's illness obliged Wellington to give Beresford, as next in seniority, the command of his detached corps in southern Portugal and Estremadura. Beresford moved to invest Badajoz, met the French relieving army at La Albuera (May 16) and won a victory costly to both sides. He resumed command of the Portuguese, was at the siege of Badajoz and was wounded at Salamanca. For the rest of the war he was a corps commander. In 1814 he was created Baron Beresford of Albuera and Cappoquin. He remained in Portuguese service until the dismissal of the British officers in 1819. In 1823 he was created a viscount. In Wellington's first cabinet in 1828 he was master general of the ordnance. He retired in 1830, lived at Bedgebury, Kent, and died on Jan. 8, 1854. (I. D. E.)

BEREZINA, a tributary of the Dnieper in the Belorussian Soviet Socialist Republic, U.S.S.R., rises near the town of Dokshitsy and flows in a fairly constant south-southeasterly direction to its outfall a few miles above Rechitsa. It is 365 mi. long. Its drainage basin, covering 9,471 sq.mi., is largely level swamp, through which the Berezina and its tributaries, notably the Svisloch, slowly meander. The average discharge is 4,662 cu.ft. per second. The Berezina canal (built 1798–1805), which once linked the river to the Ulla, a headstream of the Western Dvina, has been abandoned. The Berezina itself is navigable only for small craft and rafts of timber. The major towns on the river are Bobruisk and Borisov (*qq.v.*). Near the latter Napoleon forced a crossing of the river, with heavy casualties, during his retreat from Moscow in 1812. (R. A. F.)

BEREZNIKI, a town of Perm *oblast* of the Russian Soviet Federated Socialist Republic, U.S.S.R., lies opposite Usolye (with which it was temporarily incorporated 1932–40) on the left bank of the upper Kama river, above its confluence with the Yayva. From a pre-revolutionary mining settlement Berezniki has grown rapidly to a town of 106,000 inhabitants (1959), on the basis of its large chemical industry. The town lies in the Solikamsk-Berezniki salt and potassium mining area and there is a potassium mine in the town. Nitrate fertilizers, nitric and sulfuric acids, paint and aniline dyes and medicines are produced. There are also soda and magnesium works. Berezniki is linked by rail to Solikamsk and Chusovoi and by road to Perm. (R. A. F.)

BERG, ALBAN (1885–1935), Austrian composer best-known for his opera *Wozzeck,* was born in Vienna, Feb. 9, 1885. A pupil of Arnold Schönberg (1904–10), he continued his associa-

tion with him, and with his fellow pupil, Anton Webern, in the revolutionary "second Viennese school." His works are significant in relating the more radical aspects of Schönberg's methods of composition to tradition: he transmuted Schönberg's "atonal" style of free dissonance into a more conventional harmonic idiom. Later, after 1925, he demonstrated the potentialities of the 12-note technique as an expansion of traditional methods. Berg's musical idiom is less abstruse than that of Schönberg and Webern, and, as his music is also deeply expressive and intensely human, possessing powerful dramatic and lyrical qualities, it is pre-eminently his art that has given validity to the work of the Viennese school.

Berg worked slowly, but, though his compositions are few, each is of great significance. His first opera, *Wozzeck* (1917–21; Berlin, Dec. 14, 1925), is a powerful expressionist work, remarkable for its imposition of highly organized classical forms on the dramatic structure without impeding its flow. His *Lyric Suite* for string quartet (1925–26) was his first work to use the 12-note technique, but he dealt with the new medium so successfully that it remains one of the most intensely emotional chamber works of the century. His unfinished second opera *Lulu* (Zürich, 1937) and the expressive violin concerto (1935) revealed the great possibilities in the association of the 12-note technique with traditional harmonic and melodic elements, and decisively demonstrated the true classical lineage of 12-note music. Other compositions include the *Fünf Orchesterlieder,* Opus 4 (1911–12); *Drei Orchesterstücke,* Opus 6 (1913–14); the *Kammerkonzert* (1923–25); and *Der Wein,* for soprano and orchestra (1929).

Berg seldom left Vienna. A sufferer from asthma, he lived humbly, mainly by teaching composition. He died, of blood-poisoning, in Vienna, Dec. 24, 1935. (R. S. Br.)

BERG, former duchy of the German empire, on the right bank of the Rhine, now in the administrative districts of Düsseldorf and Cologne, Germany. In the mid-11th century the counts of Berg administered the imperial abbey of Werden, but by 1133, when the family founded the Cistercian abbey of Altenberg at their ancestral seat they had acquired comital rights and lands east of Cologne and in western and southern Westphalia. In 1161 the family lands were divided between the senior line of Berg and the junior line of Altena (later Mark). The Berg line, which had provided the see of Cologne with three archbishops and had been closely allied to the Hohenstaufen emperors, died out with the murder of Engelbert, archbishop of Cologne, in 1225, the title passing by marriage to the house of Limburg. Adolf V, who in 1283 surrendered his claims to Limburg to John of Brabant, began in 1288 to develop Düsseldorf, later the capital of Berg, as a port. In 1348 Berg passed to Gerhard VI (d. 1360), of the house of Jülich, who had married Margaret, heiress to Berg and also to Ravensberg. In 1380 Gerhard's son William received the ducal title and in 1423 the duke Adolf inherited Jülich and Gelders. In 1511 Jülich-Berg passed by marriage to the dukes of Cleves-Mark. In 1609 the succession fell vacant (*see* Jülich) and a European crisis ensued, but in 1610 the duchies passed to the counts palatine of Neuburg. Berg, famous for iron manufacture, then developed an important textile industry. In 1806 Napoleon created an enlarged grand duchy of Berg for his brother-in-law Joachim Murat, but in 1815 the congress of Vienna granted Berg to Prussia. (H. W. D.)

BERGAMASCA (Bergomask), a lusty 16th-century dance depicting the reputedly awkward manners of the natives of Bergamo in northern Italy. It never became a court dance but had some popularity as an instrumental composition, built on a ground base, in lively 2/2 time. The pastoral *bergamasque* of 19th-century France bears no likeness to the true *bergamasca.* Claude Debussy's *Suite Bergamasque* and Gabriel Fauré's *Masques et Bergamasques* were inspired by Verlaine's poem, *Clair de Lune.* (L. Ht.)

BERGAMO, a city of northern Italy in the region of Lombardy and capital of Bergamo province, is situated on the southern fringe of the Alpine foothills between the valleys of the Brembo and Serio, 30 mi. N.E. of Milan by road. Pop. (1961) 119,323 (commune). The old part of the city (Città Alta), on a hill (1,201 ft.), was fortified by the Venetians in the 15th century and retains a medieval atmosphere. The cathedral was rebuilt in 1483 and 1689; the façade dates from 1886. Beside it is the Romanesque church of Santa Maria Maggiore (1137–1355) with a baroque interior. The neighbouring Renaissance Cappella Colleoni by Giovanni Antonio Amadeo has a 14th-century façade with sculptures in polychrome and fine tombs; its ceiling frescos are by Giovanni Battista Tiepolo. Opposite the cathedral is the baptistery (1340, rebuilt 1898) and nearby is the Gothic Palazzo della Ragione or del Broletto, which with the 16-century Palazzo dello Scamozzi (containing a library) and a museum, surround the Piazza Vecchia, the old town's centre, where there is a memorial to Torquato Tasso, the poet, whose family lived in Bergamo. Other features include the Risorgimento museum in the Rocca (the ruins of a 14th-century castle), a park with a fine panorama, the citadel (1300) with a museum of geology and natural history, and the Donizetti museum where the musician Gaetano Donizetti (*q.v.*) was born. The lower city (Città Piana) has been the town centre since the 19th century and has a fine collection of paintings in the Palazzo dell'Accadémia Carrara. The two halves of the town are linked by a funicular. Bergamo imports the basic materials for the manufacture of textiles and woolen goods, cement, mechanical and electrical products and metal tubes.

Known as Bergomum to the Romans, the city was the centre of the Orobi tribe. It became a Roman city and after destruction by Attila was rebuilt and later became the capital of a Lombard dukedom. From 1264 it was ruled by the Visconti (*q.v.*) but passed to Venice in 1428, under which it remained until 1797. Dominated by the French from that year until 1815 and included in the Cisalpine republic, it became Austrian after the fall of Napoleon and part of the Italian kingdom in 1859. During World War II it was freed by the Allies and Italian partisans at the end of April 1945.

BERGAMOT, OIL OF: *see* Essential Oil; Perfume.

BERGDAMA, a Negro people (pop. about 30,000) inhabiting the mountainous regions of central South-West Africa. They speak a click language considered to be a dialect of Hottentot, but racially they are more like Negroes of Central and West Africa. Their origin has been the subject of much speculation, and they seem to be most closely related to the Koroka and Kwisi peoples living in Mossâmedes district of southwestern Angola. When first discovered many of the Bergdama were serfs of the Hottentots and Herero. Knowing the arts of forging iron and of making pottery, they provided iron implements and ornaments for their masters, and also served them as herdsmen.

Bergdama in the aboriginal state subsisted on wild foods, and some groups also kept goats. They were scattered in small exogamous patrilineal extended family bands, each inhabiting a relatively temporary circle of grass-covered huts enclosed by a thornbush fence. A holy fire burned in the centre of each village. The band chief, advised by his elder male kinsmen, controlled the group, and he was also its ritual leader and fire keeper. There was no larger scale political or military organization, and clan organization was lacking.

Bergdama religion included the concept of a supreme being responsible for rain and the annual renewal of plant life, but lacked a creation myth. There was belief in life after death and that sickness and death were caused by the deity or by the souls of departed men who required food. Many Bergdama have adopted Christianity. *See* Hottentot.

See H. Vedder, *Die Bergdama* (1923); H. Vedder, "The Berg Damara," in *The Native Tribes of South West Africa* (1928); H. Vedder, *South West Africa in Early Times,* trans. and ed. by C. G. Hall (1938); C. Estermann, *Etnografia do Sudoeste de Angola,* v. i (1956). (G. D. G.)

BERGEN, a city and seaport in western Norway, forming a separate county (*fylke*). Pop. (1960) 115,689; area 14 sq.mi. Picturesquely situated on the broad Byfjord, partly on a promontory between the inner harbour (Vaagen) and the Puddefjord, it is bounded landward by the Store Lungegaard inlet, and rises from the harbour in an amphitheatre of gaily painted houses. Since World War II there has been great expansion and many buildings, mostly domestic but also some industrial, have been erected in

the northern and southern sections of the town.

There are many interesting buildings: the church of St. Mary, the oldest building in Bergen, dating from the 12th century; the cathedral, rebuilt in the 13th century; the Bergenhus fortress guarding the harbour; the adjoining Haakon's Hall palace (Haakonshallen, 1261); and the restored Rosenkrantz tower. A university was inaugurated in 1948 and the town contains the Norwegian School of Economics and Business Administration. The most important museums are the Hanseatic, and the Historical, Botanical, Geological and Zoological museums attached to the university; there are also the Vestlandske museum of Applied Art and the Maritime and Fisheries museums. The art gallery contains a representative collection of European art and the valuable Rasmus Meyer collection of Norwegian paintings and interiors. A picturesque open-air museum, Old Bergen (Gamle Bergen), is situated a short distance along the fjord. On the outskirts of the town inland is the old stave church at Fantoft, and a few miles beyond is the medieval pilgrims' church at Fana, finely restored and reopened by King Haakon VII in 1953. Also of interest are the ruins of the Cistercian monastery nearby at Lyse, founded in 1146 by monks from the mother house at Fountains abbey in England. Edvard Grieg is probably the best known of Bergen's native sons. Others are Ole Bull, the violinist; J. C. Dahl, the landscape painter; and Ludvig Holberg, the dramatist.

As a port, Bergen ranks second only to Oslo and maintains regular shipping connections with Newcastle, Rotterdam, Hamburg, Antwerp and New York. The principal industries are shipbuilding, machinery, electrical equipment, office machinery, ship repairing and fitting, textiles, cod-liver oil refineries, foodstuffs, gold and silverwork, rope and fishing tackle. The chief exports are fish products and base metals.

Arterial roads connect the town with national highways and an airport at Flesland for international traffic. The railway to Oslo, opened in 1909, is both an engineering and a scenic triumph.

The settlement (formerly Björgvin), founded by King Olaf III *c.* 1070, grew rapidly and figured prominently in the medieval civil wars, being the seat of the court up to 1300. The Hanseatic league merchants established (*c.* 1350) in Bergen their most active northern "Kontor"; some of their 17th-century buildings have survived, notably the museum now housing Hanseatic relics. Disastrous fires occurred in 1702, 1855 and 1916, and since then the central part of the town has been reconstructed, with broad open spaces to guard against further fires. During the German invasion of 1940 and the five years of occupation, Bergen suffered severely from bombing and other disasters. (B. Lo.)

BERGEN OP ZOOM, a town of North Brabant province, Neth., lies on both sides of the small Zoom river, near its confluence with the East Scheldt, 62 km. (38.5 mi.) N.E. of Flushing by rail. Pop. (1957 est.) 33,855 (mun.).

It was taken by the Normans in 880. In the 13th century Count Gerhard of Wesemael surrounded it with walls and one of the gates (1300) has been preserved. In the 15th century it prospered greatly owing to the free fairs where much business was done in cloth, wool, linen and madder. These fairs were visited by English and Scottish merchants who enjoyed special privileges. In 1576 the town joined the United Netherlands and was fortified: it successfully resisted the Spaniards on several occasions, the last being in 1622. In the 18th century the fortifications were strengthened, the work being completed in 1740. In 1747 the town was taken by the French. Restored at the end of the war, it was again taken by the French in 1795 and successfully held by them against the English, who tried to drive them out in 1814. During World War II the Germans captured the town in 1940 but it was liberated by a Canadian army division in 1944.

The lordship of Bergen op Zoom dates from 1287 by separation from the lordship of Breda (*q.v.*). It was a hereditary fief of the duchy of Brabant (*q.v.*). Toward the end of the 15th century one of the lords built a small palace, the "Markiezenhof," which is preserved. In 1533 Bergen op Zoom was raised to a margraviate by Charles V and was held by various families until in 1742 it passed to the royal house of Bavaria, by whom it was renounced in favour of the Batavian republic in 1801.

The town has an important metal industry (factories for manufacturing hearths and stoves), engineering works, confectioneries and biscuit factories, as well as one of the largest distilleries in Europe. (C. St.)

BERGHAUS, HEINRICH (1797–1884), German geographer, cartographer and writer, best known as author of a world famous physical atlas, was born at Cleves on May 3, 1797. In 1816 he obtained an appointment in the trigonometrical survey of the Prussian war ministry. From 1821 to 1855 (from 1824 as professor) he taught applied geometry, cartographic drawing and machine building at the Berlin Bauakademie. He moved to Potsdam in 1836, where, in 1839, he founded a school for cartography and geography which continued until 1848 and where his most outstanding pupils were his nephew, Hermann Berghaus (1828–90), his foster son, August Petermann, and Henry Lange. He died at Stettin on Feb. 17, 1884.

His most important works are his cartographic contributions, notably the *Physikalischer Atlas* (1838–48, 1849–52, 1886–92). This was inspired by Alexander von Humboldt (*q.v.*) to illustrate his *Kosmos;* English edition by Alex Keith Johnston (with H. Lange). His written works include *Allgemeine Länder und Völkerkunde,* 6 vol. (1837–44); *Grundriss der Geographie* 5 parts (1840–43); *Die Völker des Erdballs . . .* (1847, etc.) and *Briefwechsel mit Alexander von Humboldt, 1825–58* (1863). Commissioned by B. H. Hodgson of Darjeeling he wrote a geography textbook for Hindu schools. It is uncertain if it was published.

See also H. Beck, "Heinrich Berghaus und Alexander von Humboldt" *Petermanns Geogr. Mitt.,* 100 (1956). (K. A. S.)

BERGISCH GLADBACH, a town of Germany which after partition of the nation following World War II became the capital of the Rheinisch-Bergisch *Kreis* (county) in the *Land* (state) of North Rhine-Wesphalia, formerly a part of the Prussian Rhineland (*q.v.*), Federal Republic of Germany. It is a resort city of woods and gardens in the hills to the east of the lower Rhine valley lying between 210 and 755 ft. high, 15 km. (9 mi.) E.N.E. of Cologne. Pop. (1959 est.) 39,942. There are a 12th-century Romanesque church in the Paffrath district, the once moated Blegge castle (18th century), the Zweifelsstrunden castle (17th century), the 16th-century headquarters of the Order of St. John in Herrenstrunden and a museum of fossils. The chief industry is papermaking but there is also manufacture of light and heavy machinery and electrical equipment, iron smelting, wool-spinning and the production of glass fibre and pharmaceutical products. Bergisch Gladbach attained the status of a city in 1856. In World War II it was captured by the Allies in April 1945. (Wi. O.)

BERGIUS, FRIEDRICH (1884–1949), German chemist and Nobel prize winner, was born Oct. 11, 1884, at Goldschmieden near Breslau. He studied at the universities of Breslau, Leipzig and Berlin and at the technical schools in Karlsruhe and Hanover. Later he founded a private technical research laboratory in Hanover and studied the influence of high pressure on chemical actions. This is described in his book *The Use of High Pressure in Chemical Actions* (1913). These studies led to his work on the conversion of coal into liquid products. Through the action of hydrogen under high pressure and at high temperature, he succeeded in converting a high percentage of coal dust directly into oil, without first obtaining intermediate products. Bergius was awarded the Nobel prize for chemistry, 1931, with Carl Bosch. He died March 30, 1949, in Buenos Aires, Arg.

BERGMAN, BO HJALMAR (1869–), Swedish lyrical poet, whose early work, with its simple rhythms and clear-cut style, contrasted strongly with the rich romanticism of the 1890s, was born in Stockholm on Oct. 6, 1869. His first collection of poems, *Marionetterna* (1903), expresses a *fin de siècle* pessimism and disillusionment. Bergman became reconciled to life, however, and during an age of war and political unrest he wrote as the champion of reason, humanity and truth. Other collections include *Elden* (1917), *Livets ögon* (1922), *Trots allt* (1931), *Gamla gudar* (1939) and *Riket* (1944). He also wrote novels and short stories. (L. G. G. T.)

BERGMAN, HJALMAR FREDRIK ELGÉRUS (1883–1931), Swedish novelist, dramatist and short-story writer, one of

the outstanding figures in Swedish literature of his generation, was born at Örebro on Nov. 19, 1883. The son of a wealthy banker, he was brought up in conventional middle-class ease, and no notice was taken of his extreme sensibility and imaginative powers. In his early teens his father, who had hitherto despised him, became aware of his precocious talents, and the shy, awkward, but observant boy became the object of an overpowering and domineering affection. At this period he accompanied his father on business trips in Bergslagen, the mining district outside Örebro, which was to form the background of many of his books. To these various factors in his early life can be traced much of his later development.

During 1900–01 Bergman studied at Uppsala university, under the eminent philosopher Hans Larsson, with whom he was to maintain permanent contact. He read much philosophy, which, with psychology and aesthetics, was to remain an abiding interest. From 1901 to 1908 he traveled in Europe, especially in Italy: Florence became his favourite city. Delicate nerves and the threat of blindness made his life difficult. In 1908 he married Stina, the daughter of the actor-producer August Lindberg, and she became his defense against the world. They settled first in Lindesberg, then for a time in Rome. For the rest of his life, except during World War I, Bergman led a restless and curiously isolated existence between Sweden and other parts of Europe.

His first play, *Maria, Jesu moder* (1905), owes much to the literary ideas of the 1890s, but shows an original approach to the psychology of Christ and the Virgin Mary. Other plays from this apprentice stage of his career reveal the influence of Ibsen. Bergman preferred the drama to any other medium, and if he had not been so discouraged by his experience of the Swedish theatre, would have written more plays. Turning to the writing of fiction, however, he applied to it his dramatic gifts and technique, and so achieved work of great individuality. In 1910 came his first popular success *Hans Nåds testamente* ("His Grace's Will"), set in Bergslagen, in which the eccentric Baron Roger and his valet Vickberg figure in richly comic scenes. Characteristically, however, as in later works, beneath the humour there are undertones of tragedy. In the same year he published a collection of short stories *Amourer*, mostly set in Italy, in which he displayed his mastery of this medium and his subtle understanding of the irrational as a decisive factor in human behaviour. Bergman went on to produce a series of novels and long short-stories, starting with *Vi Bookar, Krokar och Rothar* (1912) and ending with *En döds memoarer* (1918). These were mainly concerned with Bergslagen, from early times to the present day, and with the fortunes and complicated feuds of certain families and characters which constantly recur. His amazing memory and powers of observation enabled Bergman to create out of his own experiences, and out of oral traditions, a grotesque, fantastic, sombre and yet moving world which was peculiarly his own, despite its real-life setting. His work was appreciated by a small but discriminating public, but his experimental *Marionettspel* (1917; "Marionette Plays") was a failure, and his father's death in 1915 had made him increasingly dependent on his pen for a livelihood. With *Markurells i Wadköping* (1919; Eng. trans. by E. Classen, *God's Orchid*, 1924) he at last captured the wider public. This vigorous comic novel, the action of which takes place—with numerous recapitulations—within 24 hours, is the story of the grotesque innkeeper Markurell, who through his financial machinations has got most of the inhabitants of the town of Wadköping in his power, but, for love of his adopted son Johan, whose real father proves to be his chief enemy, shows mercy. Although the novel is written ironically, there are tragic implications.

Bergman followed this with other successes, including *Farmor och Vår Herre* (1921; Eng. trans. by C. Napier, *Thy Rod and Thy Staff*, 1937) and *Chefen Fru Ingeborg* (1924; Eng. trans. by E. Sprigge and C. Napier, *The Head of the Firm*, 1936). His play *Swedenhielms* (1925) is among the few living Swedish comedies and his dramatization of *Markurells* also remained popular. He also wrote radio and film scripts, and in 1923–24 visited Hollywood; he detested it. He died in Berlin, on Jan. 1, 1931.

His later novels, of which *Clownen Jac* (1930) was the last, tend to diffuseness and unnecessary twists of plot, but on the whole Bergman remained a remarkable stylist. Fundamentally a pessimist, he felt for all the weaknesses of man understanding pity irradiated by humour. Bergman's collected writings were edited by J. Edfelt in 30 volumes (1949–58).

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BERGMAN, TORBERN OLOF (1735–1784), Swedish chemist and naturalist, who introduced many improvements in methods of chemical analysis and made considerable contributions to mineralogical and geological chemistry and to crystallography. Born at Katrineberg, Vestergötland, on March 20, 1735, he was educated at the University of Uppsala. After taking his degree, he began to teach mathematics and physics at the university, publishing papers on the rainbow, the aurora, the pyroelectric phenomena of tourmaline, etc. In 1767 he became professor of chemistry and mineralogy. He died at Medevi on Lake Vetter on July 8, 1784. Bergman's most important chemical paper is his *Essay of Elective Attractions* (1775), a study of chemical affinity. He also made observations of the transit of Venus in 1761, and published a *Physical Description of the Earth* in 1766.

BERGMANN, ERNST VON (1836–1907), German surgeon of Russian birth, one of the greatest surgeons of his time, was born at Riga on Dec. 16, 1836. He was educated at Dorpat, where he was professor of surgery from 1871 to 1878. In the latter year he moved to the University of Würzburg and in 1882 he succeeded B. von Langenbeck at Berlin. In 1886 Bergmann introduced steam sterilization and in 1891 began to use aseptic methods. He also improved the design of operating rooms. His principal contributions are in cranial surgery, on which his work *Die chirurgische Behandlung der Hirnkrankheiten* (1888) is a classic. Bergmann died at Wiesbaden on March 25, 1907.

BERGSCHRUND (Ger. *Berg*, "mountain"; *Schrund*, "cleft" or "crevice"), a gaping crack in the upper part of a snow field or a glacier, beneath which sapping and erosion commonly produce a semicircular landform called a cirque (*q.v.*).

BERGSON, HENRI (1859–1941), one of the most influential philosophers of his time, was born in Paris, of Irish-Jewish parents, on Oct. 18, 1859. Having been naturalized as a French subject he entered the École Normale Supérieure (where Jean Jaurès was his contemporary) in 1878. After teaching philosophy in the *lycées* of Angers (1881–83) and Clermont-Ferrand (1883–88) and then at the Collège Rollin and at the Lycée Henry IV in Paris (1889–98), he received an appointment at the École Normale Supérieure, from which he went to the Collège de France as professor of philosophy in 1900. Elected to succeed Émile Ollivier in the Académie Française in 1914, he delayed his reception till 1918, serving on French diplomatic missions to Spain and to the United States during World War I. His connection with international affairs was maintained after the war when he became president of the League of Nations' committee on intellectual co-operation. He was awarded the Nobel prize for literature (1927) in 1928. Bergson died in Paris on Jan. 4, 1941. Before his death an increasing sympathy toward Roman Catholicism had been apparent in Bergson; and the fact that he did not publicly declare himself converted is attributed to a desire not to dissociate himself from the Jews during the period of persecution.

Bergson's Philosophy.—The progressive development of Bergson's thought is reflected in the series of books which won him his world-wide reputation. He was not the creator of a great system conceived as a whole in youth and gradually expressed in later life. There is, nevertheless, in his philosophy one outstanding idea which is said to have come to him during a walk at Clermont-Ferrand when he was 25 years old. Whereas, since Plato, philosophy had consisted in eliminating duration, in regarding time as an illusion and finite being and eternity as one, Bergson asked himself whether, on the contrary, the being of which the philosopher took

cognizance by reflection might not be one which endured, might not be time itself. For the phrase of Descartes, *Je suis une chose qui pense* ("I am a thing which thinks"), he substituted *Je suis une chose qui dure* ("I am a thing which continues"); and whereas Spinoza had presented reality *sub specie aeternitatis* ("in its eternal aspect"), Bergson presented it *sub specie durationis* ("in its durational aspect"). As he substituted durational for nontemporal values, so for static values he substituted values of motion and change. This was the Bergsonian revolution, which may be related to the German and English historical and evolutionist philosophies characteristic of the 19th century.

All Bergson's work is thus concerned with duration and movement. He does not proceed by general speculation. Each of his books is a study of one particular question, and this illustrates his second characteristic, originality of method. In his opinion, philosophy, like science, can only progress by disregarding general theories and universal systems so as to concentrate on particular problems, each of which demands its own point of view. The solution of any one of these does not necessarily involve an analogous solution of the others. Bergsonism implies continued striving after a precise adaptation to reality. The aim of each of his works is the elucidation of a detailed problem, though each is also part of a general philosophy, the philosophy of duration and change. For him, the true nature of things is apprehended by intuition; but those who see in Bergsonism nothing but an apotheosis of intuition and of mystical values and a depreciation of intelligence misunderstand his theories.

The *Essai sur les données immédiates de la conscience* (1889; Eng. trans., *Time and Free Will*, 1910), which was Bergson's thesis for the doctorate, constitutes an attempt, primarily, to establish his notion of *durée* (duration) as opposed to what he considered to be the spatialized conception of time employed for scientific and public purposes; and then to proceed toward an original solution of the problem of free will. *Matière et mémoire* (1896; Eng. trans., *Matter and Memory*, 1911) contains a detailed consideration of the problem of aphasia, leading to a profound study of the means, namely the memory, by which existence is made continuous. In *L'Évolution créatrice* (1907; Eng. trans., *Creative Evolution*, 1911) he studies the whole problem of existence. While Spencer merely supported evolution by evidence derived from fragments of the evolved, Bergson takes as his material the essential motion of the being changing, or rather the being which is itself both change and movement. This is his most famous and influential work and the one which most fully expresses his ideas as to the secret of the universe.

An important part of Bergson's philosophy is to be found in his minor works, such as the essay *Le Rire* (1900; Eng. trans., *Laughter*, 1911), his lectures at Oxford entitled *La Perception du changement* (1911) and the volume *Durée et simultanéité* (1922), in which he discusses Einstein's theories. His later publications are the articles collected under the title *L'Énergie spirituelle* (1919); *Les Deux Sources de la morale et de la religion* (1932; Eng. trans., *The Two Sources of Morality and Religion*, 1935); and *La Pensée et le mouvant* (1934).

Bergson's influence on Marcel Proust makes his philosophy important for 20th-century literature. His lectures at the Collège de France enjoyed great popularity; but it was probably as a master at the Lycée Henri IV that his influence was most felt.

See also Index references under "Bergson, Henri" in the Index volume.

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BERHAMPUR, a town in the district of Ganjam (*q.v.*), Orissa, India, 103 mi. S.W. of Cuttack and 9 mi. from the Bay of Bengal. Pop. (1961) 77,147. Berhampur is the headquarters of two administrative subdivisions of Ganjam district. It is the seat of Khallkiote college (1878), a coeducational institution affiliated to Utkal university. There are also a women's college, an engineering school and a teachers' training school. The town is on the Calcutta-Madras national highway and the South-eastern railway main line between Calcutta (Howrah) and Madras. It is also a road transport and commodity distribution centre for the hinterland. (MA. M.; N. K. S.)

BERHAMPUR TOWN, headquarters of the district of Murshidabad in West Bengal, India, lies on the east bank of the Bhagirathi river, 117 mi. N. of Calcutta, and is linked with the city by rail and a national highway. Pop. (1961) 62,452. A large oxbow lake occurs in the heart of the town. Silk weaving, ivory carving, gold and silverworks, and brass and bell metalworks are the chief industries. The town was founded and fortified in the mid-18th century by the East India company and continued as a cantonment until 1870. The old military barracks still stand on the bank of the Bhagirathi. Near the barracks are the old cemetery with 18th-century historical monuments, and the imposing Krishnath college. There are two other colleges, all affiliated to Calcutta university.

Cossimbazar, now merely an industrial suburb of Berhampur, is much older. Its proximity to Murshidabad, then capital of Bengal, attracted European traders in the 17th century. In those days Cossimbazar had a flourishing silk industry, and its products were exported. The English factory founded in 1658 with John Ken as its chief prospered until its capture by Nawab Siraj-ud-daula in 1757. Even after the nawab's defeat at Plassey, Cossimbazar could not fully regain its commercial importance, and it declined early in the 19th century, mainly because of the westward shifting of the Bharirathi river. The palace of the maharaja of Cossimbazar contains fine carved stone pillars. (S. P. C.)

BERIA (BERIYA), **LAVRENTI PAVLOVICH** (1899–1953), Soviet statesman who from 1938 to 1953 played an active part in the persecution of opponents to Stalin's regime, was born on March 29, 1899, at Merkheuli in the Sukhumi district of Georgia. According to his official biography he came of "poor peasant" stock, but he succeeded in obtaining an education at the local high school and at the higher technical college in Baku (1919). He joined the Communist party in 1917 and engaged in revolutionary activity among the workers of Azerbaijan and Georgia and in the armed forces. In 1921 he was drawn into intelligence and counterintelligence work, a profession in which he remained all his life. He was appointed to the political leadership of the Transcaucasian republics in 1931 and was responsible for their integration into the Soviet Union. After the political purges and show trials of the 1930s came to an end, Stalin summoned Beria to Moscow and in Dec. 1938 made him commissar for internal affairs in place of N. I. Yezhov. Beria, who had had Yezhov shot, retained this position and the supervision of the internal security organization longer than any of his predecessors. He was made a deputy prime minister of the U.S.S.R. in Feb. 1941 and was a member of the State Defense committee during World War II. Apart from being responsible for supervising the internal security of the Soviet Union during the war, Beria played an important role in armaments production, for which he was in 1945 made a marshal of the U.S.S.R.

Beria was a member of the central committee of the Communist party from 1934 and of the politburo (later presidium) from 1946. On Stalin's death in March 1953 he became one of the four deputy prime ministers and minister for internal affairs. He was one of the three leaders, with G. M. Malenkov and V. M. Molotov, to pronounce an oration at Stalin's funeral. He did not retain his high position long, for on July 10, 1953, it was announced that he had been divested of all his posts in government and party on account of "criminal anti-party and anti-State activities" and had been arrested. The truth behind the many farfetched accusations made against him appeared to be that he had tried to make his security organization the only instrument of political power, and to establish his own personal dictatorship. His trial did not take place until the end of 1953, and it was announced on Dec. 23 that he and a group of high security officials had been convicted of high treason and executed that day. (D. FD.)

BERIBERI is a disease caused, in large part, by a specific dietary deficiency of thiamine (vitamin B_1). It occurs most frequently in parts of the world where unbalanced diets are prevalent. The highest incidence has been in Asia where, from the 19th cen-

tury, rice has been highly polished during the milling process. The Asiatic importance of this disease is emphasized by its name, for the term beriberi is derived from the Singhalese word meaning extreme weakness. The history of the recognition, the cause and the cure of beriberi is dramatic and is well-documented in medical literature. In 1897 Christiaan Eijkman, working in the Netherlands Indies, demonstrated that a beriberi-like disease could be produced in chickens by a diet consisting of polished rice. That beriberi in man was also related to the ingestion of white rice was confirmed by British workers in the Malay states. There W. Fletcher in 1907 and Henry Fraser and A. T. Stanton in 1909 showed that in selected groups under close observation beriberi occurred in persons who were eating a polished rice diet whereas those eating parboiled or brown rice did not develop the disease.

In 1911, Casimir Funk demonstrated that beriberi could be cured in pigeons by feeding them a concentrate made from rice polishings. Following this discovery he proposed that this, as well as several other conditions, were due to the ingestion of diets which were deficient in specific factors which he termed "vitamines."

Later the implicated substance was isolated and its chemical structure determined. The official terminology in the *Pharmacopoea Internationalis* became *Thiamini hydrochloridum* with the synonym *Aneurini hydrochloridum*. In common parlance it is often referred to as vitamin B_1.

Beriberi has been divided into several types. The infantile form occurs in the first few months of life and is characterized by an acute onset with involvement of the heart and gastrointestinal system. The outcome is fatal unless actively treated with thiamine. It is often associated with active or latent beriberi in the nursing mother. The adult form is usually slow in onset and more chronic in its course. The symptoms are associated with the nervous and cardiovascular systems. In the neuritic or dry type there is symmetrical, ascending neuritis. At first, this causes weakness of the muscles of the legs, which leads to difficulty in walking. Later, there is also involvement of the arms. As the disease progresses, severe pain may be induced by minor stimuli, such as the weight of the sheets upon a bedridden patient. More acute than these manifestations are those connected with cardiac or wet beriberi. Here there is heart failure with the concomitant development of edema; *i.e.*, the collection of fluid in dependent parts—abdomen, thorax, etc. The heart failure may lead to sudden death unless therapy is vigorously instituted and maintained. According to D. T. Rowlands and C. F. Vilter, there are no pathological changes in the myocardium in patients with beriberi heart disease. They believe that there is a reversible biochemical lesion.

The prevention of beriberi is accomplished by eating a well-balanced diet since thiamine is present in most raw and untreated foods. The highest content is found in whole cereals, pork, yeast, peas, beans and other vegetables. Thiamine is affected by excess heat, both intensity and duration of heat causing inactivation. Excess alkali will also lead to a degradation of thiamine. Ordinary cooking, canning, freezing and dehydration of food do not cause an excessive loss of thiamine. Although thiamine is found in almost all of the tissues of the body, it is not stored in great excess. In studies by P. T. McCarthy, L. R. Cerecedo and E. V. Brown in 1954, it was noted that the highest concentrations were found in muscle, testes, kidneys, liver, heart and brain. It was also determined that 64% of thiamine that was injected intramuscularly was excreted in ten days. Because of the relatively rapid excretion and the lack of stored reserves, beriberi may occur fairly soon after a diet deficient in thiamine is begun.

Thiamine is intimately associated with the utilization of carbohydrates. It is essential for the breakdown of pyruvic acid. This being the case, the daily requirement of thiamine is dependent upon the type of diet. If the diet is rich in carbohydrates the requirement will be greater. On the other hand, if the diet contains a large proportion of fat, the requirement will be less.

The treatment of beriberi should not consist only of replacement therapy of thiamine since isolated deficiency is rarely present. Supplements of the other members of the vitamin B complex (*i.e.*, riboflavin, nicotinic acid, etc.) as well as the other vitamins should be given.

See RICE: *Preparation of Rice;* VITAMINS: *Thiamine (Vitamin B_1).*

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(R. G. PE.)

BERING, VITUS JONASSEN (1681–1741), Danish-Russian explorer who pioneered Russian arctic exploration and discovered Bering strait and Alaska, was born at Horsens, Jutland, in 1681. He went to sea, and, after a voyage to the East Indies, made the acquaintance of the Norwegian-Russian Admiral G. Cruys and joined the fleet of Peter the Great as sublieutenant. In 1724 the tsar appointed him to lead the First Kamchatkan expedition, whose main task was to determine whether Asia and America were connected by land. Having built a ship near the mouth of the Kamchatka river in Siberia, he sailed with a crew of 44 on July 13, 1728. He reached 67° 18′ N. in about 167° W. and decided that the two continents were not joined. Returning, he saw and named the Diomede Islands in the middle of the strait, but did not sight the American coast.

In St. Petersburg Bering's observations were not sufficiently credited and he appealed to the empress Anne for a second expedition. His simple plans were, however, turned into an over-ambitious scheme and a Great Northern expedition of about 600 men, inadequately supported, left St. Petersburg in 1733. The unknown north coast was attacked from the Pechora, Ob, Yenesei and Lena rivers, and the second in command, M. Spangberg, visited Japan and explored the Kurile Islands, but it was not until June 4, 1741, that Bering could put to sea in the "St. Peter" with Alexei Chirikov in the "St. Paul." After fruitlessly carrying out instructions to search for an imaginary Gamaland about 500 mi. south of the nearer Aleutian Islands, he became separated from the "St. Paul," sailed northeast and landed in the Gulf of Alaska on Aug. 20. Worn out with the hardship of the past eight years and anxious to get his ship back to safety he was only able to reconnoitre the southwestern coast of Alaska, the Alaskan peninsula and the Aleutian Islands. Suffering more and more from scurvy he was unable to maintain effective control and the "St. Peter" was allowed to go ashore on Bering Island early in November. There he died on Dec. 19, 1741, of hunger, cold and grief, within 300 mi. of his starting point, Petropavlovsk, which he had founded the year before. After his death the expedition melted away. Its reports contained a tremendous contribution to the geography of the region, but they were not used to full advantage, and Bering's work is not well known.

See P. Lauridsen, *Russian Explorations, 1725–1743: Vitus Bering: the Discoverer of Bering Strait,* trans. by J. E. Olson (1889); F. A. Golder (ed.), *Bering's Voyages* (1922, 1925).
(G. E. R. D.)

BERING SEA AND STRAIT. These are named after the explorer Vitus Jonassen Bering. Bering sea (Beringovo more) continues the Pacific ocean northward and is demarcated from it by the Aleutian Islands. It is bounded on the east by Alaska, and on the west by the Siberian and Kamchatkan coast. Its area is about 885,000 sq.mi. In the north and east it has numerous islands (St. Lawrence, St. Matthew, Nunivak and the Pribilof group) and is shallow; in the southwest it reaches a depth of 15,659 ft. (2,610 fathoms). The seal fisheries are important, since two of the three known breeding colonies of fur seals are located in this sea, and there is a Soviet whale fishery. The sea connects with the Arctic ocean by Bering strait (Proliv Beringa), at the narrowest part of which East cape (Mys Dezhneva) in Asia approaches within about 56 mi. of Cape Prince of Wales on the shore of the North American mainland, and is there 144 ft. (24 fathoms) deep.

The shallowness prevents any considerable water transport between Pacific and Arctic oceans. North and south of these points the coasts on both sides rapidly diverge. The strait contains two small islands known as the Diomede Islands (*q.v.*). These granite domes, lacking a harbour, lie more than a mile apart; and the international date line, and the boundary line between the possessions of the U.S.S.R. and the United States passes between them. They are inhabited by Eskimos, who call the western island Nunárbook and the eastern Ignálook.

The climate is severe. From November to May the temperature of the air is below 32° F., sometimes well below, and in summer it hardly exceeds 50°. The ice found in this sea is usually of local origin and not derived from the polar basin; it develops mostly on the coasts and in shallow waters. The ice limit usually runs from the eastern Aleutian Islands past St. Paul northward to 60° N. latitude, thence following the coast of Kamchatka southward. The areas of the greatest depths remain ice free. In July, August and September the ice usually retreats north of the Bering strait, because south winds drive a strong current with rather warmer water from the Pacific northward. This current was much used by the whale fishers of the 19th century and was also utilized by polar expeditions, in order to reach the north coast of North America.

Isai Ignatiev went east from the Kolyma river in 1646, and Semen Dezhnev in 1648 followed his route and prolonged it, rounding the East cape and entering the strait. The post of Anadyr was founded on the Anadyr river, and an overland way gradually opened up. At the behest of Peter the Great, Vitus Bering sailed into the strait in 1728 but did not see the Alaskan coast. The propinquity of America was discovered in 1732 by M. S. Grozdev and Ivan Fedorov. Under Bering on his last voyage (1741) was Comdr. Alexei Chirikov of the "St. Paul," who explored the Alaskan coast. Capt. James Cook, working from the south, explored the sea and strait in 1778.

Bering island (Ostrov Beringa), which was the scene of Bering's death in 1741, lies on the southwestern boundary of the sea, off the coast of Kamchatka, being one of the Commander or Komandorski group, belonging to the U.S.S.R. It is 53 mi. long and 25 mi. in extreme breadth; the area is 615 sq.mi. The extreme elevation is about 2,200 ft., and it is treeless. (T. E. A.)

BERING SEA ARBITRATION: *see* ALASKA: *History: Diplomacy Involving Alaska.*

BERKELEY, the name of an English family remarkable for its long tenure of the ancient Gloucestershire castle of Berkeley. The family descends from ROBERT FITZHARDING (d. 1171), the reeve of Bristol, to whom in 1153–54 Henry Plantagenet (afterward Henry II) gave the lordship of Berkeley. His successors came to hold extensive lands, notably in the Severn valley and in Somerset, including Redcliffe and Bedminster in the suburbs of Bristol where their interests often clashed violently with those of the growing town. They were also patrons and benefactors of St. Augustine's abbey at Bristol (now the cathedral), where many of them were buried.

The lords of Berkeley had played a prominent part in the campaigns and political upheavals of the 12th and 13th centuries. THOMAS (1245–1321) fought at the battles of Falkirk (1298) and Bannockburn (1314). His son MAURICE (*c.* 1271–1326) joined (1321–22) the earls of Lancaster and March against Edward II, forfeited his estates and died in prison. His son THOMAS (d. 1361), who married a daughter of Roger Mortimer, earl of March, was the scarcely impartial jailer of the deposed Edward II, and was certainly implicated in his prisoner's murder at Berkeley castle in 1327. His son MAURICE (1330–68) distinguished himself at the battle of Poitiers (1356), where he received wounds said to have caused his premature death.

The death of his son THOMAS without male issue in 1417 began the longest lawsuit in English history. The title of his nephew and heir male, JAMES BERKELEY (*c.* 1394–1463), to the family inheritance was contested by Thomas' daughter, ELIZABETH, wife of the powerful Richard Beauchamp, earl of Warwick, and by her descendants. Their claim was pressed forward within and without the courts, and occasionally flared into open violence: the Berkeleys fought a pitched battle in 1470 at Nibley green (Gloucestershire) with Elizabeth's great-grandson, Viscount Lisle, who was defeated and killed. This engagement is usually claimed as the last private battle on English soil. James's son, the childless WILLIAM, LORD BERKELEY (1426–92), whom the family chronicler called "the Wast all," brought further disaster to the family fortunes. Created successively a viscount (1481), earl of Nottingham (1483) and Earl Marshal (1486), his ill-judged social ambition led him to settle almost all his lands on Henry VII and his male heirs in return for the title of marquess of Berkeley. Not until Edward VI died without issue in 1553 could the Berkeleys recover their ancestral possessions. They still had to contend with Elizabeth Berkeley's descendants, whose claims passed from the Greys to the Dudleys and finally to the crown. Queen Elizabeth I pushed her title in the courts, and the Berkeleys again lost almost all their lands. A final settlement was reached in 1609, almost two centuries after the dispute had begun, and an impoverished family was left in peace.

The Berkeleys achieved an earldom in 1679. FREDERICK AUGUSTUS (1745–1810), 5th earl, disinherited his legitimate heirs by Mary Cole in favour of the children born before their marriage: the house of lords, in a famous case (1811), refused to accept the plea that he had contracted an earlier marriage with her. Berkeley castle belonged to the illegitimate branch of the family, the Lords FitzHardinge, until 1916, when it returned to the earls of Berkeley, descended from a brother of the 5th earl. The earldom became extinct in 1942, but the castle remained the home of a member of the Berkeley family. Among the many cadet branches of the family are the Berkeleys of Stratton, who held extensive properties in London's West End and gave their name to Berkeley square and Stratton street in Mayfair.

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BERKELEY, GEORGE (1685–1753), Anglican bishop active in various fields but remembered chiefly as a philosopher, was born of English stock in or near Kilkenny, in Ireland, on March 12, 1685. He began his studies at Kilkenny school, with William Congreve as a contemporary and Jonathan Swift as a predecessor. He entered Trinity college, Dublin, in 1700, became a fellow of that college in 1707, lectured from time to time on Greek, Hebrew and divinity and retained his fellowship, despite long absences between 1713 and 1721, until 1724, when he was appointed dean of Derry. The absences were spent in two tours on the continent (1713–14 and 1716–20) and in sojourns in London, where he frequented the court and moved in the circles of Swift, Joseph Addison, Richard Steele and Alexander Pope. Instead of settling at Derry he returned for a few years in London, gathering high support for his project of a college in Bermuda for the education of young colonists and Indians of the American mainland. The project had to be dropped, but not before he had spent three years (1729–31) in Newport, R.I., giving much encouragement to higher education in the colonies: he is still honoured at Yale and Harvard, and Berkeley, Calif., was named after him. His appointment to the see of Cloyne (near Cork) came in Jan. 1734. Thenceforward he devoted himself to his pastoral duties and to public promotion of the economic and spiritual betterment of Ireland. In 1744 he started the European vogue of tar water as a general medicine. Eight years later he retired to Oxford, where he died after only a few months, on Jan. 14, 1753.

His published works are distinguished by their literary quality and their range. In the handling of the English language he has few equals. The most patent features of his style are precision, economy and a seemingly inevitable grace, with here and there salty satire and teasing wit; the roots of it are a natural logicality, a rare purity of sentiment and a deep philanthropy. There is a perfect philosophical style in the early sections of his *Treatise Concerning the Principles of Human Knowledge* (1710) and almost perfect philosophical dialogue in *Three Dialogues Between Hylas and Philonous* (1713). *Alciphron* (1732), seven dialogues

in defense of morality and religion, shows all the qualities of his pen, from weight to wit. In more leisured days some of the best English men of letters savoured the curious beauty of his late scientific and philosophical meditation, *Siris* (1744). *The Querist* (1735–37) is a troop of epigrams, some of them mordant, on the economic plight of Ireland, all directed by prescient insight into principle and by detailed knowledge of relevant fact. The range of his competence is further illustrated by *The Analyst* (1734), in which he initiated what proved to be a useful criticism of Isaac Newton's differential calculus. These are his chief works, along with *An Essay Towards a New Theory of Vision* (1709), a brilliant piece of pure psychology, on the perception of space, the conclusions of which have been widely accepted.

Berkeley's philosophy, little appreciated in his own day, came into prominence chiefly through the criticism of it in Thomas Reid's *Inquiry into the Human Mind* (1764). Kant noticed it, S. T. Coleridge admired it, J. S. Mill felt much of it to be congenial, and after A. C. Fraser's edition of Berkeley's *Works* (1871) it became a regular subject of discussion in British universities. Interest in it declined in the 1930s with the emergence in England of a school of philosophers who banished metaphysics and had little interest in the history of thought; but Berkeley's title to continuing fame is likely to be secure, both because the course of British philosophy cannot be understood without him and because there is genius in the radically simple way in which he handled his problems.

"*Esse* is *percipi*" ("to be is to be perceived") is his most famous dictum and doctrine; that is, that the very existence of the immediate objects of sensation consists in their being perceived. Put concretely, colour means something seen, sound something heard, shape something seen or touched, and motion a seen or touched or otherwise felt sequence of something spatial. Therefore, to think of any of these as existing prior to, or at any time independent of, mind, is an elementary logical error. What is meant by the corporeal is always and entirely the sensory: a rock, for instance, is a shape, resistance, colour, etc. The whole corporeal world, then, can exist only as a set of objects of consciousness, as a system of ideas. So much Berkeley says unmistakably. There is some ground, therefore, for the usual designation of his philosophy as subjective idealism: the supposedly external and bodily world is nonexistent, there being nothing but minds and their internal sensations. This interpretation, however, clashes with Berkeley's often repeated avowal that he was trying to justify our natural belief that we have direct knowledge of a really corporeal world. One of the main points of his criticism of the Cartesians (especially N. Malebranche) and of Locke was that they had logically undermined that belief and had thus opened the door to subjectivism or scepticism. His antisceptical intention requires an objectivist interpretation, and his texts support one. He has not said that what he perceives by sense exists only because he perceives it and as a part of his own mind. That the mode of existence of sensory objects consists in being perceived is for him a necessary proposition, the predicate following from the very nature of such objects: shape, colour, etc., imply being perceived. "*Esse* is *percipi*" is thus a statement of a logical analysis, the entirely general proposition that the sensory as such is dependent on mind as such, the mode of dependence being that of an object to a subject. Again, that the sensory is the corporeal and that the corporeal is not mental are for him logical statements, analyses of the meaning of the terms. It is when Berkeley asks on what mind or minds the objects which we actually perceive depend that he leaves logic for experience. His explicit answer is that they are not dependent on our minds since they are obviously given to us. Further, they constitute an orderly system, as is shown by common and scientific observation. Then comes Berkeley's bold and original metaphysical leap: the only way of fitting the empirical fact of an independent corporeal universe to the logical truth that the *esse* of the corporeal is *percipi* is to postulate a cosmic mind, of which that universe is the constant object. Sensory fact is only evidenced by our perceiving; it is constituted by God's. The existence of God is thus required to explain the objectivity of the corporeal world; and the explanation saves its corporeality too, as that world, though bound to God's mind, is not taken up into His mental nature —it remains at the distance of being an object. In perceiving, Berkeley says against Malebranche, we are not looking into God's mind; we are simply being aware of certain things of which He is aware.

Berkeley's other characteristic doctrines are closely connected with that novel attitude and argument. Three may be noted. First, there is the denial of matter. He is not denying the corporeal world: he affirms this as real and as having in it all that we perceive. He is taking the term "matter" in two special meanings then current in philosophical circles. One of them followed from the prevailing assumption that the objects of sense are subjective, parts of the sensing mind. "Matter" then meant their counterpart, the corporeal as the reality existing outside of the mind. Having rejected the assumption, Berkeley has no need of the counterpart. The objects of sense are themselves the corporeal, not mental copies of it, so that to posit a second corporeal world behind them is gratuitous; and it is mischievous as well, for to suppose the perceivable world to be subjective and to posit an unperceivable world as the real one is to fall into scepticism, for it is then impossible in principle to compare the former with the latter. The other use of the term "matter" was Locke's: it meant what Locke called "a something I know not what" which he postulated as underlying the sensible properties of a thing, in order to account for their constant togetherness (*see* SUBSTANCE). Berkeley retorts, negatively, that an x to which no content from sense or reason can ever be given can explain nothing, and, positively, that on the *esse-percipi* principle the togetherness is accounted for by God's awareness and will.

Secondly, there is the denial of corporeal causality. All that we perceive, Berkeley declares, is that one quality or event uniformly attends another, and no amount of rational inspection of either can show us why. He is not alone in this contention: Locke had said much the same before him, and Hume said exactly the same thing after him. What neither of these went on to say, as Berkeley did, is that causal power belongs only to minds.

Thirdly, there is the denial of abstract general ideas. Berkeley restricted the term "idea" to sensory objects. That these, whether sensed or imagined, are in fact always particular, was an accepted commonplace. Berkeley's new point was that the particularity is essential, that the sensory means something particular and therefore that when the particularity is thought away what is left is not an abstract idea but nothing at all. A general "idea," then, is both a logical and a psychological impossibility. This does not make general names meaningless: each stands for all the particular members of a class, and the object which at any moment it may bring before the mind is any one of those indifferently. In brief, a general name is general in meaning only in its scope of reference; there is no correspondent general "idea."

No thinker's philosophy is simply, as the above summary is, a system of propositions, though he must try to make it so. To be properly understood it has to be seen in its historical and biographical setting. With Berkeley that setting is large. He was confronting not only Locke but also Hobbes and the Cartesians, and not only the philosophers but also the new mathematical physicists; and he was combating as well the rather pretentious chatter of the "free-thinkers" in the coffeehouses. As for his motives, it must be enough here to say that he had on the one hand an irresistible itch to clarify thinking and to reduce and simplify theory and on the other hand an urgent practicality that made him search for a philosophy in which a pure religion and an altruistic morality would be reasonably grounded.

See also Index references under "Berkeley, George" in the Index volume.

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Berkeley (1881); G. A. Johnston, *The Development of Berkeley's Philosophy* (1923); G. Dawes Hicks, *Berkeley* (1932); A. A. Luce, *Berkeley and Malebranche* (1934), and *Berkeley's Immaterialism* (1945); J. Wild, *George Berkeley* (1936), learned but eccentric; and G. J. Warnock, *Berkeley* (1953), an examination from the point of view of the English logical analysts. (T. E. Jp.)

BERKELEY, MILES JOSEPH (1803–1889), the foremost British mycologist and plant pathologist of his period, was born at Biggin hall, Northamptonshire on April 1, 1803, and educated at Rugby and Christ's college, Cambridge. Ordained in 1826, he was first incumbent of Apethorpe, becoming vicar of Sibbertoft, near Market Harborough, in 1868.

Approximately 6,000 species of fungi were credited to him, but his *Introduction to Cryptogamic Botany* (1857), his *Gleanings of British Algae* (1833), and his papers on "Vegetable Pathology" in the *Gardener's Chronicle* (from 1854 onward) show a broad grasp of the whole domain of physiology and morphology as understood in those days. He was largely instrumental in demolishing the wild claims made by Ernst von Hallier on the metamorphosis of fungi. In his pioneer investigations on potato murrain (late blight), Berkeley showed that the fungus, *Phytophthora infestans*, was the cause of the disease, not its result, and is consequently regarded as the father of plant pathology. He also studied grape mildew, to which he gave the name *Oidium Tuckeri*, and the pathogenic fungi of wheat rust, hop mildew, and various diseases of cabbage, pears, coffee, onions, tomatoes, etc., with important results bearing on the life history of these pests. Berkeley was the founder of British mycology, and his most important work on that subject is contained in the account of native British fungi in Sir W. Hooker's *British Flora* (1836), in his *Introduction to Cryptogamic Botany* (1857), and in his *Outlines of British Fungology* (1860). He revised the Latin of Bentham and Hooker's *Genera Plantarum*. Berkeley's herbarium at Kew, which contains over 9,000 specimens, and is enriched by numerous notes and sketches, forms one of the most important type series in the world. He died at Sibbertoft on July 30, 1889.

A list of his publications will be found in the *Catalogue of Scientific Papers* of the Royal society, and sketches of his life in *Proc. Roy. soc.*, vol. xlvii (1890); *Ann. Bot.*, vol. iii (1889), vol. xi (1897).

BERKELEY, SIR WILLIAM (1606–1677), colonial governor of Virginia, was the youngest son of Sir Maurice Berkeley and the brother of John, first Lord Berkeley of Stratton, one of the Carolina and New Jersey proprietors. Soon after his graduation from Oxford (B. A., 1624; M.A., 1629), he was given a seat in the privy chamber and served in the colonial office as a commissioner of Canadian affairs. He wrote a play, *The Lost Lady*, for the London stage in 1637, was knighted by Charles I in 1639 and was appointed governor of Virginia in 1641.

Berkeley's governorship of Virginia was almost continuous from this date until his death except during the period of the English Commonwealth, 1652–59. His first years as governor were very successful. Berkeley experimented with crop diversification, encouraged manufacturing, promoted expansion and coped successfully with both Indian and Dutch hostilities. His loyalty to the crown during the Great Rebellion led him to declare Virginia an asylum for Charles II and his friends. This loyalty also resulted in his forced retirement from the governorship until the Restoration (1660).

Berkeley's second period as governor was marred by Indian attacks on the frontier, economic depression, crop failures and high taxes. His irascibility and ineptitude in dealing with the frustrations of his people and the ambitions of his impetuous and demagogic cousin by marriage, Nathaniel Bacon (*q.v.*), resulted in a rebellion in 1676. He was recalled by Charles II to give an account of this tragedy but died on July 9, 1677, soon after his arrival in England and before he had an opportunity to report to the king.

Bibliography.—T. J. Wertenbaker *Torchbearer of the Revolution: the Story of Bacon's Rebellion and Its Leader* (1940); W. E. Washburn, *The Governor and the Rebel: a History of Bacon's Rebellion in Virginia* (1958); and W. F. Craven, *The Southern Colonies in the Seventeenth Century* (1949). (Ra. Mu.)

BERKELEY, a market town in Gloucestershire, Eng., 16 mi. S.S.W. of Gloucester by road, in the fertile Vale of Berkeley. Pop. (1961) 1,116. In the reign of Edward I Berkeley was constituted a borough and governed by a mayor and aldermen, but the corporation was dissolved in 1885. The moated castle is an excellent example of a medieval fortress and is still inhabited by the Berkeley family. The manor was granted (1153) by Henry II to Robert FitzHardinge, and building was begun on the strong castle keep. Robert's son Maurice married Alice Berkeley and later took that name. The deposed Edward II was imprisoned and brutally murdered in the castle (1327). The buildings around the inner court, including a hall 61 ft. long, are mostly 14th century. Parliamentary forces breached the west wall of the castle in 1645. It still contains many interesting portraits and relics and is open to the public at certain times. With the death of the last earl of Berkeley in 1942 the title lapsed.

Berkeley was the birthplace and home of Edward Jenner (1749–1823), who introduced vaccination against smallpox. In 1957 work was begun on a nuclear power station on the river Severn. Nearby is Sharpness, with docks, at the end of the Gloucester and Berkeley ship canal, which was opened in 1827. (B. C. F.)

BERKELEY, a city of California, U.S., on the east side of San Francisco bay in the northern part of Alameda county, directly opposite the Golden Gate bridge. The area is approximately rectangular, with 9.58 sq.mi. of land and 8 sq.mi. of water. From sea level the elevation rises to 1,500 ft. The city adjoins Oakland and Emeryville to the south and Albany and El Cerrito to the north.

The Spanish pioneers of San Francisco called the region the *Contra Costa* or "opposite shore." It was explored by Capt. Pedro Fages and Father Juan Crespi in 1772, but remained unsettled, except by Indians, until 1820, when the land now included in the cities of Berkeley, Albany, Emeryville, Oakland, Piedmont and Alameda was given in grant to Sgt. Luis Peralta by the Spanish governor of California. Twenty years later Peralta divided his grant, called Rancho San Antonio, among his four sons. Domingo Peralta was given the part which later became Berkeley but, like many another California ranchero, lost ownership of his land soon after California became a part of the United States.

In 1858 the College of California, which had been incorporated three years earlier with temporary quarters in Oakland, selected a site at the foot of the hills for a permanent campus which was dedicated in 1860. In 1866 the trustees chose the name of Berkeley for the projected college town, to commemorate Bishop George Berkeley (*q.v.*).

The trustees of the College of California donated their institution to the University of California upon its incorporation in 1868 but classes continued to be held in Oakland until 1873 when the first buildings were completed on the Berkeley site. As the university grew, it attracted other institutions to the city, including 6 divinity schools, the state's schools for the deaf and blind (founded 1866) and several private educational institutions.

While the eastern part of the city was becoming a major centre of learning, West Berkeley, originally called Ocean View, began to develop light manufacturing. It shared in the industrial development of San Francisco bay, enjoying the same advantages of transportation, climate and scenic beauty.

The city was incorporated in 1878, adopted its first charter in 1895 and the present charter in 1909. After 1923 it has operated under the council-manager form of municipal government. Public cultural and recreational facilities are many: the Berkeley Public library, Community Theatre, Municipal Rose garden, public parks, a municipal yacht harbour and fishing pier, and an aquatic park are maintained by the city, and Tilden park, one of a series of regional parks jointly supported by all the east bay communities, adjoins Berkeley on its eastern border.

The climate of Berkeley is temperate: summers are cool; winters are mild. A rainy season, characterized by intermittent storms, lasts from late November through February; little rain falls during the rest of the year.

A quiet village of little more than 5,000 inhabitants in 1890, Berkeley grew rapidly thereafter and numbered more than 40,000 inhabitants by 1910. In 1960 Berkeley's population was 111,268. (For comparative population figures *see* table in California:

Population.) Most of the city's residents lived in single-family homes. Berkeley has become a favourite residential area for many who work in the neighbouring business centres of San Francisco and Oakland. (G. P. Hd.)

BERKELIUM. The synthetic element berkelium has the chemical symbol Bk and the atomic number 97. It occupies a position in the periodic system of the elements as the eighth member of a rare-earth like transition series, the actinide series, which includes the heaviest known elements and in which an inner electronic shell (the 5f shell) is being filled. For a discussion of its discovery, *see* TRANSURANIUM ELEMENTS.

The tracer method of investigation has been used to study the chemical properties of berkelium. Berkelium (as Bk^{249} which has a half life of 290 days) was isolated in weighable amounts for the first time by S. G. Thompson and B. B. Cunningham in 1958. This isotope can be prepared by the intense neutron bombardment of Cm^{244} (*see* CURIUM) as the result of the capture of successive neutrons in a sequence of reactions forming first Cm^{245}, then Cm^{246}, Cm^{247}, Cm^{248} and Cm^{249}. The Cm^{249} decays with the emission of a negative beta particle to form Bk^{249}. There appears to be no completely logical way of assigning an atomic weight for this element, which has only relatively short-lived isotopes, but the mass number 249 (more precisely, 249.08 on the chemical scale) might be used since this species can be produced in weighable amounts, isotopically pure.

Isotopes of Berkelium

Isotope	Half life	Type* and energy of radiation (Mev)
Bk^{243}	4.5 hr.	EC α (~0.1%): 6.72 (30%) 6.55 (53%) 6.20 (17%)
Bk^{244}	4.4 hr.	EC α (6×10^{-4}%) 6.67 (100%)
Bk^{245}	4.95 days	EC α (~0.1%): 6.33 (33%) 6.17 (41%) 5.89 (26%)
Bk^{246}	1.9 days	EC
Bk^{247}	$\sim10^4$ yr.	α 5.30 (5%) 5.51 (58%) 5.67 (37%)
Bk^{248}	16 hr.	β^- (70%) 0.65 EC (30%)
Bk^{249}	290 days	β-0.1 α (~10^{-4}%): 5.40
Bk^{250}	3.13 hr.	β^- 0.9, 1.9

*EC = electron capture; α = alpha particle; β^- = negative beta particle.

The tracer chemical studies have demonstrated that berkelium exists in aqueous solution in two oxidation states, the (III) and the (IV) states, and the ionic species presumably correspond to Bk^{+3} and Bk^{+4}. The oxidation potential for the berkelium (III) —berkelium (IV) couple is about −1.6 v. on the scale where that for the hydrogen-hydrogen ion couple is taken as zero.

The solubility properties of berkelium in its two oxidation states are entirely analogous to those of the actinide and lanthanide elements in the corresponding oxidation states. Thus in the tripositive state such compounds as the fluoride and the oxalate are insoluble in acid solution, and the tetrapositive state exhibits such insoluble compounds as the iodate and phosphate in acid solution. The nitrate, sulfate, halides, perchlorate and sulfide of both oxidation states apparently are soluble.

Much of the chemical information which has been obtained for berkelium has been concerned with its ion exchange and elution behaviour with columns packed with ion exchange resins.

An interesting aspect of the chemistry of tripositive berkelium is its solution behaviour following adsorption on a column packed with the ion-exchange resin Dowex-50. There is a remarkable similarity in the relative rates of elution of the lanthanide quadrad, europium-gadolinium-terbium-dysprosium, and the actinide quadrad, americium-curium-berkelium-californium. The remarkable similarity between these two groups of elements indicates the same kind of change in ionic size (and consequently, rate of elution) on filling in the 4f and 5f electrons. The break in change of radius which is encountered after the half-filling of the 4f shell and which results in the large separation of terbium from gadolinium occurs again at the half-filling of the 5f shell and results in the large separation of berkelium from curium.

Berkelium is best separated in the tripositive form from the other tripositive actinide elements by the above described, ion-exchange, adsorption-elution method; from the tripositive rare-earth elements it is best separated by the additional use of elution with concentrated hydrochloric acid in which the actinide elements form complex ions under conditions where the lanthanides do so to a much smaller extent. Separation from tripositive actinides and lanthanides may also be effected by making use of the tetrapositive state of berkelium.

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(G. T. Sg.)

BERKHAMSTED, an urban district of Hertfordshire, Eng., 28 mi. N.W. of London by road, lies in the wooded Bulbourne valley which runs through the Chiltern hills. Pop. (1961) 13,048. The town is mainly residential and has a church dating from the 13th century and many old houses and schools, the largest of which, Berkhamsted school, was founded in 1541. Through the Bulbourne valley run the Grand Union canal, the London-Northampton railway line and the London-Warwick road. Veterinary remedies, sheep dips, clothing and office furniture are made and there are timber mills. Berkhamsted was important in Saxon times and it was there that the Saxon nobles offered the English crown to William of Normandy in 1066. A moated castle was built by Robert, half-brother of William I, and its later residents included Thomas Becket, Edward III and the Black Prince. In 1216 the castle was besieged by the dauphin of France. After 1496, when it was last occupied, the castle fell into ruin and in 1930 was thoroughly excavated and is now preserved. William Cowper was born in Berkhamsted rectory. The Foundling hospital was transferred from London to Berkhamsted in 1935 and renamed the Thomas Coram school, but the premises are now occupied by Ashlyns county secondary and grammar school. Ashridge house, since 1929 the Bonar Law college for citizenship, is 3 mi. north. Ashridge estate (5.6 sq.mi.) is owned by the National Trust, and Berkhamsted common (part of the estate until 1928), which dates from Anglo-Saxon times, was the scene of a fantastic escapade in 1866 when a special midnight train from London secretly unloaded, nearby, more than 100 workmen who set about before dawn dismantling an iron fence which had been erected around parts of the common. This vigorous action of the Commons Preservation society was later upheld by law.

BERKSHIRE, a southern county of England, is bounded on the north by Oxfordshire and Buckinghamshire, on the east by Surrey, on the south by Hampshire and on the west by Wiltshire. The area of the geographical county is 725.0 sq.mi.

Physical Features.—The county is a somewhat haphazard cross section of the Jurassic and Cretaceous scarplands of southern England and sections of the main structural elements are represented from south to north in the pattern which follows. The Tertiary sands and clays in the axial trough of the Thames-Kennet Tertiary basin (the axis running roughly along the southern boundary of the county) are found in the south and east, stretching from the Surrey boundary almost to Newbury. To the north, the Berkshire downs are a part of the principal chalk syncline (trough) of south-eastern England and form a section of the line of hills stretching from the Marlborough downs across to the eastern end of the Chiltern hills. In the downland area, south and east of a line from Compton to Hungerford, deposits of clay with flints occur and are often recognizable by the fact that they support islands of mixed woodland in the midst of agricultural land. Beneath the steep northern slopes of the downs lies the fertile Vale of the White Horse, comprising Gault and Kimmeridge clays, separated from the chalk by a band of Upper Greensand at the base of the escarpment. Between the vale and the Thames lies an elevated ridge of Corallian beds running from Faringdon eastward to the Cumnor and Wytham hills, overlooking the city of Oxford. North of this ridge lies the Oxford clay of the Upper Thames valley.

The most significant physical features of Berkshire are the

valleys of the Thames and its tributaries, the Ock, Pang, Kennet and Loddon, and of the Lambourn and the Enborne flowing into the Kennet, and the Blackwater flowing into the Loddon. Between them they form natural lines of communication, unifying an otherwise heterogeneous administrative area. The Thames forms the northern boundary of the county, while the Enborne marks a considerable part of the southern boundary before turning northward to join the Kennet near Aldermaston. The Enborne rises in an outcrop of the Hampshire chalk downs and the highest point in Berkshire and indeed of the chalklands of southern England, Inkpen Beacon (975 ft.), is a part of this outcrop. The Kennet, the principal tributary, joins the Thames at Reading. The Kennet valley stretching westward from Newbury almost joins with the Vale of Pewsey in Wiltshire near Savernake and the two form an east-west lowland route of great historical importance. The valley of the Lambourn, which joins the Kennet at Newbury, forms a line of approach to the heart of the downland and to the Vale of the White Horse. The Goring gap, where the Thames breaks through between the Berkshire downs and the Chilterns, provides a means of access from Reading northwestward to northern Berkshire, Oxford and the Midlands. To the east of Reading, where a border of hills flanking the Thames rises to its highest in the Cookham area, the land is flat, crossed by the Loddon, and rises to a sandy plateau of heath and woodland in the extreme southeast.

The former administrative divisions of Berkshire—Hill, Vale and Forest—coincide with the main recognizable physical divisions. The face of the county is as varied as the geological structure would suggest. The Tertiary sands and clays of eastern and southern Berkshire produce soils which are not particularly suitable for cultivation, but support extensive areas of heath and wooded common in Windsor forest. The continuation of these soils along the Kennet valley accounts for similar expanses of heath and wooded common west of Reading at Burghfield, Bucklebury, Padworth, Greenham and Crookham. The Kennet itself, the main drainage channel of the chalk uplands of Berkshire and Hampshire, follows a meandering course and is flanked by flat, marshy lands. The Vale of the White Horse, with its flat, cultivated lands, affords a contrast with the downs with their bare, grassy slopes.

History.—Natural features and lines of communication have combined to exert a great influence on the county's development from prehistoric times. The distribution of the remains of prehistoric man, more especially from Neolithic times, clearly demonstrates that the Berkshire downs were the centre of first settlement and the point from which later settlement radiated. Running like a spinal column along the downs, the ancient Ridgeway formed part of the network of ancient roads radiating from Salisbury plain with convenient routes to lower, more fertile ground and to waterways. Once they had left the height of the downs, men could travel the Lambourn and Ock valleys, the White Horse vale and the Kennet valley till they reached the Thames and the forest and lowland. Such evidence as has been found suggests little settlement of the damper forestland of eastern Berkshire or the river valleys before the Iron Age, although archaeological finds in the bed of the Thames, point to its use as a highway from Neolithic times. The principal fortifications of prehistoric Berkshire, notably Uffington castle, and Letcombe castle or Sagsbury, are all on downland sites, and the lower parts of the downs are dotted with lesser fortification works and barrows.

From the Iron Age onward, the evidence of the spread of settlement from downland to lowland becomes more plentiful and by the time of the Belgic habitation of Silchester, just over the Hampshire border, the spread is clearly marked. Roman evidence is distributed fairly evenly throughout the county, which was well served by roads radiating from Silchester. The immediate vicinity of the Thames itself began to be inhabited and the first seeds of future urban development can be seen dotted along the river. There was, however, no major Romano-British settlement in the county, although there is evidence that at Sutton Courtenay, for example, was a Romano-British village taken over by the Saxons.

Of the effects of Saxon settlement little is known, but the district became a buffer frontier province of the kingdom of Wessex and it suffered the fate of all such buffers through the marauding warfare which crossed and recrossed its frontiers. In 779 it was annexed by Offa to his kingdom of Mercia and it was not until some time between 840 and 850 that Wessex regained what was to be the native shire of Alfred the Great, who was born at Wantage about 848. In those unsettled times, the first monastery at Abingdon perished under the sword and the Danes from Mercia encamped at Reading. It was on Berkshire soil that Aethelred I and Alfred won their victory over the Danish "Great Army" at the battle of Ashdown early in 871, although Alfred was obliged to buy peace before the end of the year. As late as 1006 Danish raids were laying waste the fortifications of Wallingford.

E. W. TATTERSALL

TOWER AND SPIRE OF ST. HELEN'S CHURCH OVERLOOKING THE THAMES, ABINGDON; 14TH CENTURY

In 1086 the image of later Berkshire is barely discernible. Of the towns, Wallingford was predominant; Old Windsor was next in importance; Abingdon was but a cluster of dwellings around the abbey gates; Newbury, Maidenhead and Wokingham were hardly entities; Reading was slowly gaining stature; and William the Conqueror's castle at Windsor was still under construction. Lambourn and Faringdon occupied a more important position than now. The predominance of royal and monastic landholding is clearly marked, the former remaining an actuality until the 19th century, the latter disappearing at the time of the Dissolution. By the late 13th century the pattern had changed and Berkshire as it is now known was clearly emerging. Wallingford was declining, Reading rapidly advancing in importance. The bridge at Maidenhead had encouraged the development of a town at the riverside, and the advent of the wool and cloth trades had fostered Newbury's growth. Sheep, wool and cloth became the staple industries of the county. The new bridge at Abingdon, rebuilt in 1416, forced on the growth of the town and hastened Wallingford's decline.

A speculative land market, resulting from the Dissolution, coupled with the slow decay of the wool and cloth trades, brought on by the rise of "new draperies" elsewhere, characterize Berkshire in the 16th century. The "skittish lands" of Berkshire, as Thomas Fuller calls them, from which few great estates were carved and in which few great families took root, were born in this century. The cloth trade never recovered and by the late 17th century had died away. Agriculture remained the sole industry of note until the mid-19th century. Jethro Tull conducted many of his experiments on Berkshire soils and "Farmer" George III tried out his new Flemish and Norfolk husbandry in Windsor Great park.

The Civil War brought armies to Berkshire, which had heard few martial blasts since the clash of Stephen's and Matilda's forces in the mid-12th century, and at Newbury in 1643 and 1644 royalist and parliamentarian joined battle. The county was split between king in the west and parliament in the east. Personalities connected with the county illustrate the political and social cleavage: William Laud and Henry Marten, prelate and regicide, John Wildman and William Penn, plotter and Quaker.

With the changes in communication in the 18th century, the tempo of Berkshire life quickened. The stagecoaches made their way to Bath and Bristol along the new turnpike road begun in 1746, and improvements to navigation along the Kennet and Thames set a greater flow of products on their way to wider markets from the agricultural lands of the county. With the coming of the railways, Berkshire was served by the main Great Western line to Bristol in the 1840s, by the line to Hungerford and Devizes, which siphoned off the Kennet traffic, and by the lines from London to Oxford and the Midlands and the feeder line from Didcot to Newbury and Southampton in the 1880s.

The 19th century saw Reading rise to primacy among Berkshire's towns at the expense of Abingdon, which had succeeded Wallingford as county town. Reading became the commercial and industrial centre of the county with its threefold supports of biscuits, beer and seeds. The railways, which could have meant much to Berkshire's towns, unfortunately passed by those which might have benefited most—Abingdon, Wallingford, Wantage and Faringdon—and only served to enhance the status of Reading.

Until the end of World War II, Berkshire remained an agrarian county changing little in character. After 1945, however, it became increasingly more industrial as a result of the influx of nuclear research establishments and light industry.

Windsor castle (*q.v.*) is the most noted building in the county. The 15th-century Ockwell manor near Bray, the 14th-century tithe barn at Great Coxwell and painted ceiling in St. Helen's church, Abingdon, are some of the notable late medieval antiquities. The Norman church at Avington and the 12th-century church at Uffington represent earlier Berkshire. The later buildings are Ufton court; Bisham abbey; Christ's hospital, Abingdon; Shaw house and St. Bartholomew's hospital, Newbury. Abingdon, Radley, Wellington and Bradfield colleges are boys' public schools; the Royal Military academy is at Sandhurst (*q.v.*).

Population and Administration.—The geographical county had a population of 503,357 in 1961 of whom 119,870 lived in the county borough of Reading, now the county town, and 383,487 in the administrative county. The other principal towns within the county, all of which are municipal boroughs, with their population, are Abingdon (14,283), Maidenhead (35,374), Newbury (20,386), Wallingford (4,829) (*qq.v.*), Wokingham (11,400) and New Windsor (27,126). The population of the county grew rapidly after 1945 and in the early 1960s was increasing at the rate of 3% a year. Between 1951 and 1961, the total percentage increase was 24.9%.

The county, excluding the boroughs, is divided into 1 urban and 11 rural districts comprising 176 civil parishes. There is a court of quarter sessions for the county, divided into 12 petty sessional divisions, and Abingdon, Newbury, New Windsor and Reading have separate commissions of the peace and courts of quarter sessions. The assizes, on the Oxford circuit, are held at Reading. One new town has been established under the New Towns act, 1946, at Bracknell (*q.v.*), the designated area forming a separate civil parish. Five members represent the county in parliament, one each from the constituencies of Abingdon, Newbury, Windsor and Wokingham and one from the parliamentary borough of Reading.

Ecclesiastically, the geographical county is virtually coterminous with the archdeaconry of Berkshire and since 1836 has been in the diocese of Oxford to which it was transferred from the diocese of Salisbury. The archdeaconry comprises Berkshire less the parishes of Wytham and North and South Hinksey, but including Benson, Warborough and Crowmarsh Gifford in Oxfordshire. The archdeacon of Berkshire is suffragan bishop of Reading. Berkshire forms part of the Roman Catholic diocese of Portsmouth in the Westminster province.

The Economy.—Farming, for centuries the county's staple industry, is declining in importance, though it is still the most widespread industry in the county. In the early 1960s more than 150,000 ac. were under crop or fallow and about 107,000 ac. were under permanent grass. Barley is the principal grain crop, followed by wheat and oats. Potatoes and cabbage and kale for fodder are grown in quantity. Dairy, pig and poultry farming are extensively practised, but sheep farming is declining. The chief fruit growing areas are apple and cherry orchards in the White Horse vale and on the northern slope of the downs. The eastern part of the county is well wooded, mainly by oaks and conifers. Approximately 45,000 ac. are occupied by woodland.

Horticulturally, the county is noted for its seed warehouses and testing grounds in the immediate vicinity of Reading. There are agricultural or horticultural research stations at Shinfield, Warfield and Compton, while Reading university (chartered in 1926) is a centre of agricultural education and research.

Industry.—After 1945 the supremacy of farming in Berkshire was overcome by the rapid influx of industry. Farming provided work for less than 6% of an employed population of about 170,000. Before World War II the manufacture of agricultural implements and machinery coupled with a certain amount of light industry were the only industrial enterprises in the county. The location within the county of two nuclear research centres—the Atomic Energy Research establishment at Harwell and the Atomic Weapons Research establishment at Aldermaston—and the influx of a variety of light industries to the Reading and, particularly, the Bracknell areas have noticeably influenced the industrial aspect of the county and affected both the size and character of its population. The automobile industry has offshoots at Abingdon, while paper and board are manufactured at Colthrop.

Communications.—There were 1,612 mi. of roads in 1960, the two principal ones being part of the Great West road—the main trunk road to Bristol and the west—and a section of the trunk road from Winchester to Birmingham and beyond, both of which bisect the county. The projected London to south Wales motorway will cross Berkshire also. The Western Region railway lines to the west and the midlands cross the county, and the Southern Region services to Guildford, London, Basingstoke and the south coast commence at Reading, which is an important rail centre.

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BERKSHIRES, the highlands of western Massachusetts, are a part of the Appalachian system, and a continuation of the Green mountains of Vermont. The Berkshire country is among the most beautiful regions in the United States. It is a rolling highland dominated by long, wooded ridges, remarkably even-topped in general elevation (about 1,500 ft.), and intersected and broken by deep valleys. The chief streams are the Deerfield and Westfield in the east and the Hoosac and Housatonic in the west. About a score of the summits are over 2,000 ft. above sea level, and of these the highest are Greylock, or Saddleback (3,491 ft.) and Mt. Williams (2,951 ft.), in the extreme northwest corner of the state. Because of its numerous lakes, the district is often called the Lake Region of America, partly from the comparableness of its scenic beauties with the English lake country. The Berkshires, home of the Berkshire Symphonic festivals at Tanglewood, have been, for many years, a favourite holiday resort.

BERLAGE, HENDRIK PETRUS (1856–1934), Dutch architect and urban designer, was born in Amsterdam, Neth., on Feb. 21, 1856. He received his technical training in Amsterdam and Zürich and eventually settled in The Hague. By the 1890s Berlage had attacked the eclectic practices of the traditional architecture of the period. His most famous and influential building was the Amsterdam stock exchange (1898–1903). His rediscovery of the beauty of the naked wall and the flat surface was a revelation to the younger generation. After a visit to the United States in 1911, Berlage became a strong advocate of Frank Lloyd Wright. In his master plans for south Amsterdam in 1902 and 1915 he opened the era of large-scale urban design. He died on Aug. 12, 1934, at The Hague. (S. GN.)

BERLICHINGEN, GÖTZ (or GOTTFRIED) **VON** (1481–1562), called "Götz of the Iron Hand," a Franconian knight born the youngest of five sons at the castle of Jagsthausen in Württemberg. Famous as the hero of Goethe's play *Götz von Berlichingen* and often affectionately regarded and romanticized as a sort of bluff, fearless German Robin Hood, Götz belonged to the class of imperial knights fast becoming anachronistic as medieval conditions were superseded by the new modern Europe taking shape, and he spent his life in a manner typical of this class in a succession of feuds, battles and campaigns, in which the warrior of popular legend becomes something bordering on a wellborn highway robber. His iron hand was a substitute for the hand, whether left or right is uncertain, shot away in 1504 while Götz was assisting Albert IV, duke of Bavaria, at the siege of Landshut. An

iron hand claiming, possibly correctly, to be the original one is still exhibited at Jagsthausen. Perhaps the most remarkable thing about Götz' life is that he survived in a turbulent and violent era to live to a ripe old age and tell all about it in his *Autobiography*, the main source of our knowledge of him and, for all its inaccuracies, an entertaining account of a life covering a very eventful period of German history.

Götz pursued his feuds, mainly for booty and ransom, against other nobles and against towns and cities, and took part in the many wars that marked the times, beginning with campaigns in Burgundy, Lorraine, Brabant and Switzerland under Frederick IV, margrave of Brandenburg-Ansbach, and the emperor Maximilian I in 1497 and 1498, and ending with the wars against the Turks in Hungary in 1542 and the campaign of Charles V against the French in 1544. He was twice put under the ban of the empire and twice taken prisoner; sometimes he had to pay ransoms to obtain his freedom, at other times he extracted money himself, as in 1516, when he held Graf Philipp von Waldeck to ransom and used the 8,900 ducats to pay for the castle of Hornberg, where he eventually died on July 23, 1562.

Götz played an active role in the Peasants' War of 1525. To cover himself he made it appear that he had been compelled by the rebels to take part in the uprising, and in fact led a section of them in the Odenwald district. For his part in the rebellion he was acquitted by the imperial chamber (Oct. 17, 1526), but seized by the Swabian league in 1528, when a promise of safe conduct was broken, and kept prisoner at Augsburg until 1530. At some period in his life Götz became a Protestant, though he gives no details of this. He married twice and left three daughters and seven sons.

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BERLIN, IRVING (original name, ISRAEL BALINE) (1888–), U.S. composer who played a leading part in the evolution of the popular song from the early ragtime to jazz (*q.v.*). Born at Temoyun, Kirgizia, Russia, May 11, 1888, he went to the United States in 1893, where his early years were spent in great poverty. In 1904 he worked as a singing waiter in Chinatown and Bowery cabarets of New York city. In 1911 he became a pioneer of ragtime with "Alexander's Ragtime Band" (originally "Alexander and his Clarinet") and "Everybody's Doin' It." In 1914 he wrote his first musical comedy, *Watch Your Step*, and in 1919 started a firm for the publication of his music. Thereafter he wrote scores for numerous musical comedies from *Music Box Revue* (first edition, 1921) to *Annie Get Your Gun* (1946). His gift for simple, fresh melody won him immense popularity. Among his best-known songs are "Always," "All Alone," "Remember," "White Christmas," "Oh, How I Hate to Get Up in the Morning" and "God Bless America." He wrote his first film score, *The Cocoanuts*, in 1929. In 1945 he won the medal for merit for his musical comedy, *This is the Army*, which had been played to U.S. troops in many parts of the world and had earned large sums for war charities.

See D. Ewen, *The Story of Irving Berlin* (1950).

BERLIN, capital of the German *Reich* from 1871 to 1945, in former Prussia, 165 mi. S.E. of Hamburg. The city is divided into two municipalities; east Berlin, the capital of the German Democratic Republic, and west Berlin, a *Land* (state) and a city of the Federal Republic of Germany, although not a constituent part of the Federal Republic. The 20 districts of greater Berlin together cover 341 sq.mi. The city lies in a flat sandy plain, 110 ft. above sea level, on both banks of the Spree, which intersects it from southeast to northeast. The highest natural point in the immediate neighbourhood is the Kreuzberg (216 ft.), a hill in the southern district of Schöneberg. A rather higher point than the Kreuzberg was built up in the Grunewald after 1945 out of countless tons of rubble from bombed buildings.

Berlin lies at the centre of a great system of canals, begun in the 17th century. The routes of these canals were marked out by nature, for the passing away of the great ice sheets of the Pleistocene epoch left on the northern European plain, lines of low hills formed of terminal moraines running east to west. The rivers follow the troughs between the moraines until they break through to the north at weak spots in the successive lines. It is these east and west courses that were organized into the canal system which emphasized the focal position of Berlin. By these canals, by roads and later by railways Berlin gathered traffic to itself and became a power which was to dominate the northern plain.

So great a change was made in the city's existence by World War II and the divisions of the postwar period that the history and even the appearance of the city must be seen in two parts—the years before and after the collapse of the third *Reich*.

BEFORE WORLD WAR II

Rise of the City.—Berlin is a comparatively young town by European standards. When the Saxon north mark, or border region, was founded in the 12th century by Albert the Bear, after successful wars against the indigenous Slavs, it comprised at first only a little land on the east bank of the Elbe. It was only gradually that Albert's successors penetrated farther into the districts of the upper Havel and the Spree, and only at the beginning of the 13th century that the first towns, Berlin and Kölln, were founded in these districts. The choice of this particular site for the foundation of the two towns probably resulted from the wish to safeguard the important crossing of the Spree.

Berlin grew up south of the Spree, Kölln north of it, on the island formed by the two arms of the river. The first mention of Berlin in the records that have been preserved occurs in 1230; Kölln appears to be a little older. The charter and administration of the two towns were at first totally separate, even though they had a common civil government and common courts of justice from 1307 onward. Only in 1709 were they completely amalgamated.

It was soon found that the situation of the two new towns was advantageous for commerce to the east and northeast and they quickly became prosperous. Their military importance became secondary when the frontiers of the mark were extended farther to the north and east. Their rapid commercial growth brought an increasing need to enter into closer and permanent relations with the other commercial cities of northern Germany, which were growing up rapidly. They joined the great Hanseatic league (*q.v.*), which was formed in the latter half of the 13th century. They were soon among the leading cities of the mark of Brandenburg and were thus involved in the many internal struggles which arose between princes, nobles and cities after the Ascanian family, the descendents of Albert the Bear, became extinct in the 14th century.

The cities of Berlin and Kölln, however, long remained almost wholly independent, their connection with the Hanseatic league putting them in a strong position, even toward their own sovereign prince. In 1391 they received complete judicial authority within their walls.

Conditions changed only after 1415, when the Hohenzollerns had permanently established their rule in the mark. Frederick II (1440–70) aimed at incorporating the large cities more closely into his territory. He subdued Berlin and Kölln, although not without a sharp struggle, and deprived the cities of part of their old privileges, in particular of the right of concluding independent alliances with other towns. He built a fortress in Kölln on the site later occupied by the royal palace and his successor made this spot his principal seat. From the end of the 15th century Berlin-Kölln was the permanent residence of the Hohenzollerns and the capital of the electorate of Brandenburg.

In 1654 the united population of the two towns was only about 10,000. At that time they played a comparatively subordinate part in the history of the electorate and could not challenge any comparison with the wealth and repute of the great old commercial cities of Germany, such as Nürnberg, Augsburg, Strasbourg, Frankfurt am Main or Cologne. They suffered severely, moreover, from sackings and forced levies during the Thirty Years' War.

It was only with the growing power of the electors of Branden-

Viktoria falls cascading over the Kreuzberg, highest natural point in Berlin, district of Schöneberg. The spire of the cathedral can be seen in the background

The Brandenburg gate showing part of the dividing wall built in 1961 by the government of the German Democratic Republic

The Kurfürstendamm, the main street in West Berlin. The ruined Kaiser Wilhelm Memorial church stands in marked contrast to the adjacent new memorial church

Tugboat pulling a train of barges on the Havel river, part of a system of waterways which cut through Berlin

Alexander Platz, meeting point of Frankfurter Allee and Lenin Allee, two main avenues in East Berlin

Brindes *Autobahn*, a major traffic artery in West Berlin. In the background is the *Funkturm*, a 400-ft.-high radio tower

VIEWS OF EAST AND WEST BERLIN

PHOTOGRAPHS, (TOP LEFT, CENTRE RIGHT) FRITZ ESCHEN, (TOP RIGHT) UNITED PRESS INTERNATIONAL, (CENTRE LEFT, BOTTOM RIGHT) LANDESBILDSTELLE BERLIN, (BOTTOM LEFT) DALMAS—PIX FROM PUBLIX

BERLIN

Charlottenburg Schloss, West Berlin. Originally a 17th–18th-century palace, it is now a museum

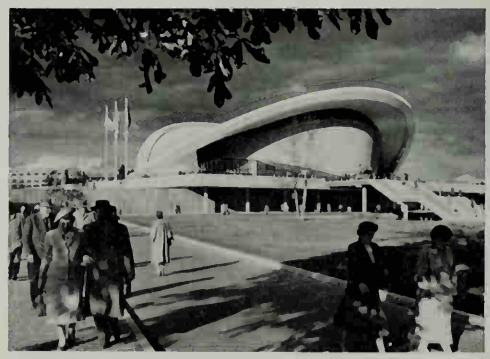
Modern apartment house in the Hansa district, a residential area in the British sector of Berlin

Church of St. Ansgar, Hansa district; built by Willy Kreuer, 1957

Soviet war memorial at Treptow, East Berlin. Red marble from Hitler's chancery—which was torn down after World War II—was used in its construction

The National gallery built in the form of a Corinthian temple, 1866–76, by H. J. Strack

German state opera house on the Unter den Linden, East Berlin. Originally constructed 1741–43, it was rebuilt after World War II



Congress hall, an international meeting hall in the Tiergarten, West Berlin; completed in 1957 by Hugh Stubbins

OLD AND NEW BUILDINGS OF BERLIN

PHOTOGRAPHS, (TOP LEFT AND CENTRE) FRITZ ESCHEN, (TOP RIGHT) AUTHENTICATED NEWS, (CENTRE LEFT) DALMAS—PIX FROM PUBLIX, (CENTRE RIGHT) SCHALL—PIX FROM PUBLIX, (BOTTOM LEFT) EASTFOTO, (BOTTOM RIGHT) HUGH STUBBINS, ARCHITECT, U.S.A.

burg from the 17th century onward that the extent and importance of their place of residence began to grow. Frederick William the Great Elector (1640–88) married a Dutch princess and during his reign Brandenburg became a Protestant refuge and a field for Dutch energy. Canals were built and the name of the Friedrich Wilhelm canal from the Oder to the Spree commemorates an achievement of this time.

Frederick William laid out extensive fortifications and founded three small towns, Friedrichwerder, Dorotheenstadt and Friedrichstadt, which soon amalgamated with Berlin and Kölln. Huguenots, refugees from the French persecutions, settled there and brought into the city elements whose influence on commerce and industry was considerable. At the end of the 17th century there were more than 5,000 French Huguenots out of a total population of about 25,000.

Frederick William's successor, Frederick I, the first king in Prussia, amalgamated the towns into a single municipality, the city of Berlin, and, in the new palace built by Andreas Schlüter (pulled down after World War II), gave it the first nonecclesiastical building of any architectural importance. Almost adjoining this Frederick built the arsenal, laid out the plans on which this quarter of the modern town developed and erected a beautiful monument to his father (by Schlüter). He encouraged education by founding the Academy of Sciences (Akademie der Wissenschaften).

Under the two kings who succeeded him the city expanded in all directions. Frederick William I had the old fortifications razed, thus making further expansion possible. Frederick the Great adorned the city with a number of new buildings, among which the opera deserves chief mention. He also turned the Tiergarten into a large park. The population, which had numbered about 70,000 at his accession, had risen by the end of the 18th century to 172,000. Even the temporary occupation of the town by the Austrians and the Russians during the Seven Years' War (1756–1763) was unable to check its development.

19th-Century Prosperity.—Berlin passed through a difficult period at the beginning of the 19th century; it was occupied by the French after the battle of Jena (1806) and the king was obliged to transfer his seat temporarily to Königsberg. After the fall of Napoleon and the restoration and enlargement of the state of Prussia, however, Berlin became the capital of the second largest German state, the centre of a European world power. As Prussia's influence over the development of Germany grew in the following decades, so did Berlin rise higher and higher above the other German towns.

The foundation of the Friedrich Wilhelm university in 1809 and the erection of the Altes museum, designed by K. F. Schinkel (1822–30), gave the town new intellectual centres. The university was founded when Prussia lost the University of Halle to Napoleon's newly created kingdom of Westphalia. Wilhelm von Humboldt, J. G. Fichte, J. A. W. Neander, Georg Hegel, Barthold Niebuhr and others began to make its fame and they were followed by such men as Franz Bopp, Friedrich Schelling and the brothers Grimm.

In 1870 Berlin was practically bounded on the south by the Landwehr canal, but it afterward extended far beyond. An idea of the rapid growth of the city since 1800 may be gathered from the population statistics. In 1816 the population was 197,717; in 1871, 826,341; in 1905, 2,040,148; in 1933, 4,242,501; and in 1939, 4,332,242. Part of this phenomenal rise was the result of extension of boundaries. The boundaries of the city itself remained the same from 1860 to 1920, although in 1912 an association was formed of the city and its suburbs (the towns of Charlottenburg, Schöneberg, Neukölln, Wilmersdorf and Lichtenberg, and the administrative circles of Teltow and Niederbarnim) and the whole was called greater Berlin. The objects of this association were to institute a common control of streets and the elevated railway and of building plans, to co-ordinate police regulations and to acquire tracts of forest and land for building. It soon became manifest that further co-ordination was needed.

In 1920 a new municipality of Berlin was formed, embracing all the suburbs in a single administration. The law that brought this into effect left large powers of local self-government to the individual communes.

Communications.—Of decisive importance for the development of Berlin was the construction of the German railway system, which began about the middle of the 19th century. Berlin became the centre of this great network, no fewer than 12 lines concentrating upon it. Internal communication was provided for by the *Ringbahn,* ("circular railway"), which was opened in 1871, and by a system connecting the main-line terminals. The through traffic from east to west was carried by the *Stadtbahn* ("city railway"), which connected with the *Ringbahn.* This line ran through the heart of the city. The north and south tube, begun before 1914, was opened in 1923. Later it was connected with a subway system running east and west beneath Unter den Linden and extending far into the suburbs.

The canals have already been mentioned. The Landwehr canal, leaving the Spree near the Schlesische Tor and rejoining it at Charlottenburg, was designed to relieve the congestion of the water traffic in the heart of Berlin. It was superseded in 1906 by the Teltow canal to the south, which leaves the Spree above Berlin at Köpenick and enters the Havel at Teltow. In 1914 a ship canal to Stettin was begun and in Sept. 1923 a new harbour, called the West harbour, was opened; there 68 large ships from the Elbe could be loaded simultaneously.

Industry and Commerce.—Machinery factories which were established in the first half of the 19th century were the starting point of Berlin's great industrial prosperity. By 1939 it had become the greatest industrial and commercial city on the continent of Europe and the sixth largest city in the world. The old wool industry had become much expanded and included such products as shawls, carpets and hosiery.

The city excelled in the working of iron and steel and cloth and in the by-products of these. Among the chief manufactures were locomotives, sewing machines, bicycles, chronometers, electrical equipment and appliances, bronze, chemicals and china. It had extensive breweries. Berlin was also the centre and chief market for wheat, rye and other cereals which reached it by water from eastern Germany, from Poland, Austria and the U.S.S.R. It was a large publishing centre, even rivaling Leipzig.

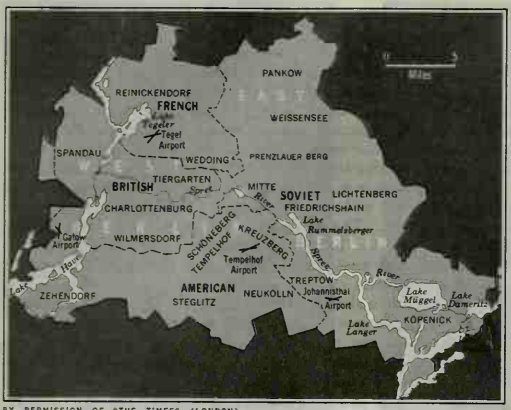
Appearance of the City.—The oldest part of Berlin, the city and Alt-Kölln, built along the arms of the Spree, was, together with that portion of the town lying immediately west, the centre of business activity. The west end and the southwest were the residential quarters; the northwest was largely occupied by academic, scientific and military institutions; the north was the seat of machinery works; the northeast of the woolen manufactures; the east and southeast of the dyeing, furniture and metal industries; and the south of railway works.

The social and official life of the capital centred upon Unter den Linden, running from the former royal palace to the Brandenburger Tor. This street, one of the finest and most spacious in Europe, nearly a mile in length, its double avenue divided by a promenade planted with linden trees (cut down in Hitler's day), presented Berlin life in all its aspects. South of Unter den Linden lies the Friedrichstadt, with its parallel lines of straight streets —the official quarter of the capital—which extends to the busy Leipziger Strasse, running from the Potsdamer Platz to the Dönhoff Platz. This street and Unter den Linden are crossed at right angles by the Friedrich Strasse, two miles long, and formed the chief shopping centres.

The establishment of the imperial government in Berlin naturally brought with it the erection of a large number of public buildings and the great prosperity of the country from 1870 to 1914, as well as the enhanced national feeling, enabled them to be built on a fine scale.

The former royal palace was a huge quadrangular building with four courts. In 1921 the Schloss museum of pottery, silver and furniture was opened in this palace. After 1919, much of the former palace was used for government offices. The state-supported opera and theatre were of old standing.

A sport field and great concrete stadium seating 100,000 spectators was built in west Berlin for the Olympic games of 1936,



BY PERMISSION OF "THE TIMES" (LONDON)

DIVISION OF BERLIN, AS IT WAS INSTITUTED IN JUNE 1945

with a powerful radio transmitting station nearby.

On the east, north and west the city was surrounded at a distance of about five miles from its centre by a thick belt of pine woods, the Jungfernheide, the Spandauer forest and the Grunewald, the last-named stretching away in a southwesterly direction as far as Potsdam and fringing the beautiful chain of Havel lakes. After the opening of the circular railway in 1871 these districts were developed and a "villa colony" was built at the edge of the Grunewald between the station Westend and the Spandauer Bock. From these beginnings, mainly because of the expansion of the important suburb of Charlottenburg, resulted a complete transformation of the eastern part of the Grunewald into a picturesque villa suburb connected by the Kurfürstendamm with the city. The former fishing villages on the shores of the lakes, notably the Wannsee, became a residential area. (E. Bra.; S. B. F.)

WORLD WAR II AND AFTER

The Devastation.—On the outbreak of World War II Hermann Göring, chief of the *Luftwaffe*, publicly stated that not an enemy bomb would fall on Berlin. The Royal Air Force, however, made more than 30 air raids on the city in 1940 alone. The attacks grew in intensity, especially during the last two years of hostilities when, with the participation of U.S. aircraft, the city suffered a succession of 1,000-bomber raids and, apart from some of the outlying residential districts, was extensively damaged. From the first British air raid on Aug. 25, 1940, until April 20, 1945, the city was blasted with more than 75,000 tons of explosives and incendiary bombs. The devastation was increased by Soviet artillery which in the culminating battle of the last ten days of April concentrated about 40,000 tons of shells on the city.

Berlin was captured by Soviet forces on May 1, 1945. The last military aircraft to leave Berlin took off from the lower part of the "east-west axis," a broad highway continuing the Unter den Linden from the Brandenburger Tor through the Tiergarten and out to the *Reichsautobahn*. The site of Hitler's chancery, where he died by his own hand the day before the city was captured, was later cleared by the Russians, who included most of the red marble in their massive war memorial at Treptow. The pleasantly wooded Tiergarten, raked by bombs and shellfire, had been cleared at the height of the food shortage to make way for vegetable plots; but after the war most of it was landscaped and replanted. Most public buildings had been brought down or badly gutted during the war, though many of Berlin's fine art collections had been moved from the museums to places of safety. The *Reichstag* was reduced to a gaunt wreck and when troops of the western Allies took over their sectors ten weeks after the Soviet entry it was difficult to identify many ministries, embassies and once-handsome office buildings in the Unter den Linden. The cathedral, erected in 1893, was badly holed, as was the old schloss, the ruins of which were cleared away by the east Berlin authorities. The former palace of the crown prince, which had been used as an art gallery, and the state opera house, were restored. The schools did not escape and for years after the war classes were working in three shifts a day for want of accommodation. The city's theatres were hard hit, though by 1959 eight theatres were functioning in the east sector and nine in the western sectors, including the newly built Schiller theatre.

Berlin suffered more than any other part of Germany after the end of World War II. It was under four-power control but cut off from natural markets in the west by political disagreements and in the east by Soviet disinterest in the future of the city. By 1948 it was completely divided into the Soviet sector on the one hand and the three western sectors on the other.

East Berlin became virtually part of the Soviet zone and by the late 1950s almost no vestige of four-power administration remained.

In 1939 Berlin had a population of 4,332,242. By 1950 it had dropped to 3,336,026 and there was only a small rise after that time. In 1959 west Berlin had an estimated 2,207,984 and east Berlin 1,082,349 inhabitants. The birth rate fell from 17.2 per thousand in 1941 to 10.5 in 1950, with a low point of 8.6 in 1944. The death rate rose from 13.2 in 1938 to 55.5 in 1945, but was down to 12.9 in 1950. Infant mortality figures are similar, illustrating the special horror of 1945.

The Political Difficulties.—Berlin came under four-power (originally three-power) control soon after the end of the war and as a result of the proposal of the European Advisory commission in 1944 which was confirmed by the Yalta and Potsdam agreements. An Allied *Kommandantura* of four military commandants was created to administer the city but was increasingly paralyzed by the differing German policies of the four occupying powers. In Berlin, as in the rest of Germany, the principal difference was in economic policy. The Russians rigorously dismantled west Berlin industries before handing over two-thirds of Berlin to the three western powers; in their own sector they encouraged rising industrial production but took a large proportion of it as reparations.

Berlin stands about 100 mi. inside the boundary of the German Democratic Republic. Its communications with the west were poor and for a long time consisted only of the road and rail line to the west German town of Helmstedt, and of defined air corridors and waterways. An Allied military train ran from Helmstedt and members of the three former occupying western powers had special use of the Berlin-Helmstedt *Autobahn*. West Berlin continued to receive most of its foodstuffs and essential raw materials from the west.

Political developments accentuated the differences between the two parts of the city. In 1946 the Social Democratic and Communist parties in the Soviet zone were fused into the Socialist Unity party (*Sozialistische Einheitspartei Deutschlands;* S.E.D.) which was soundly beaten in the 1946 all-Berlin city elections. The S.E.D. polled 20% of the electorate; the Social Democrats (*Sozialdemokratische Partei Deutschlands;* S.P.D.) secured 49%. They appointed the first chief burgomaster, Otto Ostrowski. In June 1948 the Soviet commandant proclaimed the division of Berlin by dissolving the *Kommandantura*. As a result the east Berliners appointed their own burgomaster, Fritz Ebert, son of the first president of the Weimar republic. Ernst Reuter became chief burgomaster of west Berlin at the head of a preponderantly Social Democratic coalition, which was gradually given complete powers by the western commandants. The 1948 city elections gave his party 65% of the electorate. The percentages for the C.D.U. (*Christlich Demokratische Union*) and the Free Democratic party (*Freie Demokratische Partei; F.D.P.*) were 19%, and 16%. In 1950 the balance in west Berlin moved in favour of the two latter parties whose percentages of the total vote moved up to 24% and 23%. Ernst Reuter, by far the most famous Berliner of the post-war era, died in Sept. 1953. At the 1954 elections the C.D.U.'s vote rose to 30% but that of the Free Democrats dropped to under 13%. The S.P.D. once again appointed the chief burgomaster, Otto Suhr. The 1958 elections gave the S.P.D. 52.6% of a record 93% poll of the 1,760,000 voters. Willy Brandt, who succeeded

Otto Suhr when the latter died in 1957, remained chief burgomaster.

The division of Berlin (western sectors 481 sq.km. [186 sq.mi.], east Berlin 403 sq.km. [156 sq.mi.]) became more absolute as time passed. West Berlin became the greatest focus for refugees from the German Democratic Republic, with an average of 7,000 a month arriving in the late 1950s. In Aug. 1960 about 16,000 arrived. A wall was built and the border sealed by the east Germans in 1961. (*See* GERMANY: *History: German Democratic Republic.*)

The government of the Democratic Republic sits in Pankow, east Berlin; both the west German *Bundestag* and *Bundesrat* (upper chamber) have held meetings in west Berlin and the federal president was re-elected there for his second term in July 1954. In July 1959 a new federal president, Heinrich Lübke, was elected in Berlin. The division of Berlin was accentuated by the rising of July 1953, which began in the eastern part of the city and spread to the whole of the Democratic Republic. For the first time since 1945 Red army troops and tanks moved into the middle of Berlin, shooting a number of German citizens and restoring order. The western commandants made formal protests.

The Berlin Blockade.—A blockade was imposed by the Soviet authorities in June 1948, in an attempt to force the western powers to abandon their rights in the city. The blockade began after several Soviet protests against steps taken in western Germany toward self-government and coincided with the introduction in west Berlin of the new Deutschemark, which the Russians regarded as a threat to the east German currency. The blockade was placed on all land and water communications between Berlin and the west. The western powers countered with the air lift and in spite of crippling shortages of fuel and electric power the life of west Berlin was maintained for 11 months. During this period a total of 1,583,686 tons of foodstuffs and other vital supplies was flown into west Berlin by U.S. and British aircraft which used three west Berlin airfields and the waters of the Havel river as landing grounds. An industrial air lift was organized in the opposite direction for west Berlin's greatly reduced exports.

The people of west Berlin remained loyal to west Germany and only about 4% of them at any time accepted the eastern bribe of better food rations which they drew, during the blockade, in the Soviet sector of the city.

The blockade ended on May 12, 1949, after the air lift had cost $170,000,000. (The air lift was actually continued until Sept. 1949.) This was partly due to the countermeasures imposed by the western powers on east German communications, but even more to the embargo placed on strategic goods previously exported to the countries of the eastern bloc. Attempts by the security council of the United Nations to bring the blockade to an end failed.

The Soviet and east German authorities never entirely relaxed their grip on west Berlin's communications. There was interference with the Berlin railways in 1949, the imposition of a tiresome system of bills of lading for goods shipments from Berlin in 1951 and the cutting of telephone connections between east and west Berlin in the same year. Rail and road traffic between Berlin and the west was frequently held up over short periods and dislocated. In 1952 the east Germans completed their rail and canal bypasses around west Berlin.

Reconstruction.—After the end of the blockade west Berlin made remarkable strides along the road to comparative prosperity. In mid-1949 industrial production was still only 19% of the 1936 figure. By 1954 it had risen to 70% and by 1959 to 132%. For years west Berlin suffered from a lack of capital and from the removal of factories and head offices of banks and other commercial enterprises. In 1950 unemployment was still around 300,000; in Sept. 1959 it reached the lowest postwar figure, 36,000. This was achieved in spite of the continuing influx of east German refugees. One reason was the increase in investment, which increased sixfold between 1950 and 1960. Another was the steady help, amounting to an average of 650,000,000 DM. a year, given by the Federal Republic, and reaching over 1,000,000,000 DM. in 1960.

In the early 1950s Berlin was still a ruined city, although after the blockade it became Allied policy to make west Berlin a "western shopwindow" for the east. The effects of this policy were at first more apparent than real. First to recover their former prosperity in west Berlin were shops, restaurants, places of entertainment and particularly the large network of bars and night clubs for which the city has always been famous. While west Berlin was recapturing a great deal of glitter, east Berlin remained bleak and forlorn, and its main décor was the flags and bunting draped on whole houses and ruins alike and the monster pictures and placards of the leaders of communism.

West Berlin gradually regained its position as the artistic centre of Germany; and its festivals of music and drama and many of its exhibitions compared favourably with prewar days. In 1948 the Free University of Berlin was founded in the western sector, with the help of a big grant from the Ford foundation, because the old Humboldt university, formerly the University of Berlin, is in the eastern sector. But both the western powers and the west Berlin authorities realized that the major effort in the recovery of the city had to be made in two fields, the rebuilding of the city and the development of its industries. Total rebuilding was estimated at 12,000,000,000 DM. and allocations had averaged 700,000,000 DM. a year from 1953 to 1956. In 1957 the "Hansa" district of the British sector of Berlin was rebuilt as a model homes exhibition. Blocks of flats were designed by outstanding European architects. Extensive plans were made for the rebuilding of the central parts of the city and for the laying out of parks and recreation grounds and increasing sums of money were channeled into the electrical, light metal and clothing industries which are west Berlin's main sources of livelihood.

See also references under "Berlin" in the Index.

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Current history and statistics are summarized annually in *Britannica Book of the Year.* (T. C. PE.)

BERLIN: *see* CARRIAGE.

BERLIN, CONGRESS OF (1878). By the treaty of San Stefano (*q.v.*) of March 3, 1878, which terminated the Russo-Turkish War of 1877, Russia compelled Turkey to agree to the creation of a large Bulgarian state, the so-called "Great Bulgaria," in accordance with the policy of the Asiatic department of the Russian foreign office. A large unwieldy Bulgaria would necessarily have looked to Russia for support. This solution, however, was unacceptable to Austria-Hungary because the formation of large Slav states in the Balkans would serve to attract the Slavs of the southern regions of the Habsburg empire, thus threatening its integrity. Lord Beaconsfield's Conservative government in Great Britain likewise objected to any solution which might detract from the authority of the Ottoman sultans. Before the signing of the treaty, the German chancellor, Prince von Bismarck, on Feb. 19, 1878, had proposed a congress in which Germany would have the role of "honest broker" reconciling the various powers, for which reason the congress was held in Berlin.

On May 29, 1878, Lord Salisbury, the British foreign secretary, came to an agreement with the Russian government through its ambassador in London, Count P. A. Shuvalov, by which Russia abandoned the "Great Bulgaria" policy. Austria and Great Britain by their convention of June 6, 1878, agreed to work together at the congress for the creation of an autonomous Bulgarian state which was not to extend south or southwest of the Balkan range. Thus before the congress of Berlin met the "Small Bulgaria" solution had been accepted in principle.

The congress assembled in Berlin on June 13 under Bismarck's presidency. The principal plenipotentiaries were Lord Beaconsfield and Lord Salisbury for Great Britain, Count Gyula Andrássy for Austria-Hungary, Prince A. M. Gorchakov and Count Shuvalov for Russia, and Alexandros Karatheodori (Carathéodory) Pasha, a Phanariot Greek, for Turkey. France was represented by the foreign minister, W. H. Waddington, and Italy by Luigi Corti, who played only a small part in the working of the congress. In view of his poor health and failing memory Gorchakov left the effective negotiating in Shuvalov's hands, while on the British side Beacons-

field's lack of familiarity with Balkan problems meant that Salisbury was the more important British representative. Andrássy tended to allow the British to take the initiative in resisting the Russians. The Russian experts' closer acquaintance with the Balkan terrain permitted Russia, within the limitations imposed by the understanding with Great Britain, to achieve certain minor successes.

The provisions of the treaty signed on July 13, 1878, may be divided into four main groups:

1. *Bulgaria.*—The congress constructed a "Small Bulgaria" north of the Balkan range including the towns of Varna and Sofia, which was to be an autonomous and tributary principality under Turkish suzerainty, but ruled by an elected Christian prince. South of the Balkan range a province of Eastern Rumelia was formed, to enjoy administrative autonomy under the sultan's direct military and political authority, but with a Christian governor general. The purpose of this was to satisfy the demands of the Bulgarian population, but at the same time to give Turkey an adequate defense line in the Balkan mountains. This latter aim was, however, to some extent modified by the grant to Bulgaria of the sanjak as well as the town of Sofia.

2. *Bosnia-Hercegovina and Montenegro.*—Bosnia-Hercegovina was placed under the occupation and administration of Austria-Hungary, but technically remained part of the Ottoman empire. Montenegro was given some extension of territory including access to the Adriatic at Bar (Antivari), but this extension was much less than that accorded by the treaty of San Stefano. Austria-Hungary also obtained the right in case of need to garrison the sanjak of Novibazar (Novi Pazar), which divided Montenegro from Serbia, and to maintain lines of communication there. Thus Andrássy obtained the main aims of Austro-Hungarian policy. The Slavs of Bosnia-Hercegovina could be kept under control by Austrian troops without at the same time their being citizens of Austria-Hungary, while the right to intervene in the sanjak of Novibazar placed Austria-Hungary in a position to prevent a union of Serbia and Montenegro.

3. *Rumania, Serbia, Greece and the Danube.*—Rumania and Serbia obtained recognition of their independence together with some territorial changes, Rumania receiving part of the Dobruja as compensation for the retrocession of southern Bessarabia to Russia, and Serbia receiving extension including the towns of Nis, Pirot and Vranje. Greece obtained the provision that Crete should be governed in accordance with the organic statute of 1868. Provision was made for the international supervision of navigation on the Danube.

4. *Asia Minor.*—Turkey ceded to Russia the territories of Ardahan, Kars and Batum, subject to the condition that Batum should be a free port. Turkey undertook to institute reforms in areas inhabited by Armenians and to observe religious toleration throughout the Ottoman dominions.

While Austria-Hungary made real gains and Great Britain was reasonably content, the treaty of Berlin did not solve the Eastern question (*q.v.*). The Christian populations subject to Turkey remained discontented—a situation which the chronic disorder of the Ottoman administration did nothing to improve.

BIBLIOGRAPHY.—For the text of the treaty *see* E. Hertslet, *History of Europe by Treaty*, vol. iv, p. 2759 (1891). *See* also W. N. Medlicott, *The Congress of Berlin and After* (1938); B. H. Sumner, *Russia and the Balkans, 1870–1880* (1937). (R. F. LE.)

BERLIN-STETTIN CANAL is a canal system consisting of three parts: the Havel river below Spandau, the lower Oder to Stettin (Szczecin, Pol.) and the interconnecting Oder-Havel canal. The last, from below Oranienburg on the Havel to Hohensaaten on the Oder, also named the Hohenzollern canal, built in 1914, is 56 km. (35 mi.) long. The whole stretch of this waterway is available for 750-ton barges, but although it was the principal water-outlet for Berlin before World War II, its postwar traffic has been greatly reduced. (R. E. DI.)

BERLIOZ, (LOUIS) HECTOR (1803–1869), French composer, critic and conductor, a many-sided genius whose contributions to 19th-century music only began to be fully understood some 50 years after his death. He was born on Dec. 11, 1803, in the village of La Côte-Saint-André 35 mi. N.W. of Grenoble in the French Alps. France was at war, the schools were disrupted and Berlioz received his education from his father, an enlightened and cultured physician, who gave him his first lessons in music as well as in Latin. But, like many great composers, Berlioz received in his early years little formal training in music. He worked out for himself the elements of harmony and by his 12th year was composing for local chamber music groups. With help from performers he learned to play the flute and the guitar, becoming a virtuoso on the latter instrument.

In 1821 his father sent him to Paris to study medicine, and for a year he followed his courses faithfully enough to obtain his first degree in science. But he took every opportunity to go to the Opéra, where he studied the works of Gluck, score in hand. His vocation was so clear in his mind that he contrived to become accepted as a pupil of Jean François Lesueur, professor of composition at the Conservatoire de Musique. This led to disagreements with his family that embittered nearly eight years of his life. He persevered, took the obligatory courses at the Conservatoire, notably Anton Reicha's in counterpoint, and in 1830 won the Prix de Rome, having received second prize in an earlier competition. These successes pacified his family but were, in a sense, incidental to his career, for in the same year he had finished and obtained a performance of his first great score, which is also a seminal work in 19th-century music, the *Symphonie Fantastique*.

It was in some respects unfortunate that instead of being able to follow up this success Berlioz was required, under the terms of his prize, to spend three years abroad, two of them in Italy. During his long Paris apprenticeship he had experienced the "revelation" of two modern musicians, Beethoven and Weber, and of two great poets, Shakespeare and Goethe. He had meanwhile fallen in love, at a distance, with Harriet Smithson, a Shakespearian actress who had taken Paris by storm; he on the rebound, had become engaged to a brilliant and beautiful pianist, Camille Moke, later Mme Pleyel. In leaving Paris, Berlioz was not only leaving a flirtatious fiancée and the artistic environment that had stimulated his powers; he was also leaving the opportunity to demonstrate what modern French music should be. The public was content with the "Paris school," dating back to the 1780s and 1790s, and there is evidence that all Europe (including the Vienna of Beethoven and Schubert) accepted the productions of Grétry, Méhul, Cherubini and their followers as leading the musical world.

Berlioz wanted to bring forward the work of Weber and Beethoven (including the last quartets) and add contributions of his own. He also preached, for the sake of dramatic expression in music, a return to an older master, Gluck. These three musicians were all in some sense dramatists, and to Berlioz music must first and foremost be dramatically expressive. This doctrine he had begun to expound in his first musical reviews, as early as 1823, and, because of the sharpness and strength of his early vision, it remained the artistic creed of his mature years. When one understands its intellectual and intuitive basis, one understands also the reasons for his dynamic career. What may look like self-seeking—the unceasing effort to have his music played—was in fact the dedication of his tremendous energies to a cause, often at the expense of his own creative work. The result of his many journeys to Germany, Belgium, England, Russia and Austria-Hungary was that he taught the leading orchestras of Europe a new style, and through them a new idiom to the young composers and critics who flocked wherever he went.

But before these "campaigns" began, Berlioz had his time of reflection in Italy. He has told in his *Mémoires* (1870) how bored he was, and unproductive, after the rich output of the Paris years, which had brought forth an oratorio, numerous cantatas, two dozen songs, a mass, part of an opera, two overtures, a fantasia on Shakespeare's *Tempest*, and eight scenes from Goethe's *Faust*, as well as the *Symphonie Fantastique*. However, even in Italy, Berlioz filled notebooks, met Glinka, made a lifelong friend of Mendelssohn and tramped the hills with his guitar over his shoulder, playing for the peasants and *banditti* whose meals he shared. The impressions gathered in Italy remained a source of

both musical and dramatic inspiration to his last works, *Les Troyens* and *Béatrice et Bénédict*.

Meanwhile, his love affair not prospering and his impatience with life at the Villa Medici in Rome becoming acute, he returned to France after 18 months, thus forfeiting part of his prize.

Back in Paris, he set about conquering it anew. He put together a collection of earlier pieces in a form then fashionable, the monodrama, or recitation by one actor interspersed with musical scenes. Since the *Symphonie Fantastique* had ended with the death of the protagonist, Berlioz called his new work *Le Retour à la Vie* (later *Lélio,* after the hero's name). First performed in 1832, this concoction, which contains three or four delightful pieces, enjoyed great success, and Berlioz had reason to think himself launched again.

A series of accidents brought him in touch with the actress Harriet Smithson, still beautiful but in financial straits, and, his mental and artistic attachment to her reviving, he married her on Oct. 3, 1833. The marriage did not last, though for some years the couple led a peaceful existence at Montmartre in the house that Maurice Utrillo later never tired of painting. Among the visitors there were the young poets and musicians of the romantic movement, including Alfred de Vigny and Chopin. It was there that Berlioz's only child, Louis, was born and also where he composed his great Requiem, the *Grande Messe des Morts* (1837), the symphonies *Harold en Italie* (1834, inspired by Byron's *Childe Harold*) and *Roméo et Juliette* (1839), and the opera *Benvenuto Cellini* (Paris, 1838).

It was after the *première* of *Harold en Italie* that Berlioz had the astonishing experience of seeing the world-famous violin virtuoso Paganini fall at his feet and declare that he was a genius destined to carry on the new musical tradition initiated by Beethoven. The next day Berlioz received 20,000 francs with a letter from Paganini repeating this judgment. He used the money to free himself from journalistic drudgery and to compose the choral symphony, *Roméo et Juliette,* dedicated to Paganini.

But in Paris it was always expected that a composer, regardless of his bent, should be tested at the Opéra. Berlioz's friends intrigued to procure the assignment of a libretto. An adaptation of Benvenuto Cellini's autobiography was secured, and Berlioz finished his score in a short time. But the intrigue now passed to the other side, which saw to it that the production of *Benvenuto Cellini* at the Opéra failed. From this blow the work itself and the composer's reputation in France never recovered during his lifetime. The score, still little known in the early 1960s, is a masterpiece, and the attribution of the failure to the libretto shows ignorance of the qualities of both the libretto and the music.

The Requiem of 1837 had been a government commission for a military and ceremonial occasion designed to encourage the Rome laureate, and the request to compose the *Symphonie funèbre et triomphale* for military band, chorus and strings for the tenth anniversary of the July Revolution (1840) was intended as a partial solace for the defeat of *Benvenuto Cellini.* A few years before, Berlioz's literary gifts had won him the post of music critic for the leading Paris newspaper, the *Journal des Débats,* and his employers wielded political influence. Once again there were intrigues, but the score was ready for the inauguration of the Bastille column. Unfortunately the music was drowned by the assembled drum corps, a disaster that Berlioz repaired by giving the work the following month at a concert hall. This was the score that Wagner, then seeking fame and fortune in Paris, admired so wholeheartedly.

Berlioz was able to put Wagner in the way of some musical journalism, and thus began a fitful connection of 30 years between the two men whose influence on modern music still resembles a battle of ideals: Berlioz aiming at the creation of drama in and through music alone; Wagner at a marriage of symphony with opera. Though they met again in London in 1855 and found each other congenial, their philosophical differences generally kept them apart, as did also Wagner's habitual duplicity.

After 1840 Berlioz's life consisted of a series of tours across Europe. The last was an exhausting series of concerts in St. Petersburg and Moscow in 1867, when he was desperately ill. But it had the effect of introducing the Russian "Five," notably Moussorgsky, to his style through his manuscript scores and his conducting. For Berlioz was the first of the virtuoso conductors, having made himself such in order to supply the deficiencies of men who were unable to direct the new music according to the new canon: play what is written. Moreover the rhythmical difficulties of his scores and the unfamiliar curve of his melodies disconcerted many. The orchestras themselves had to be taught a new precision, vigour and ensemble, and this was Berlioz's handiwork.

On orchestration itself (and, even more important, on instrumentation) Berlioz produced the leading treatise, *Grand Traité d' Instrumentation et d'orchestration modernes* (1844). Being much more than a technical handbook, it served later generations as an introduction to the aesthetic expressiveness in music. As Albert Schweitzer has shown, its principle is as applicable to Bach as to Berlioz, and it is in no way governed by considerations of so-called "program music."

Among Berlioz's dramatic works two became internationally known: the *Damnation de Faust* (1846) and *L'Enfance du Christ* (1854). Two others began to emerge from neglect after World War I: the massive two-part drama *Les Troyens* (composed 1855–58; part II produced in Paris, 1863; entire, in Carlsruhe, 1890) based on Virgil's story of Dido and Aeneas, and the short, witty comedy *Béatrice et Bénédict* written between 1860 and 1862 and based on Shakespeare's *Much Ado About Nothing.* For all these Berlioz wrote his own librettos. He also wrote a *Te Deum* (1849; performed 1855), which is a fitting counterpart to the Requiem, and between 1843 and 1856 he orchestrated his songs, including the song cycle *Nuits d'été.* Among his best-known overtures are *Le Roi Lear* (performed 1833); *Le Carnaval romain* (1844) based on material from *Benvenuto Cellini,* and *Le Corsaire* (1855).

Berlioz's last years were marked by fame abroad and vulgar hostility at home. In his private life he was incapacitated by illness and saddened by many deaths. His first wife, from whom he was separated but to whom he still felt a deep attachment, died in 1854; his second wife, Marie Recio, who had been his companion for many years and whom he had married when he became a widower, died suddenly in 1862. Finally, his son, who was a sea captain and on whom he concentrated the affection of his declining years, died of yellow fever in Havana at the age of 33, two years before Berlioz's own death in Paris on March 8, 1869.

Characteristics of Berlioz's Music.—The outstanding characteristics of Berlioz's music—its dramatic expressiveness and variety—account for the feeling of attraction or repulsion that it produces in the listener. Its variety also means that devotees of one work may dislike others, as one finds lovers of Shakespeare who detest *Othello.* But Berlioz also presents a particular difficulty of musicianship in being closer to the true sources of music than to its German, Italian or French conventions; his melody is abundant and extended, and disconcerting to the lover of four-bar phrases; his harmony may be obvious or subtle, but it is always functional and frequently depends on elements of timbre; his modulations can be harsh and may even seem harsher than they would in another composer, because he uses his effects sparingly and achieves much by small means and adroit contrasts. This is also true of his orchestration, generally light and transparent, never pasty. As Shaw said: "Call no conductor sensitive in the highest degree to musical impressions until you have heard him in Berlioz and Mozart."

Estimates of Berlioz's Art.—César Franck once said that Berlioz's whole output is made up of masterpieces. He meant by this that each of the composer's dozen great works was the realization of a conception distinct from all the others, rather than successive efforts to attain perfection in the last or best of the series. Franck's judgment is borne out by the fact that, unlike many composers, Berlioz almost never repeats himself. Rather, he creates a fresh style for each of his subjects, with the result that familiarity with one is no guaranty of ready access to another. Nothing could be less alike than the *Symphonie funèbre et triomphale* and *Roméo et Juliette,* or than the *Requiem* and *L'Enfance du Christ.* To be sure, Berlioz's harmonic system seems the same throughout, partly because it deviates so noticeably from common expectation, partly because its nuances have scarcely begun to be appreciated. Again, his melody and free counterpoint everywhere carry his

mark—the sinewy originality and dynamic equilibrium of the former, the ingeniously careless independence of the latter—but out of similar elements Berlioz makes a radically different atmosphere for each of his dramas, and within them for each of his dramatis personae. Only a repeated hearing of any given work discloses all the power and art that it contains. This does not mean that these works are without flaw; it does mean that they are unique creations, to be taken for what they have to give, which no other composer provides.

In the creation of drama and atmosphere Berlioz excels in scenes of melancholy, introspection, love—gentle or passionate—the contemplation of nature, and the tumult of crowds. His intention throughout is to combine truth with musical sensations, be they powerful, or (to quote Shaw again): "wonderful in their tenuity and delicacy, unearthly, unexpected, unaccountable."

Much might be added or quoted that would show the extent to which Berlioz's music still needs careful and dispassionate study. In 1935 Donald Tovey, who had not before heard *Les Troyens*, declared that it is "one of the most gigantic and convincing masterpieces of music drama." And he went on: "You never know where you are with Berlioz." What is certain is that books that date from the 19th century or echo its views, with or without a bias toward Wagner or Debussy, will mislead the student and possibly close the ears of the listener. It is easy to represent Berlioz as merely a craftsman in tone colour who helped develop the resources of the orchestra. The cause that has begun to change both the hostile and the bewildered views is the repeated performance of the major works. Before 1945 the Berlioz repertoire in the western world was limited to the *Symphonie Fantastique* and a few brief extracts. The great works, done once, and usually with insufficient preparation, produced little effect and confirmed the wisdom of letting them lie. The advent of long-playing records radically altered the situation. Audiences can now judge the interpretations that they are increasingly being given, so that with respect to Berlioz they are approaching the state in which they hear the other classical composers. Still wanting is an intensive study of the musical and aesthetic elements in Berlioz's work as a whole—a study based on the original scores and one that should lead to a scholarly edition of the works, the so-called German edition being untrustworthy for either study or performance.

When Berlioz is truly known in both the scholar's and the listener's way it will be time to attempt a final assessment of his art.

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(JA. BA.)

BERMEJO, BARTOLOMÉ (BARTOLOMÉ DE CÁRDENAS) (fl. 1474–1495), Spanish painter of Córdoban origin, a cultivator of the Flemish style, was trained, apparently, in the circle of Dierick Bouts, though little is known of his early activity. It is certain that between 1474 and 1477 he worked in Aragon, where he left disciples, and between 1486 and 1495 in Catalonia, where he collaborated with J. Huguet, the principal master of that school.

Among his main works are the "Santo Domingo de Silos" (Prado, Madrid), a monumental figure seated on a rich gilt throne, and the "San Miguel With Donor" (Ludlow collection) from Tous, Valencia. The latter is signed "Bartolomeus Rubeus"—the latinized form of his name—and its background is of the gold so much to the taste of the region. In another masterpiece, the "Pietà" with the portrait of Canon Luis Desplá (Barcelona cathedral), completed in 1480 and probably the most important Spanish painting of the 15th century, he omitted the gold and painted as background a beautiful landscape very much in the Eyckian manner. Other works are "Virgin with Donor" (Acqui cathedral, Italy), "Adoration of the Kings" (Capilla Real, Granada) "Santa Engracia" (Gardner collection, Boston) and "Santo Domingo de Silos" (Art Institute, Chicago).

(DI. A.)

BERMONDSEY, a metropolitan borough of London, Eng., which under the London Government Act 1963 was to be joined on April 1, 1965, with Camberwell and Southwark to form the new London borough of Southwark (*see* LONDON). Bermondsey metropolitan borough is bounded by Deptford, Camberwell, Southwark and the Thames, there crossed by Tower bridge. Area 2.7 sq.mi. Pop. (1961) 51,815. The Norman kings had a palace at Bermondesye, so spelled in Domesday Book, and there may have been a Saxon palace earlier. The influential Cluniac monastery, built 1082–89, stood approximately where Bermondsey square now is; Henry II held his Christmas court there in 1154 and Catherine of Valois and Elizabeth Woodville, the widows respectively of Henry V and Edward IV, died there. Its most glorious possession was a miracle-working rood. The foundation became an abbey in 1399 and was razed in the 16th century. St. Olave's and St. Saviour's Grammar school in Tooley street dates from 1562.

The parish of Rotherhithe, once Redriff, in the northeast has long been associated with a seafaring population, and the extensive Surrey Commercial docks are there. St. Mary's parish church (rebuilt 1714–15) has registers recording the burial of Christopher Jones (March 5, 1621), who was master and part owner of the "Mayflower." The burial in 1638 of John Moore, also part owner, and the baptism in 1575 of John Clarke, who was probably the master's mate and pilot, are also recorded. Clarke married at St. Mary's (1610); Clarke's island in Plymouth bay, Mass., is named after him. Rotherhithe appraisers condemned the "Mayflower" in 1624 and at Rotherhithe the ship was probably broken up. A road tunnel (1¼ mi.) to Whitechapel on the opposite shore of the river was opened in 1908. The neighbouring Thames tunnel to Wapping was the joint work of Sir Marc Isambard Brunel and his son Isambard Kingdom Brunel, and opened in 1843; it is now part of the Metropolitan line.

Apart from its docks and wharves Bermondsey is a highly industrialized area. The manufacture, storage and distribution of food are extremely important but the borough is also noted for its tanneries and leather works, exemplified by the National Leathersellers' college and museum of leathercraft in Tower Bridge road. There are other industries and much commercial activity. Southwark park, roughly in the middle of the borough, is south of Jamaica road. Bermondsey returns one member to parliament.

BERMUDA GRASS (*Cynodon dactylon*), a native of the Mediterranean region, is perhaps the most important pasture grass in the southern and southwestern United States and is also much used on lawns and golf greens. On moist fertile soils it may become sufficiently tall to be cut for hay. It is a low growing perennial grass, with creeping rhizomes and stolons, and slender digitate spikes borne at the ends of the stems. Propagation is by seeds and by the rhizomes and stolons, and, because of the latter method, it often becomes a troublesome weed in cultivated ground. *See* also LAWNS, CARE OF; GRASSES.

(J. M. BL.)

BERMUDA RIG (also known as the MARCONI or JIB-HEADED RIG), the lofty, triangular fore-and-aft mainsail of modern racing and cruising yachts. Its prototype is generally held to be the "shoulder-of-mutton" rig used in ships' boats and other small naval vessels, and it was first seen in about 1808 on the small craft of the Bermudas.

In its original form it consisted of a tall mast, raking well aft, and a loose-footed sail with a sprit to hold it out instead of a boom. As developed for use in yachts the mast was lengthened considerably, being well stayed with spreaders for strength, and the foot of the sail shortened. This was to give a long "leading edge" to the sail, the ratio of height (or hoist) to foot being as high as 2.5 to 1 on small yachts, although 2 to 1 or 1.5 to 1 is more common in yachts over 50 ft. long. The rig is very efficient in working to windward, there being no gaff to sag away to leeward and so spill the wind out of the sail. In its modified form the rig did not come into general use on yachts outside the Bermudas until after 1918, but between World Wars I and II its advantages in efficiency and ease of handling became widely appreciated, and by the 1950s it had been adopted throughout the world in the majority of auxiliary yachts as well as racing yachts and dinghies.

See also YACHTING.

BERMUDAS, a British colony consisting of a group of islands in the western North Atlantic, about 570 mi. E.S.E. of Cape Hatteras, N.C. The group comprises about 300 islands, islets and rocks clustered in a chain shaped like a fishhook, with an over-all length of about 22 mi. and an area of 20.59 sq.mi. Only about 20 of the islands are inhabited. Great Bermuda or the "mainland" is the largest (about 14 mi. long) and contains the capital, Hamilton (*q.v.*). It is linked by bridge and causeway to six other islands: St. George's and St. David's to the east, and Somerset, Watford, Boaz and Ireland to the west. This chain partially encloses four large expanses of sea—St. George's harbour, Castle harbour, Harrington sound, and Great sound—in which most of the remaining small islands are situated.

Geology and Relief.—The Bermudas form one of the northernmost groups of coral islands in the world and consist principally of wind-blown calcareous deposits capping a submerged and beveled volcanic cone which rises over 10,000 ft. from the floor of the Atlantic. The deposits are thought to derive from an extensive shelf, now submerged, which surrounds the islands and was probably dry land during Pleistocene phases of lowered sea level. Relief is generally low, with hills rising to a maximum height of about 260 ft., and there is no surface water. The soil consists of thin red-brown clay and loam, often mixed with white coral sand.

Climate.—Mild and fairly humid conditions are experienced. The average temperature for January is 62.6° F. and for July 78.4°, with recorded extremes of 94° and 39°. Rainfall is evenly distributed throughout the year and averages 58 in. It is the only source of fresh water, and is collected from the roof tops of almost all buildings and stored in tanks.

Vegetation and Animal Life.—When first discovered the islands were thickly wooded. The commonest tree was (and still is) a species of juniper known as Bermuda cedar, but it has suffered a severe infestation of juniper scale disease and dead trees disfigure large areas. Replanting began in 1952. Many plants have been introduced, deliberately or accidentally, and some of them, such as prickly pear cactus, have spread widely. Due to their remote oceanic position the Bermudas have no native mammals, only one native reptile—a lizard—and seven species of native land birds; but several animals, such as frogs, rats and mice, have been introduced, and many land birds migrate to the islands. Among the sea birds is the Bermuda petrel (*Pterodrama cahow*). Before 1951, when it was rediscovered, this bird had been supposed extinct for over 300 years. The surrounding waters are rich in fish and lobsters and in 1960 attempts were made to develop both a local fishing industry and game fishing as a sport for visiting tourists.

History.—Mystery surrounds the discovery and naming of the islands. The Spanish navigator and historian Fernandez de Oviedo sailed close to them in 1515; they were then already known as the Bermudas and he ascribed their discovery to his countryman, Juan de Bermúdez. Other ships visited them in the 16th century, and they were accidentally settled by the British in 1609 when the ship "Sea Venture" under Sir George Somers, taking colonists to the Virginia plantations, was wrecked off the Bermudas. Somers' narrative of the wreck was one of the sources used by Shakespeare in 1611 for *The Tempest*, which mentions "the still-vexed Bermoothes." In May 1610, the castaways reached Virginia and in 1612 the Bermudas were included in the third charter of the Virginia company, 60 settlers then being sent out. The Bermudas have been a British possession ever since, remaining under company rule until 1684 when they reverted to the crown. In the 18th century they became a British naval base and from 1797 had a garrison. During the 1950s the naval dockyard was closed and the troops withdrawn. In 1941 the United States was granted a 99-year lease of sites for naval and air bases.

Population.—The Bermudas were uninhabited when first discovered. Following British settlement Negro slaves were imported, as later were Portuguese labourers from Madeira and the Azores. By 1881 the total population numbered about 14,000, but by 1960 it had increased to 42,640 so that the average density was over 2,000 per sq.mi. About 60% of the population is Negro.

BY COURTESY OF BERMUDA NEWS BUREAU

GOVERNMENT HOUSE, HAMILTON, GREAT BERMUDA

The population of Hamilton was 2,763 and of the former capital, St. George, 1,335. If the growth of population continued at the rate reached at the beginning of the 1960s, it would produce acute overcrowding and emigration would become increasingly necessary.

Administration.—The colony has representative but not responsible government. Executive government is conducted by a governor, appointed by the crown, who is advised by an executive council of seven members. Legislative authority rests in the governor, in a legislative council of 11 members and in a representative house of assembly of 36 members, 4 of whom are elected by each of the nine parishes for a term of five years. There is adult suffrage for men and women, subject to a property qualification. Primary education, from 7 to 13 years of age, is compulsory and free, and there are a number of secondary schools.

The Economy.—The economy depends primarily on tourism, but in the past agriculture and the building and repairing of ships sustained the colony. With the increase of population and housing the land available for cultivation has greatly diminished. In 1956 only about 2,000 ac. remained available, of which about one-half was devoted to pasture, supporting mainly dairy cattle; about one-third to vegetables, principally potatoes, carrots and tomatoes; and the remainder to fruits, flowers and bulbs (chiefly bananas, citrus fruits and Easter lilies). The islands' main sources of employment are the tourist and ship-repairing industries and the installations of the United States forces. Attempts to attract light industries have resulted in the establishment of factories making pharmaceutical products and concentrated essences which, in 1958, provided the two most valuable exports. Lily flowers and bulbs are the only important agricultural exports; foodstuffs from the United States are the main imports. The railway was discontinued in 1948.

Motor vehicles, which were prohibited until 1946 and are now limited in size and power, provide transport on the 128 mi. of public roads, and ferries ply across the Great sound. External communications are maintained by numerous shipping and air lines which use the harbour at Hamilton and Kindley Field airport on St. David's Island. In 1959 more than 109,000 tourists visited the Bermudas, 88% of whom arrived by air.

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BERN (BERNE), a Swiss canton and its capital city, which is also the capital of the Swiss confederation.

The City.—Bern stands mainly in a narrow loop of the Aare river, 1,800 ft. above sea level. Six road bridges connect old Bern with the newer residential area; a seventh bridge was being built in 1960. The population in 1960 was 163,172, of whom the majority were German-speaking. In the 1950 census there were 118,823 Protestants, 24,384 Roman Catholics and 792 Jews.

The existence of the ancient castle of Nydegg at the eastern end of the peninsula, guarding the passage over the Aare, probably

led Berchtold V, duke of Zähringen, to found Bern in 1191 as a military post on the frontier between the German-speaking Alamannians and the French-speaking Burgundians. The walls protecting the town were three times moved westward—in 1256, 1346 and 1622. After the extinction of the Zähringen dynasty (1218) Bern became a free imperial city, and gradually extended its power by acquiring surrounding territory, establishing its position over its rivals by the victories of Dornbühl (1298) and Laupen (1339) and becoming an independent state that in 1353 entered the Swiss confederation, founded in 1291. It soon took the lead within the confederation. In 1528 it was the scene of a disputation between Catholics and reformers that led to its acceptance and subsequent championship of reformed doctrines. In the 18th century the town governed 52 territories, the Bernese patricians thus being extremely powerful. Attempts to break down this monopoly failed in 1723 and 1749, but the whole system was swept away by the French in 1798, and though partially revived in 1815, ended in 1831 (*see* SWITZERLAND: *History*). In 1848 Bern became the political capital of the Swiss confederation.

Bern preserves more of its medieval appearance than any other town in Switzerland. The Gothic *Münster* (cathedral) dominates the city; begun in 1421, the spire was not finished until 1893. The city hall dates from 1406 and was restored in 1942. West of the central Nydegg bridge stretch a number of picturesque old streets lined with flower-decked houses and arcades in which are excellent shops. At the main crossroads is the famous *Zeitglockenturm* (clock tower) with a 16th-century clock and puppets (a crowing cock, bears, etc.) that revolve at the hour. This and the *Käfigturm* (prison tower) at the other end of the *Marktgasse* are the two remaining towers of the old walls. Some of the sites of outlying fortifications have been converted into promenades: one of the most famous is the *Schänzli* (little fortress) terrace just across the river, with magnificent views of the Alps, and a restaurant and casino. The federal houses of parliament, of which the oldest part dates from 1852–57, occupy a commanding position on a bluff 130 ft. above the river, also with fine Alpine views from the terrace. The buildings also house the administrative and executive offices; nearby are the headquarters of the national bank. The city and university library contains more than 800,000 volumes, including many manuscripts and rare printed books. The Swiss national library is also in Bern and houses more than 1,000,000 volumes. There are historical, natural history, art, rifle and Alpine museums. The university was founded in 1834 and incorporates the theological school (founded 1528). Bern has several exceptionally well-equipped and well-run hospitals.

The bear (Old High German *bero*), the town's heraldic device which appears on the first known seal (1224) and from which the town is said to take its name, is a favourite decorative motif. The famous bear pit, where bears have been kept since 1513, is just across the Nydegg bridge. There is a nature reserve and deer park along the river at Elfenau.

As well as being the seat of the Swiss parliament and administration, Bern has become headquarters of the international postal, telegraph, railway and copyright unions. It has flourishing industries, notably chocolate-making, engine-building, instrument-making and the manufacture of textiles and chemical and pharmaceutical products. It is also a market for local agricultural produce. It is an important railway junction and has an airport at Belpmoos, 4 mi. S.E. of the city, with a regular summer service that links Bern with Zürich's international airport.

The Canton.—Bern canton extends from beyond the Jura to the snow-clad ranges over against the canton of Valais. The second largest canton, it covers 2,659 sq.mi., of which more than 100 sq.mi. are occupied by glaciers. Pop. (1960) 889,523. It is mainly watered by the Aare (*q.v.*) river, with its affluents, the Saane (left) and the Emme (right); the Aare forms the two lakes of Brienz and Thun. Three divisions are usually distinguished: (1) the Oberland (highlands), which includes the snowy Alps culminating in the Finsteraarhorn, 14,022 ft., and the Jungfrau, 13,642 ft., as well as the famous summer resorts of Interlaken, Thun (*qq.v.*) and Meiringen, and the summer and winter resorts of Grindelwald, Mürren, Kandersteg (*qq.v.*) and Gstaad. (2) The Mittelland (midlands), comprising the valley of the Aare below Thun, that of the Emme, the outliers of the high Alps, the open country around the town of Bern and the Seeland (lakeland) around Lake Biel; (3) the Jura, extending from Biel across the Jura to Porrentruy, in the extreme northwest of Switzerland. The Oberland, Mittelland and Seeland form the "old" canton, the Jura having been acquired only in 1815 and differing from the rest of the canton in being French-speaking and predominantly (54%) Roman Catholic. The population, mainly German-speaking Protestants, numbered 869,000 in 1959, the second highest of any Swiss canton. Besides Bern, other important towns are Biel (*q.v.*), Burgdorf, Delémont, Porrentruy, Thun and Langenthal. The canton is divided into 30 administrative districts and contains 492 communes. The existing constitution dates from 1893, but in 1906 the direct popular election of the executive (*Regierungsrat*) of nine members (hitherto named by the legislature) was introduced. The legislature or *Grosse Rat* is elected for four years (like the executive). The obligatory referendum obtains in the case of all laws, and of decrees relating to an expenditure of over 1,000,000 Fr., while 12,000 citizens have the right of initiative in the case of legislative projects, and 15,000 may demand the revision of the cantonal constitution. The two members sent by the canton to the federal *Ständerat* (council of states) are elected by the *Grosse Rat*, while the 33 members sent, on the basis of the census of 1950, to the federal *Nationalrat* (national council), are chosen by a popular vote.

In the Alpine portions of the canton the tourist trade both in summer and winter, agriculture, cattle-breeding, cheese-making (Emmental) and the operation of hydroelectric power stations are the important means of living; other occupations are wood carving (at Brienz) and pottery making at Heimberg near Thun. The Mittelland is both agricultural and industrial; vine culture is carried on in the Seeland (around Lake Biel). Watch-making is the principal industry of the Jura; horse-breeding and engineering works are also important.

The canton of Bern is composed of the various districts acquired by the town of Bern. The more important, with dates of acquisition, are the following: Laupen (1324); Hasli and Meiringen (1334); Thun and Burgdorf (1384); Unterseen and the upper Simme valley (1386); Frutigen (1400); lower Simme valley (1439–49); Interlaken, with Grindelwald, Lauterbrunnen and Brienz (1528); Saanen or Gessenay (1555); Köniz (1729), and the Bernese Jura with Biel. But certain regions previously won were lost in 1798: Aargau (1415); Aigle and Grandson (1475); Vaud (1536); and the Pays d'Enhaut (1555). From 1803 to 1814 the canton of Bern was one of the six "directorial" cantons of the confederation. Its position on the frontier between the German- and French-speaking parts of Switzerland has permitted, and still permits, Bern to exercise an important unifying influence.

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BERNADETTE, SAINT, OF LOURDES (MARIE BERNARDE SOUBIROUS) (1844–1879), French peasant girl whose visions led to the foundation of the shrine of Lourdes (*q.v.*), was born at Lourdes on Jan. 7, 1844. The eldest of nine children, she was brought up in extreme poverty. Though very backward at school, she had good practical ability and a lively, simple and lovable character; and she shared her parents' religious piety.

At the age of 14 she had a series of visions of the Blessed Virgin Mary, who revealed her identity with the words "I am the Immaculate Conception." Bernadette steadfastly defended the genuineness of these visions despite strong opposition from her parents, the local clergy and civil authorities, and faithfully transmitted the heavenly visitor's messages. She returned to school

and everyday life with unspoiled simplicity; but to escape public attention she later became a boarder in the local school run by the Sisters of Charity of Nevers. In 1866 she begged for, and was reluctantly granted, admission into this congregation of nuns, and passed her remaining 12 years in the mother house at Nevers in prayer and seclusion, happy and loved for her kindliness, holiness and wit, despite almost constant sickness and pain.

She died in agony on April 16, 1879, willingly accepting her great sufferings in faithful fulfillment of her "Lady's" request for penance. She was canonized in 1933. Her feast day is Feb. 18 in France; elsewhere it is celebrated on April 16.

See F. Trochu, *St. Bernadette*, Eng. trans. (1957). (Jn. R. J.)

BERNADOTTE, JEAN: *see* Charles XIV.

BERNADOTTE AF WISBORG, FOLKE, Count (1895–1948), Swedish army officer and humanitarian, was born at Stockholm, on Jan. 2, 1895, the son of Prince Oscar August and nephew of King Gustavus V. An official of the Boy Scout movement and the Red Cross organization, he was appointed mediator between the Arabs and Jews in Palestine by the United Nations security council in May 1948. Following a number of threats against his life, he was assassinated in Jerusalem by Jewish extremists on Sept. 17, 1948. *See* Israel; United Nations.

BERNANOS, GEORGES (1888–1948), French novelist and polemical writer, whose first novel, *Sous le soleil de Satan* (1926; Eng. trans., 1940, 1946), established him as one of the most original and independent Catholic writers of his time, was born in Paris on Feb. 20, 1888. He began life as a royalist journalist and later worked as an inspector for an insurance company. Like his predecessor Léon Bloy, Bernanos was a visionary for whom the supernatural world was never far away. He was also a man of humor and humanity, who abhorred materialism and any compromise with evil. His vehement sincerity inspired his political pamphlets *La Grande Peur des bien-pensants* (1931) and *Les Grands Cimetières sous la lune* (1938; Eng. trans., *A Diary of My Times*, 1938), the latter a fierce attack on fascist excesses during the Spanish civil war and on the church dignitaries who supported them.

In controversy his views were sometimes inconsistent or oversimplified. As a novelist he made his theme the struggle between the forces of good and evil for the soul of man, a conflict particularly exemplified in his studies of the priesthood. His characters represent far extremes of human behaviour, ranging from saintliness to utter depravity: they are powerfully imagined and realistically drawn, but at times come too close to melodrama.

In 1936 Bernanos published his masterpiece, *Journal d'un curé de campagne* (Eng. trans., *The Diary of a Country Priest*, 1937), a story of a young priest's war against sin despite mortal illness, much apparent failure and almost unending frustration. Other notable works were *La Joie* (1929; Eng. trans., 1946), *Nouvelle Histoire de Mouchette* (1937) and *Monsieur Ouine* (written, 1931–40; published in Rio de Janeiro in 1943, in Paris 1946; Eng. trans., *The Open Mind*, 1945). Over this last novel critical opinion was much divided.

Political events troubled Bernanos increasingly. In July 1938 he went into self-imposed exile with his wife and six children and began an unsuccessful farming career in Brazil. He felt acutely what he regarded as the moral degradation of the Munich agreement (*Scandale de la vérité*, 1939). This pamphlet contained a violent denunciation of Charles Maurras (*q.v.*), leader of the *Action française* group, with whose policies Bernanos had found himself increasingly at variance from 1919 onward. In June 1940 he gave his support to Gen. Charles de Gaulle. His broadcast messages and his *Lettre aux Anglais* (1942; Eng. trans., *Plea for Liberty*, 1944) influenced his compatriots during World War II. A return to France in 1945 brought disillusionment.

Shortly before his death at Neuilly-sur-Seine on July 5, 1948, Bernanos completed the dialogues for a film scenario. This was a moving account of the attitude of 16 nuns martyred during the French Revolution, based on the story, *Die Letzte am Schafott*, by Gertrud von le Fort. In 1949 it was made into a play by Marcelle Tassencourt and Albert Béguin under the title *Dialogues des Carmélites* (Eng. trans., *The Fearless Heart*, 1952) and performed in 1952. An opera by Francis Poulenc, based on this work, was first performed in Milan in 1957. Béguin also edited *Georges Bernanos: Essais et témoignages inédits* (1949) and *Bernanos par lui-même* (1954; Eng. trans. of both, *Last Essays*, 1955).

Bibliography.—Luc Estang, *Présence de Bernanos* (1947); Pierre de Boisdeffre, *Métamorphose de la littérature*, 3rd ed., vol. 1 (1953); Louis Chaigne, *Georges Bernanos* (1954); Germaine Brée and Margaret Guiton, *An Age of Fiction* (1958). (S. C. Gd.)

BERNARD, SAINT (1090–1153), abbot of Clairvaux, mystic and reformer, was born either at Fontaines, Burgundy, the family seat near Dijon, or at Châtillon-sur-Seine, where his family, members of the Burgundian nobility, also had a residence. A centuries-old tradition favours Fontaines. Timid and retiring, Bernard was marked out early by his parents for an ecclesiastical career and was accordingly sent, as soon as he was old enough, to be educated by the canons who served the church of St. Vorles at Châtillon. There he became a literary genius of sorts (especially, one contemporary suggestion has it, in the composition of ribald verses) and more timid than ever. His studies would not seem to have progressed beyond the medieval trivium of grammar-rhetoric-dialectic, if indeed they progressed that far.

When he was 17 the death of his mother, Aleth, who earlier had been the chief influence upon his life, set in motion his long "conversion," as he called it. Eventually, becoming "conscious that my weak character needed a strong medicine," he considered joining a Benedictine monastery of an especially strict religious observance that had been founded recently at nearby Cîteaux. But to his own natural repugnance for a life of such austerity there were added the persistent inducements of his friends to a life of pleasure and the urgings, no less persistent, of his relatives to a life of further study and ecclesiastical preferment. After four years of this, when he was at the very point of saying good-by before setting out for Germany and more studies, he abruptly resolved upon Cîteaux. The opposition of his relatives and friends he overcame by simply persuading them, about 30 in number, to join Cîteaux along with him. This astonishing ability of the shy, dedicated Bernard suddenly to transform intransigent opponents into enthusiastic followers remained with him almost to his dying day. After a period of six months in which he conducted, for them and for himself, a prefatory trial of the monastic mode of existence in his father's house at Châtillon, the strange and varied group presented itself at Cîteaux. It included married men who, to follow Bernard, had foresworn their wives and their children; churchmen who, under the same powerful suasion, had abandoned their profitable benefices. And it embraced, it would seem, all his available relatives: two uncles, two cousins and four of his five brothers (the fifth, too young at the time, later also donned the Cistercian habit, as did his father, Tescelin). Small wonder that, as a contemporary chronicle attests, "mothers hid their sons and wives their husbands" from Bernard in those days. He was then 22 years old.

The period of his novitiate, April 1112 to June 1115, was one of extraordinary, self-imposed penances which in large part induced the ill-health which was to plague Bernard the rest of his days. In 1115 the abbot, Stephen Harding, put him at the head of 12 monks whom he sent to found an abbey at Clairvaux in Champagne. There, to the fatigues which the pioneering condition of the new foundation imposed upon his already debilitated physical condition, was added an acute psychic distress: Bernard found himself split between his aspirations for a solitary life, wholly given over to contemplation, and the duty of directing his fellow monks. At first he sought to heal the lesion by adjusting his religious duty to his private preference and drove his monks along the road he followed himself. Gradually, however, he acquired an attitude of greater patience and reserve, which, if it did not resolve his difficulty, made it possible for him to live with it and for others to live with him. It was a self-adjustment that stood him in good stead in his career as "the conscience of all Europe," which now opened before him.

It was within the monastic system itself that his influence was initially exercised. The Cistercian experiment (*see* Cistercians), which upon his arrival at Cîteaux seemed close to failing, took on

a new and vigorous life under his influence and grew rapidly into a far-flung order; before his death there were 338 monasteries with several hundred monks in each. But even more important than this numerical expansion was the development in depth which he effected by his writings, chiefly sermons or treatises, such as *The Steps of Humility*, which were elaborations of original sermons. He, who had been so rigid, took as his constant theme liberty of spirit, the cherished, hard-won insight which is so luminously presented in his *Grace and Free Will*, and which dictated his response to Hugh of St. Victor ("Letter 77"): freedom of opinion in all matters not determined by faith. His unvarying centre of reference is Christ, whom he views with predilection as the Word. Indeed so marked is this orientation in the writings of Bernard that he has been credited, unjustifiably, with having originated Christocentrism in spirituality.

It is with even less warrant that Bernard has been termed the Marian doctor. Upon the salutary mediation of the Virgin Mary he expressed himself with more vigour, but with less exactitude, than had any previous monastic author. Texts in which he preaches on Mary justify neither by their number, their extent, their theological solidity nor their doctrinal originality the traditional appellation accorded him.

In all his preaching and writing Bernard had constant recourse to the Scriptures. His manner of doing so was of a singular effectiveness not only upon his intended auditors or readers but also upon the formation of an entire subsequent tradition of monastic theology, for he made no pretense at exegesis. His purpose, he declared, was "to penetrate hearts rather than to explain words." Apropos of the Bible, with the aid of the Bible, it was his own thought that he expressed. The perpetual relevancy of the words of Scripture consists in this: each reader can use them as expressive of his enthusiasm or as bespeaking his own experience. Only by exception, when engaged in strictly dogmatic matters, does Bernard approach the scriptural text with an attempt at objectivity.

From the earliest years, his influence, quite against his will, began to extend beyond the confines of monasticism, and with increasing frequency he was drawn out of his solitude to act as peacemaker, reformer, judge. He took part in important ecclesiastical discussions, was adviser to papal legates and in 1128 was secretary of the Council of Troyes. But, aside from the eulogy which the council asked him to compose in praise of the Knights Templars as an aid to recruitment, and the initial draft of a rule of life for such military orders which he wrote at that time, his work was comparatively circumscribed and local. With the election of two contenders to the papacy in 1130, however, he was drawn fully into the public eye, and for almost a quarter of a century all Europe became his parish.

At the Council of Étampes, convoked by Louis VI of France to aid him in finding out whether it was Innocent II or Anacletus II who was the legitimate successor of Honorius II, Bernard began with the postulate (derived from Yves de Chartres) that such a problem is to be resolved, first and foremost, in terms of the personalities involved: the one who is the better man is the lawful pope. There was no doubt in his own mind who of the two in this instance was the better man. Anacletus had been a monk of that earlier community at Cluny which Bernard despised even more than he did the existing one; Anacletus was of Jewish origin and, as Bernard was to write later, "it would be an insult to Christ if the offspring of a Jew occupied the throne of Peter"; Anacletus was not the friend of Bernard's friend, Haimeric, who had engineered the election of Innocent. There was no doubt in the king's mind either when Bernard had finished and the council pronounced for Innocent. With the pronouncement Bernard assumed the task of convincing Europe. Unceasing correspondence, travel and deployment of his oratorical skills soon won over France, Germany and England. It was largely due to his own efforts that he was able to say of Innocent before long: *Pulsus urbe, ab orbe suscipitur*, "From Rome expelled, by the world he is accepted." But then, not uncharacteristically, he went on to use the felicitous and memorable formula as an argument in favour of the validity of Innocent's election. By 1133 he was in a position to negotiate successfully with the emperor and the cities of Italy and so enter Rome with Innocent and see him precariously installed at the Lateran.

Then followed the years, crowded with politics, which forced from him the cry: "I have become a sort of modern chimera, neither a cleric nor a layman." All his political activities were marked by the same singleness of purpose and ambiguity of method that characterized his handling of the Anacletus incident; they differed merely in a heightened intenseness of activity. No one not actually pope, with the possible exception of Athanasius (*q.v.*), ever determined the policy and fortunes of the church so markedly as did Bernard in the last two decades of his life. Having confirmed one pope, in his *On Consideration* he undertook the instruction of another, Eugenius III. It was Bernard who put down the revolutions at Milan, in Lorraine, at Bamber, and brought the new antipope, Gregory (Victor IV), to his knees in repentance at Rome. He decided the agenda for councils. He deposed princes and replaced bishops. He fought Cluny, the greatest monastic federation the west had ever seen, and Peter Abelard (*q.v.*), the most incisive mind the new dialectic had produced (*see* MYSTICISM: *Antidialectical*). In 1145 he sent Christendom on its second crusade. And all the while he was drawing to his abbey at Clairvaux and sending abroad throughout Europe a powerful elite that included a pope, cardinals, bishops and saints.

Historical opinion is not at one in its assessment of these turbulent decades and of the man who was at their centre. Most scholars, like the majority of his own contemporaries, have been inclined simply to bow before the manifest goodness and disinterestedness of Bernard and to inquire no further. Others have gone on to consider the highly specialized character of that disinterestedness. To all that fell within the perspective of Bernard's ideal of reform, he gave himself without a thought to his own reputation, physical discomfort or danger. To all who seemed to agree with him in that ideal he turned an astonishingly credulous ear. The upshot was an unhappy ability to believe—and precipitately to noise abroad—the very worst about ideals dissimilar to his own and about people other than his friends. And yet, it has also been felt, his sustained campaigns of personal vilification against Anacletus, the Cluniacs, Girard of Angoulème, Abelard, William of York and others, which served to distort the historical record of those years, can distort as well the figure of Bernard if divorced from the picture of him provided by his *Sermons on the Canticle of Canticles* of those same years: the timid, pain-racked saint, seated in the quiet eye of the continental hurricane he raised, speaking to his monks of the love of God. No chimera, St. Bernard was and remains a mystery.

He died at Clairvaux, Aug. 20, 1153, and was canonized in 1174. His feast day is Aug. 20. He was named a doctor of the church in 1830.

Most of St. Bernard's authentic works are to be found in J. P. Migne, *Patrologia Latina*, clxxxii–clxxxiii. English versions are found in G. Lewis, *St. Bernard On Consideration* (1908); E. G. Gardiner, *The Book of St. Bernard on the Love of God* (1915); a priest of Mount Meleray, *Works*, six volumes (1920–25); W. Williams, *Grace and Free Will* (1920), *Of Conversion* (1938); G. B. Burch, *The Steps of Humility* (1940); B. S. James, *Letters* (1953).

BIBLIOGRAPHY.—Four ancient lives are provided in J. P. Migne (ed.), *Patrologia Latina*, clxxxv, 225–550. Of the *Vita prima* (225–466), the chief source of information for the biographer, only bk. i (by William of St. Thierry), ii (by Arnold Bonneval), iii–v (by Geoffrey of Auxerre) were checked and approved by the bishops and abbots gathered at Clairvaux in 1155. The chronology of St. Bernard has been established by E. Vacandard in his *Vie de S. Bernard* (1895), the standard biography. Doctrine is emphasized in A. J. Luddy, *Life and Teachings of St. Bernard* (1907); political activity in W. Williams, *St. Bernard of Clairvaux* (1935); and his personality in B. S. James, *Saint Bernard of Clairvaux* (1958). *See* also Étienne Gilson, *The Mystical Theology of St. Bernard* (Eng. trans., 1940). (E. O'B.)

BERNARD OF CHARTRES (d. *c.* 1130), French scholastic philosopher, described by John of Salisbury as *perfectissimus inter Platonicos nostri saeculi* ("the most consummate Platonist of our age"), was a distinguished member of the school of Chartres, being head of this school from 1114 to 1119 and chancellor of the cathedral of Chartres from 1119 to 1124. Bernard was deeply interested in the classics and was an extreme realist in the Platonic tradition. He divided being into three categories: (1) the supreme

and eternal reality, God; (2) matter created by God out of nothing; and (3) ideas, the eternal exemplars in the Divine Mind through which the individuals of the finite world are ever present to God. John of Salisbury, whose *Metalogicus* is the source of information on Bernard's teaching, states that Bernard tried to reconcile Plato and Aristotle. Gilbert de la Porrée (who succeeded him as head of the school) and William of Conches were his pupils.

BIBLIOGRAPHY.—A. Clerval, *Les Écoles de Chartres* (1895); R. L. Poole, *Illustrations of the History of Medieval Thought and Learning*, 2nd ed. (1920); F. Copleston, *A History of Philosophy*, vol. 2 (1950).
(S. J. C.)

BERNARD, CHARLES DE (PIERRE MARIE CHARLES BERNARD DU GRAIL DE LA VILLETTE) (1804–1850), French writer whose novels and short stories present vivid and amusing pictures of Parisian and provincial society during the reign of Louis-Philippe, was born in Besançon, Feb. 24, 1804. He studied law, became a journalist and, encouraged by his friend Balzac, settled in Paris and wrote stories for Legitimist newspapers. *Le Noeud Gordien* (1838) and *L'Écueil* (1842) contain his best *nouvelles;* his novels include *Gerfaut* (1838), *Les Ailes d'Icare* (1840) and *Un Homme sérieux* (1843). In *French Poets and Novelists* (1878) Henry James describes Bernard as "a second-rate genius," but one with "the lightness, the ease, the gaiety, the urbanity, the good taste, the good spirits, the discretion . . . that have traditionally marked the French character." He died at Neuilly, March 6, 1850.

BIBLIOGRAPHY.—Bernard's *Oeuvres*, 10 vol. (1854–55); *see* Thackeray's *Paris Sketch-Book* (1840); G. Saintsbury, "C. de Bernard," *Fortnightly Review*, no. cxxxviii (1878); J. S. van der Wal, *C. de Bernard* (1940).

BERNARD, CLAUDE (1813–1878), French physiologist, one of the greatest of the great 19th-century physiologists and teachers, was born on July 12, 1813, in the village of Saint-Julien near Villefranche. He received his early education in the Jesuit school of that town, and then proceeded to the college at Lyons, which, however, he soon left to become assistant in a druggist's shop. His leisure hours were devoted to the composition of a vaudeville comedy, *La Rose du Rhône;* and the success it achieved moved him to attempt a prose drama in five acts, *Arthur de Bretagne*. At the age of 21 he went to Paris, armed with this play and an introduction to Saint-Marc Girardin, but the critic urged him to take up the study of medicine, and in due course he became interne at the Hôtel-Dieu. He worked under the great physiologist François Magendie (*q.v.*), who was physician to the hospital, became his deputy in 1848 and in 1855 succeeded him as full professor. Some time previously he had been chosen the first occupant of the newly instituted chair of physiology at the Sorbonne. There no laboratory was provided for his use, but Louis Napoleon, after an interview with him in 1864, remedied the deficiency, at the same time building a laboratory at the natural history museum in the Jardin des Plantes, and establishing a professorship, which Bernard left the Sorbonne to accept in 1868—the year in which he was admitted a member of the institute. He died in Paris on Feb. 10, 1878, and was accorded a public funeral—an honour never before bestowed by France on a man of science.

Claude Bernard's first important work was on the functions of the pancreas gland, the juice of which he proved to be of great significance in the process of digestion. A second investigation (perhaps his most famous) was on the glycogenic function of the liver; in the course of this he was led to the conclusion, which threw light on the causation of diabetes, that the liver, in addition to secreting bile, is the seat of an "internal secretion," by which it prepares sugar at the expense of the elements of the blood passing through it. A third research resulted in the discovery of the vasomotor system. While engaged, about 1851, in examining the effects produced in the temperature of various parts of the body by section of the nerve or nerves belonging to them, he noticed that division of the cervical sympathetic gave rise to more active circulation and more forcible pulsation of the arteries in certain parts of the head, and a few months afterward he observed that electrical excitation of the upper portion of the divided nerve had the contrary effect. In this way he established the existence of vasomotor nerves—both vasodilator and vasoconstrictor. The study of the physiological action of poisons was also a favourite one with him, his attention being devoted in particular to curare and carbon monoxide gas.

The full exposition of his views, and even the statement of some of the original facts, can be found only in the 17 volumes of Bernard's published lectures. He also published *Introduction à la médecine expérimentale* (1865) and *Physiologie générale* (1872).

An English *Life of Bernard*, by Sir Michael Foster, was published in London in 1899. A more extensive one was published in 1938 by J. M. D. Olmsted.

BERNARD, JACQUES (1658–1718), French Protestant minister and publicist, chiefly important for his continuation of influential periodicals begun by Jean le Clerc and Pierre Bayle (*qq.v.*). Born at Nyons, Dauphiné, Sept. 1, 1658, and educated in Geneva, he became a pastor at Ventesol in 1679. In 1685 he fled to Geneva, and thence to Holland, where he continued his ministry and also opened a school. He became an associate professor at Leyden in 1705, and full professor of philosophy in 1712. He died on April 27, 1718.

In 1691 Jean le Clerc, who was Bernard's cousin, asked him to edit some volumes of his *Bibliothèque universelle et historique*, and in 1699 he succeeded Bayle as editor of the *Nouvelles de la république des lettres*. He himself began another similar work, *Lettres historiques*, which was published by him from 1692 to 1698, and continued by others. He also wrote a short history of Europe (1686–88), a *Recueil de traités de paix . . . 536–1700* (1700), and works on Christian faith and practice. His style is laborious, but shows the vigour of a zealous preacher and propagandist.

BERNARD, JEAN JACQUES (1888–), French playwright, the chief representative of the "school of silence," or, more exactly, "the drama of the unexpressed," exemplified particularly by *Martine* (1922), in which the spoken dialogue does not express the characters' real attitudes. He was born at Enghien, July 30, 1888, the son of the dramatist Tristan Bernard, and began writing plays before World War I. Unconscious jealousy forms the theme of two somewhat static dramas, *Le Feu qui reprend mal* (1921) and *Le Printemps des autres* (1924). In *L'Ame en peine* (1926) Bernard turned to mysticism: two characters who never meet feel a strange disquiet whenever they are in the same vicinity. *A la Recherche des coeurs* (1931) and *Jeanne de Pantin* (1933) show a partial return to traditional methods. Bernard's nondramatic writings include *Le Camp de la mort lente* (1944; Eng. trans., *The Camp of Slow Death*, 1945), a description of the German concentration camp at Compiègne in which he was interned as a Jew, and *Mon Ami le théâtre* (1958). A translation by J. L. Frith of five of Bernard's plays appeared under the title *The Sulky Fire* (1939).

See P. Blanchart, *Jean-Jacques Bernard* (1928); May Daniels, *The French Drama of the Unspoken* (1953).
(D. Ks.)

BERNARD, TRISTAN (real name PAUL) (1866–1947), French playwright and novelist, whose work is characterized by mocking humour and acute observation, was born at Besançon on Sept. 7, 1866. His plays range from one-act comedies like *Le Fardeau de la liberté* (1897) and *L'Anglais tel qu'on le parle* (1899) to full-length comedies of character, intrigue or manners, such as *Monsieur Codomat* (1907), *Le Cordon bleu* (1920) and *Jules, Juliette et Julien* (1929). The title of the comedy *La Volonté de l'homme* (1917, "The Will of Man") indicates his favourite theme, while *Triplepatte* (1905), written in collaboration with André Godfernaux, offers a representative incarnation of his favourite hero. Among his novels were *Les Mémoires d'un jeune homme rangé* (1899) and *La Féerie bourgeoise* (1924).

He died in Paris on Dec. 7, 1947.

See P. Blanchart, *Tristan Bernard: son oeuvre* (1932); Jean Jacques Bernard, *Mon Père Tristan Bernard* (1955).
(D. Ks.)

BERNARDIN DE SAINT-PIERRE, JACQUES HENRI (1737–1814), French man of letters, author of *Paul et Virginie*, was a friend of Jean Jacques Rousseau (*q.v.*) and a precursor of romanticism. Born at Le Havre, Jan. 19, 1737, he was devoted in his childhood to the reading of travel tales, particularly *Robinson Crusoe*. He visited Martinique at the age of 12. Completing his education on his return to France, at Rouen, Caen and Paris (where he spent two years), he embarked on a military

career which took him to Germany, Malta, Holland and Russia. In 1768 he received an engineering appointment in Mauritius, where he had several sentimental adventures. In 1771 he returned to France and lived for some years in poverty. His description of Mauritius, *Voyage à l'Île de France*, two volumes (1773), opened his literary career. Meanwhile he had made the acquaintance of many writers of the day, most notably of Rousseau, whose close friend and disciple he became. This friendship did much to mold Bernardin's outlook, as is particularly evident in his *Études de la nature*, three volumes (1784), in which he combines a teleological discussion of the affinities between man and nature with highly poetic descriptions of natural beauty. To the third edition of the *Études* (1788) was appended *Paul et Virginie*, a novel and his most celebrated work, in which he realizes most successfully the declared aim of uniting to the beauty of nature in the tropics the moral beauty of a small society. In 1790 he published another exotic tale, *La Chaumière indienne*. He was twice married: in 1793 to Félicité Didot, who brought a substantial dowry, and after her death in 1800 to Désirée Pelleporc, then only 20, who survived him. He died at Éragny (Seine-et-Oise), Jan. 21, 1814.

See M. Souriau, *Bernardin de Saint-Pierre d'après ses manuscrits* (1905). Previous studies contain many inaccuracies and are to be treated with great reserve. (Rt. S.)

BERNARDINO, SAINT, of Siena (1380–1444), Italian Franciscan theologian and preacher of great eloquence, was born at Massa Marittima on Sept. 8, 1380, of a noble family. Orphaned early, he completed his education and then served the sick in the hospitals of Siena, where he contracted and nearly died of plague. In 1402 he entered the strict branch of the Franciscan order (the Observant) and with St. John of Capistrano (*q.v.*) became one of its chief promoters (*see* Franciscans). Bernardino became a priest in 1404, but did not begin his preaching tours through Italy until 1417. Appalled by the breakdown in morals, the lawlessness and the civil strife which resulted from the Great Schism of the West, he strove to restore morals by inculcating a deep love of Jesus Christ, personalizing it through devotion to the name of Jesus. Lawlessness was to be curbed by insisting on the prestige of the papacy and of legitimate rulers. He took part in the Council of Florence in 1439, furthering the union of the Greek Church with the Roman. The centre of his movement was a small chapel in Rome, Il Gesù, later given to St. Ignatius of Loyola. Bernardino died at Aquila on May 20, 1444, and was canonized in 1450. His feast day is May 20.

Bernardino's *Opera omnia* were published in five volumes in 1950–56.

See Paul Thureau-Dangin, *The Life of St. Bernardino of Siena*, Eng. trans. by G. von Hügel (1909). (A. S. Tr.)

BERNAUER, AGNES (d. 1435), daughter of an Augsburg baker, was secretly married about 1432 to Albert (1401–60), son of Ernest, duke of Bavaria-Munich. Ignorant of the marriage, Ernest urged his son to marry and reproached him with his connection with Agnes. Albert then declared she was his lawful wife; and subsequently, during his absence, she was seized by order of Duke Ernest and condemned to death for witchcraft. On Oct. 12, 1435, she was drowned in the Danube near Straubing. This story lived long in the memory of the people, and has afforded material for several dramas. Adolf Böttger, Christian Friedrich Hebbel and Otto Ludwig have each written a play entitled *Agnes Bernauer*.

BERNBURG, a town in the district of Halle, in former Saxony-Anhalt (*see* Anhalt), Germany, lies on the Saale river about 50 km. (31 mi.) S. of Magdeburg by road. Pop. (1959 est.) 44,464. The castle, probably built in the 10th century, was later converted into a Renaissance-style château. It was the residence of the dukes when the town was the capital of the duchy of Anhalt-Bernburg. The *Autobahn* from Magdeburg to Halle passes the town. Bernburg produces salt, soda, paper, agricultural machinery and pharmaceutical products (serums). First mentioned in 961, it was important in the middle ages as it lay on an ancient trade route. Bernburg consisted of two almost completely separate and independent communities both of which acquired civic rights in 1278, extended in 1311 and 1366 on the pattern of the civic rights of Magdeburg (*q.v.*). The hill settlement (now called Bergstadt) was raised to the status of a town in 1457. The hill and valley towns have been united since 1825 and in 1871 Waldaus was incorporated in Bernburg. The town is built over salt and shell-lime deposits which began to be exploited commercially in the 19th century. In World War II Bernburg was captured by U.S. forces in April 1945. Since it was in the zone of Russian occupation, the U.S. forces withdrew in July 1945, and Bernburg was included in the German Democratic Republic. (Ho. M.)

BERNE: *see* Bern.

BERNERS, JOHN BOURCHIER, 2nd Baron (*c.* 1469–1533), English translator of Jean Froissart's *Chronicle*, was born probably at Tharfield, Hertfordshire. He succeeded to his grandfather's title in 1474 and was knighted in 1477. He early began his active political and military career, and in 1484, having been involved in a premature attempt to make Henry Richmond (later Henry VII) king, was forced to flee to Brittany. He helped to suppress the 1497 Cornish rebellion in favour of the pretender Perkin Warbeck, and continued his military services to the Tudor dynasty during the French and Scottish campaigns of 1513.

Berners was also involved in the tortuous diplomacy supporting Henry VIII's alternative alliances with France and Spain. He went as chamberlain to princess Mary on her marriage to Louis XII in 1514, and was present at the Field of Cloth of Gold. In 1518 he inaugurated conversations in Madrid which led ultimately to a Spanish treaty. His appointment in 1520 as deputy of Calais represented not advancement but an attempt to provide a stable income and terminate the loans he had been receiving from the crown since 1511. He held the post with an interval from 1526 to 1531 until his death on March 15, 1533.

His greatest work is the translation of Froissart's *Chronicle* (first printed in two volumes, 1523 and 1525), in which the style matches Froissart's own in its fresh and energetic simplicity. Berners' achievement in this respect approaches Sir Thomas Malory's in catching at the last moment for English prose the virtues of the best medieval narrative. With descriptive force and vivid dialogue Berners has helped to make permanently English Froissart's feeling for the glamour of medieval chivalry and for both the virtues and vices of medieval men. His *The Boke Huon de Bordeuxe* (1534?), a translation of the delightful French romance, has almost equal virtues, and the added distinction of introducing Oberon, king of the fairies, into English literature. Another translation, *Arthur of Lytell Brytane* (1555?) is duller.

Near the end of his life he translated two of the newly fashionable courtesy books: *The Castell of Love* (1540?) from Diego de San Pedro, and *The Golden Boke of Marcus Aurelius* (1535) from Antonio Guevara. This last was by far the most popular of his works. These two translations, like their originals, are written in the then new antithetical style (euphuism; *q.v.*) later perfected by John Lyly; *The Golden Boke* was one of the several sources of this style in England.

The best edition of Berners' translation of Froissart is by W. P. Ker, six volumes (1901–03), reprinted, eight volumes (1927–28).

For Berners' life *see* Sir Sidney Lee's introduction to *Huon of Bordeuxe* (Early English Text society; 1882–87) and J. H. McQill, in the *Times Literary Supplement* (April 17, 1930). (D. S. B.)

BERNHARD of Saxe-Weimar (1604–1639), Protestant general during the Thirty Years' War, was born in Weimar on Aug. 16, 1604, the 11th son of the reigning duke. Without hereditary prospects, he tried to win a livelihood and, if possible, a principality in military service. From 1622 he fought under Palatine, Baden and Danish colours against the Roman Catholic and imperial forces and in 1631 joined Gustavus Adolphus, first as a colonel and from April 1632 as a general. After the battle of Breitenfeld he undertook successful raids into southern and western Germany. On the king's death in the battle of Lützen (1632), Bernhard assumed command and decided the Swedish victory. Together with the Swedish general G. K. Horn he invaded south Germany, acquired the duchy of Franconia (chiefly the bishoprics of Bamberg and Würzburg) as a Swedish fief (June 1633) and crowned his successes by the conquest of Regensburg (Nov. 1633), which contributed largely to Wallenstein's downfall. In 1634, however, he

suffered severe reverses, largely because of his incessant quarrels with Axel Oxenstierna and Horn who advocated a defensive warfare, the loss of Regensburg (July) and his and Horn's crushing defeat of Nördlingen (*q.v.*) at the hands of Ferdinand III and Matthias Gallas (September), for which Bernhard bears the main responsibility and which cost him his duchy of Franconia. By the treaty of St. Germain-en-Laye (Oct. 1635) Bernhard entered French service, and Richelieu promised him the duchy of Alsace as reward. A series of victories in Lorraine and the upper Rhine valley against the imperial general Gallas and the Bavarian general Johann von Werth (whom he took prisoner, March 1638) culminated in the capture of Rheinfelden, Freiburg and (Nov. 1638) the key fortress of Breisach, thereby decisively breaking the Habsburg stranglehold on France. On the eve of a fresh campaign he suddenly died, probably of smallpox, at Neuenburg (between Breisach and Basel) on July 18, 1639. His conquests and his army were taken over by France.

See G. Droysen, *Bernhard von Weimar*, 2 vol. (1885); A. M. R. A. de Noailles, *Bernhard de Saxe-Weimar* (1908). (S. H. S.)

BERNHARDI, FRIEDRICH VON (1849–1930), German general and military writer whose work provoked much anti-German feeling in the years just before World War I, was born in St. Petersburg, Russia, on Nov. 22, 1849, his father being in the Prussian diplomatic service. He entered the Prussian army just before the Franco-German War (1870–71). From 1891 to 1894 he was German military attaché in Bern, Switz., after which he joined the military history department in Berlin. In 1907–08 he was given command of the VII army corps and the rank of general of cavalry, but in 1909 he retired to become a military writer, and it was in this field that he became best known.

Bernhardi held the view that a European war was inevitable and that Germany must either conquer or go under. Consequently he advocated the policy of German armament up to the limit of the country's manhood and financial resources. This theory was explained in detail in his book *Deutschland und der nächste Krieg* (1912), which was translated into English and widely read in the English-speaking world, where it caused a great sensation and was responsible for the widespread belief in Germany's aggressive intentions. The German army officer Erich Ludendorff went so far as to suggest that its publication in English was a deliberate piece of British anti-German propaganda.

On the outbreak of war in 1914 Bernhardi emerged from retirement and served on the eastern front. In 1918 he was transferred to the western front and played a prominent part in the battle of Armentières.

Bernhardi appears to have been a very efficient officer, but one who shunned publicity. He was highly regarded in German military circles. The most important of his later writings on military subjects was *Deutschlands Heldenkampf 1914–1918* (1921). Bernhardi died at Kunersdorf near Hirschberg in Silesia, on July 11, 1930. (C. N. B.)

BERNHARDT, SARAH (HENRIETTE ROSINE BERNARD) (1844–1923), French actress, was born in Paris in 1844. The exact date of her birth has been a subject of much controversy; Oct. 22 is the date on the records of the Conservatoire, which she entered, after a convent education, at the age of 16. For two years she studied both the classical style of acting and the popular tradition of the boulevard theatres. She made her debut at the Comédie Française on Aug. 11, 1862, in the title role of Racine's *Iphigénie en Aulide*, attracting the attention of the most formidable critic, Francisque Sarcey. After minor engagements elsewhere she joined the Odéon in December 1866, remaining there until July 1872. She had her first resounding success as the page Zanetto in François Coppée's *Le Passant* (1869). From that time she steadily increased her reputation, especially after her return to the Comédie Française in 1872, when she was given the title roles in Racine's *Andromaque* (1873) and *Phèdre* (1874) as well as the parts of Doña Sol in Victor Hugo's *Hernani* (1877) and Queen Maria in his *Ruy Blas* (1879).

Mlle Bernhardt appeared at the Gaiety Theatre in London during the summer of 1879, discovering there that she could be successful on foreign soil, though Henry James denigrated her as an "advertising genius" and "too American not to succeed in America." In 1880 she resigned from the Comédie and began a series of world tours that led her to England, Belgium, Denmark, the United States, and Canada. At last she was the star in a company she had assembled. For her United States tour she included Dumas' *La Dame aux camélias* in her repertory, in which *Adrienne Lecouvreur* ranked second in popularity. She appeared in New York for the first time on Nov. 8, 1880, with a grandiose reception for which ingenious advertising had paved the way. She was to make eight more tours in the United States.

After conquering Russian audiences, Mlle Bernhardt returned to Paris, where the playwright and director Victorien Sardou (*q.v.*) provided her with three parts that were to be her greatest successes: the title roles of *Fédora* (1882), *Théodora* (1884), and *La Tosca* (1887). It was Sardou who finally shaped the melodramatic Bernhardt style. Bernard Shaw labeled it "hackneyed and old-fashioned," but there were always audiences to enjoy the flutelike tone of the actress's voice and her broad, histrionic movements. In 1886 she performed in South America and in 1891 embarked on a world tour that led her across the United States to Australia and Africa and brought her large financial profits. She assumed the management of the Théâtre de la Renaissance in 1893 but relinquished the house six years later because she associated it with bad luck. She then opened the Théâtre Sarah Bernhardt, where she first performed as Shakespeare's Hamlet; she had played Musset's Florentine Hamlet in *Lorenzaccio* and was to create still another "Hamlet," the duc de Reichstadt in Rostand's *L'Aiglon* (1900).

In 1905 Mlle Bernhardt injured her knee in an accident, and ten years later her right leg had to be amputated; nevertheless she toured America again in 1917. In 1922 she created her last part in Verneuil's *Régine Armand*. She died in Paris on March 26, 1923.

Mlle Bernhardt had some talent as a sculptor, and she wrote a few dramatic trifles. In 1907 she published her memoirs, *Ma double vie*.

BIBLIOGRAPHY.—M. Colombier, *Le Voyage de Sarah Bernhardt en Amérique* (1881); M. Baring, *Sarah Bernhardt* (1934); G. Binet-Valmer, *Sarah Bernhardt* (1936); L. Verneuil, *The Fabulous Life of Sarah Bernhardt* (1942); A. W. Row, *Sarah the Divine* (1957); J. Richardson, *Sarah Bernhardt* (1959). (A. M. N.)

BERNI, FRANCESCO (1498–1535), Italian poet famous for his burlesque poems, was born in Lamporecchio (Tuscany) in 1498 and spent his early years in Florence. He went to Rome in the service of Cardinal da Bibbiena and of Bibbiena's nephew, Angelo Dovizi, then to Verona as secretary to the bishop, Giammatteo Ghiberti, and finally returned to Florence where he died, on May 26, 1535. Despite his ridicule of literary convention and of slavish imitation of Petrarch, he was himself essentially a "literary" writer and used his native language in a masterly way. His free version (*rifacimento*) in pure Tuscan of Boiardo's *Orlando Innamorato* is evidence of his literary ability. Two rustic farces in Tuscan dialect (*Catrina* and *Mogliazzo*) show his love for colourful words and lively expressions. The same characteristics are shown in his burlesque poems (sonnets and *capitoli*, or satires) most of which deal with trivial or obscene subjects; others, such as the sonnets against the popes Hadrian VI and Clement VII, are merely violent invectives. The best are those in which paradoxical exaggeration is developed for its own sake, such as the sonnet on the mule of Galeazzo Florimonte and the one on the beard of Domenico D'Ancona. Thanks to Berni, the old Italian tradition of burlesque and satirical poetry reached the dignity of a literary genre, called after him the *bernesco*.

BIBLIOGRAPHY.—His *Poesie e prose* were ed. by E. Chiorboli (1934) and the *Orlando Innamorato rifatto* by S. Ferrari (1911); *see* also A. Sorrentino, *Francesco Berni, poeta della scapigliatura del Rinascimento* (1933). (G. A.)

BERNICIA, the northern of the two Anglo-Saxon kingdoms which were united in the kingdom of Northumbria (*q.v.*). It stretched northward from the river Tyne, ultimately reaching the Firth of Forth and beyond the Solway firth. It had a royal residence at Bamburgh and another at Yeavering, where excavation has revealed an impressive complex of buildings and a great wooden

structure like an amphitheatre. The first recorded king is Ida, whose accession is dated 547. His grandson Aethelfrith (*q.v.*), reigning from 593 to 616, united Bernicia and Deira (*q.v.*), and his successor, Edwin of Deira, ruled both kingdoms. These split apart on his death in 632, but from the accession of Aethelfrith's son Oswald in 633 kings of Bernicia ruled Deira also.

See Bede, *Historia Ecclesiastica*, bk. i, ch. 34, bk. ii, ch. 14, bk. iii, ch. 1–4, 6, 12, 16, bk. v, ch. 24; Nennius, *Historia Brittonum*, ed. by T. Mommsen (1894), ch. 63. (D. Wk.)

BERNINI, GIOVANNI LORENZO (1598–1680), Italian architect and sculptor, in whose works are found many of the greatest realizations of the tendencies of baroque art, was born at Naples on Dec. 7, 1598. After studying sculpture with his father, Bernini found a patron in Maffeo Barberini, later Pope Urban VIII, whose palace he designed. In statues such as the "David" (1623) or the "Apollo and Daphne" (1622–24) in the Borghese gallery, Rome, the beginning of the baroque manner can be seen. Its full development came in the Cornaro chapel in Santa Maria della Vittoria at Rome, where indirect theatrical lighting illuminates Bernini's sculpture of the "Ecstasy of St. Theresa" (1645–52). By amazing control of the techniques of carving Bernini was able to convey in marble the difference in the textures of flesh, silk, feathers and even clouds. Baroque interest in colour was dramatically presented with varicoloured marbles and gilded bronze in his tomb of Pope Urban VIII (1628–47) in St. Peter's at Rome. Among Bernini's works one of the finest was a bust of Louis XIV of France (1665) at Versailles in which the proud, dominating personality was magnificently expressed. The wonderful water displays of the outdoor fountains at Rome owe much to Bernini, who designed the fountain of the Triton (completed 1637) in the Piazza Barberini and the fountain of the Four Rivers (1648–51) in the Piazza Navona.

As an architect of St. Peter's in Rome Bernini added the great altar canopy (1624–33) over the tomb of St. Peter and the bronze chair of St. Peter (1657–66) dominating the west end of the church, but his finest architectural creation was the tremendous square in front of St. Peter's in which the arms of the colonnade seem to come out to embrace all visitors. Bernini's fame as an artist was so great that in 1665 he was invited by Louis XIV of France to come to Paris to design the palace of the Louvre, but nothing came of his architectural design. Other examples of his architecture are Sant'Andrea al Quirinale (1658–65) and the Palazzo Montecitorio (1650–55) in Rome and churches at Castel Gandolfo (1658–61) and Ariccia (1662–64). He died at Rome on Nov. 28, 1680.

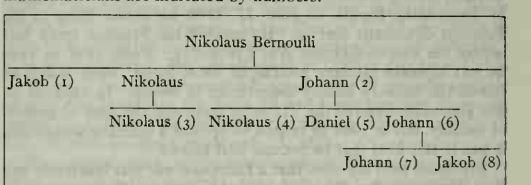
See Baroque and Post-Baroque Architecture; Baroque Art; Sculpture: *Baroque Sculpture; see* also references under "Bernini, Giovanni Lorenzo" in the Index.

See R. Pane, *Bernini architetto* (1953); Rudolf Wittkower, *Gian Lorenzo Bernini, the Sculptor of the Roman Baroque* (1955) and *Art and Architecture in Italy, 1600 to 1750* (1958). (D. R. Cn.)

BERNIS, FRANÇOIS JOACHIM DE PIERRE DE (1715–1794), French statesman and cardinal who played an important part in the diplomatic revolution of 1756–57, in the suppression of the Society of Jesus by the papacy in 1773, and in the unsuccessful negotiations in 1790–91 between the French government and Pius VI for the recognition of the Constituent Assembly's ecclesiastical reforms. Born of aristocratic parentage, on May 22, 1715, at St. Marcel d'Ardèche, Bernis was trained for the church and did not become prominent in French politics until 1745, when he became a member of the entourage of Madame Le Normant, later known as Madame de Pompadour. Diplomatic experience acquired as ambassador to Venice between 1752 and 1755 and the favour of Madame de Pompadour caused his nomination as confidential and secret intermediary to discuss with the Austrian ambassador in Paris, G. A. von Starhemberg, Austria's proposals for a French alliance (Aug. 1755). Strongly supported by Louis XV himself, these negotiations led to the first, defensive, treaty of Versailles between France and Austria (May 1, 1756) and then to the second, offensive, treaty of Versailles (May 1, 1757). This alliance with France's old enemy and the abandonment of the former alliance with Prussia formed the diplomatic prelude to the Seven Years' War. Bernis held office as French foreign minister from June 27, 1757, until Dec. 1758, when his fall was precipitated by French military reverses, by his desire to reform the financial system and by the hostility of Madame de Pompadour. He became a cardinal in 1758 and archbishop of Albi in 1764. Though he used his influence with Pope Clement XIV to promote the suppression of the Jesuits, he exercised a moderating influence on French policy and did not approve of the drastic pressure exerted on the papacy by Charles III of Spain. Between 1769 and 1794 he acted as French ambassador to Rome. Hostile to the ecclesiastical reforms of the Revolution, which affected his status and income as a prelate, he was in touch with the French *émigré* princes and played an ambiguous part in helping to crystallize papal opposition to the Civil Constitution of the Clergy. He died at Rome on Nov. 3, 1794. There is an edition of his *Mémoires et lettres* by F. Masson, two volumes (1878).

See F. Masson, *Le Cardinal de Bernis depuis son ministère* (1884); Sir Marcus Cheke, *The Cardinal de Bernis* (1958). (A. Gn.)

BERNOULLI or Bernouilli, the name of a Swiss family of famous scientists and mathematicians, who made their home in Basel, Switz. In the following family tree the most distinguished mathematicians are indicated by numbers.



(1) Jakob (Jacques) Bernoulli (1654–1705) studied theology upon the insistence of his father. After six years of travel he returned to Basel, refused a church appointment and began lecturing on experimental physics. In 1687 he became professor of mathematics at the university; later he served as its rector. His first papers concern astronomy, particularly the motion of comets. Later he wrote on infinite series and their summation; the Bernoulli numbers are named for him. Upon the discovery of the infinitesimal calculus, Bernoulli entered into a correspondence with Leibniz and made important applications of the new theory. In his study of the isoperimetric problem he introduced the first principles of the calculus of variation. He examined many special curves, among them the lemniscate and the logarithmic spiral, using polar co-ordinates for the first time. He determined the catenary, the curve of a hanging chain and the isochrone, the curve along which a body falls with uniform vertical velocity. His *Ars Conjectandi* (published posthumously, 1713) was one of the pioneer works in the theory of probability (*see* also Bernoulli Numbers; Probability). His works were published as *Opera Jacobi Bernoullii*, 2 vol. (1744).

(2) Johann (Jean) Bernoulli (1667–1748), Jakob's younger brother, studied medicine and obtained his doctor's degree in Basel in 1694, with a thesis on muscular contraction. Like his brother, he became fascinated by the new mathematical calculus, which he applied to the determination of length and area of curves, to differential equations and to mechanical problems—for instance, the determination of the tautochrone curve, important in clock construction. This pendulum curve, which is a cycloid, is characterized by the property that the time of fall of a particle to the lowest point is independent of the amplitude. Marquis de l'Hôpital wrote the first text on calculus, *Analyse des infiniment petits* (1696), largely on the basis of lectures and letters from Johann Bernoulli; in return, the latter received a considerable pension from the marquis. The two Bernoulli brothers worked partly on the same problems; this gave rise to jealousy and even violent public feuds. Most bitter was the dispute over the brachystochrone problem, *i.e.*, the determination of the curve of most rapid descent of a particle under the influence of gravity; this curve is also a cycloid. In 1695, under the recommendation of Huygens, Johann was appointed professor at Groningen, Holland; after the death of

his brother he became his successor in Basel. During his last years he worked mainly on the principles of mechanics.

See Opera Johannis Bernoullii, 4 vol. (1742); and J. O. Fleckenstein, *Johann und Jakob Bernoulli* (*Kurze Mathematikerbiographien*, Heft 6, 1949). His correspondence with Leibniz appeared in 1745.

(3) Nikolaus (Nicolaus) Bernoulli (1687–1759), a nephew and pupil of Jakob and Johann, first studied law, then was professor of mathematics in Padua (1716–19). His works dealt with infinite series and probability. He returned to Basel to become professor of logic (1722), and of jurisprudence (1731).

Johann Bernoulli had three sons who were mathematicians:

(4) Nikolaus Bernoulli (1695–1726), eldest son of Johann, studied law and became professor in this subject in Bern at the age of 27. In order to devote his time to his real fancy, mathematics, he accepted a position at the Russian academy, but died shortly after his arrival in St. Petersburg.

(5) Daniel Bernoulli (1700–1782), was the most distinguished of Johann's sons. He received his doctorate in medicine with a thesis on the action of the lungs. He spent seven years (1726–33) as mathematician at the Russian academy. Upon his return to Basel he was successively professor of botany, anatomy and natural philosophy. The prize of the French Academy was awarded him no less than ten times. His most important work is the *Hydrodynamica* (1738) dealing with the theory of statics and motion of fluids, with practical applications; *e.g.*, the propulsion of ships. Later he studied probability and its applications to statistics.

(6) Johann Bernoulli (1710–1790), brother of Nikolaus and Daniel, was professor of rhetoric from 1738 until he became his father's successor to the chair of mathematics (1743). He received the prizes of the French Academy on three occasions. Among his numerous children may be mentioned:

(7) Johann Bernoulli (1744–1807), doctor of law and later director for the observatory in Berlin.

(8) Jakob Bernoulli (1759–1789), who first studied law and then became professor of mathematics at the Russian academy. His works are related to those of his uncle and teacher, Daniel.

The first volume of the correspondence of the mathematicians Bernoulli, *Der Briefwechsel von Johann Bernoulli*, was published in 1955.

See also Eric T. Bell, *Men of Mathematics* (1937). (O. Oe.)

BERNOULLI NUMBERS (Bernoullian Numbers), an important sequence of rational numbers occurring in many branches of mathematics, first introduced by Jakob Bernoulli (*q.v.*) in a posthumous work *Ars Conjectandi* (1713). The nth Bernoulli number is usually denoted by the symbol B_n and the first few Bernoulli numbers are as follows: $B_0 = 1$, $B_1 = -\frac{1}{2}$, $B_2 = \frac{1}{6}$, $B_3 = 0$, $B_4 = -\frac{1}{30}$, $B_5 = 0$, $B_6 = \frac{1}{42}$, $B_7 = 0$, $B_8 = -\frac{1}{30}$, $B_9 = 0$, $B_{10} = \frac{5}{66}$.

The Bernoulli numbers of odd order, aside from B_1, are zero, while the Bernoulli numbers of even order, aside from B_0, alternate in sign. For this reason some authors label the Bernoulli numbers somewhat differently, omitting B_0, B_1, B_3, B_5, . . . from consideration and writing B_k for the absolute value of B_{2k}.

Several simple definitions of Bernoulli numbers can be given. Each represents a different field of application and suggests generalizations in different directions. Historically the first of these, as given by Bernoulli himself, is

$$1^k + 2^k + 3^k + \cdots + (N-1)^k = \frac{1}{k+1}\left\{ B_0 N^{k+1} + B_1 \binom{k+1}{1} N^k + \cdots + B_k \binom{k+1}{k} N \right\} \quad (1)$$

where $\binom{n}{m} = \dfrac{n!}{m!(n-m)!}$

(If n is a positive whole number, the symbol $n!$ denotes the product of the positive whole numbers from 1 up to n inclusive.)

A more common definition is the following symbolic one

$$B_n = (B+1)^n \quad (2)$$

where, after expanding the binomial, the exponents of B are degraded to subscripts; in this definition $n > 1$. Thus, for example, for $n = 4$

$$B_4 = (B+1)^4 = B_4 + 4B_3 + 6B_2 + 4B_1 + B_0$$

This does not determine B_4 but expresses B_3 in terms of earlier B's. This is the simplest of a host of recursion formulas which have been proposed for the calculation of the B's. Most of these may be derived from the general formula

$$f(x + B + 1) - f(x + B) = f'(x)$$

where $f(x)$ is any polynomial or formal power series, $f'(x)$ its derivative, and where the above convention about powers of B holds. Any recursion formula expressing B_n in terms of previous B's may be used to express B_n as a determinant.

Another common definition of B_n is by means of one of the generating functions

$$\frac{x}{e^x - 1} = \sum_{n=0}^{\infty} \frac{B_n x^n}{n!}, \quad x \cot x = \sum_{n=0}^{\infty} \frac{(-1)^n B_{2n} (2x)^{2n}}{(2n)!} \quad (3)$$

Another definition of B_n, this time as a direct formula, is

$$B_{2n} = \frac{2(-1)^{n-1}(2n)!}{(2\pi)^{2n}} \left(1 + \frac{1}{2^{2n}} + \frac{1}{3^{2n}} + \frac{1}{4^{2n}} + \cdots \right) \quad (4)$$

This striking result is due to Euler who thus made (in 1748) an independent discovery of Bernoulli numbers. It was used by S. E. Serebrennikov in computing B_{154}. It also shows that although the early Bernoulli numbers are comparatively small, the numbers $|B_{2n}|$ tend to infinity with more than exponential rapidity. In fact for n large $|B_{2n}| = 4n^{2n}(\pi e)^{-2n}\sqrt{\pi n}$ (approximately).

Bernoulli Polynomials—Each of the above definitions of B_n is easily extended to an important polynomial of degree n usually denoted by $B_n(x)$ and introduced originally by Bernoulli. These definitions are, in order:

$$1^k + 2^k + 3^k + \cdots + (N-1)^k = \{B_{k+1}(N) - B_{k+1}(0)\}/(k+1) \quad (1')$$

$$(B + x)^n = B_n(x) \quad (2')$$

$$xe^{xt}/(e^x - 1) = \sum_{n=0}^{\infty} B_n(t)\, x^n/n! \quad (3')$$

$$B_n(x) = -2n! \sum_{m=1}^{\infty} (2\pi m)^{-n} \cos(2\pi m x - \tfrac{1}{2}\pi n) \quad (0 < x < 1) \quad (4')$$

An independent definition of $B_n(x)$ may be given by the relations:

$$B_0(x) = 1,\ B_n'(x) = nB_{n-1}(x) \text{ if } n > 0$$

$$\int_0^1 B_n(x)dx = \begin{cases} 1 \text{ if } n = 0 \\ 0 \text{ if } n > 0 \end{cases}$$

This gives in fact still another useful approach to Bernoulli numbers which may be defined now as $B_n = B_n(0)$. The first Bernoulli polynomials are:

$$B_0(x) = 1,\ B_1(x) = x - \tfrac{1}{2},\ B_2(x) = x^2 - x + \tfrac{1}{6}$$
$$B_3(x) = x^3 - \tfrac{3}{2}x^2 + \tfrac{1}{2}x,\ B_4(x) = x^4 - 2x^2 + x^2 - \tfrac{1}{30}$$

These polynomials $B_n(x)$ are possessed of a number of interesting and useful properties such as

$$B_n(x+1) - B_n(x) = nx^{n-1}$$
$$B_n(1-x) = (-1)^n B_n(x)$$

$$B_n(kx) = k^{n-1} \sum_{r=0}^{k-1} B_n\left(x + \frac{r}{k}\right)$$

If the function $f(x)$ can be expressed in a series of Bernoulli polynomials:

$$f(x) = \frac{C_0 B_0(x)}{0!} + \frac{C_1 B_1(x)}{1!} + \frac{C_2 B_2(x)}{2!} + \cdots$$

then the general coefficient C_n is given by $\int_0^1 f^{(n)}(x)dx$. This statement is equivalent to the celebrated Euler-Maclaurin summa-

tion formula. (*See* CALCULUS OF DIFFERENCES.)

Arithmetical Properties of B_n.—These are the subject of numerous interesting but often difficult investigations. Some of these properties are still imperfectly understood. Perhaps the most famous number-theoretic property of B_n is the Von Staudt-Clausen theorem to the effect that

$$B_{2n} = A_n - \frac{1}{p_1} - \frac{1}{p_2} - \cdots - \frac{1}{p_k}$$

where A_n is an integer and $p_1, p_2, \ldots, p_k$ are those primes which exceed by 1 a divisor of $2n$. For example

$$B_{12} = -\frac{691}{2730} = 1 - \frac{1}{2} - \frac{1}{3} - \frac{1}{5} - \frac{1}{7} - \frac{1}{13}$$

This striking theorem has many applications.

Bernoulli numbers occur in many problems in number theory, the most famous of which is Fermat's last theorem (*q.v.*). A theorem of E. E. Kummer states that if p is an odd prime not dividing the numerators of $B_2, B_4, \ldots, B_{p-3}$, then $x^p + y^p = z^p$ cannot be solved in positive integers x, y, z. Much of the 20th century work on Bernoulli numbers has been connected with Fermat's last theorem.

Tables of Bernoulli Numbers.—Many engineering handbooks, collected mathematical tables, and textbooks on infinite series have short tables of the first dozen Bernoulli numbers. These are sufficient for routine applications of these numbers. More extensive tables are needed for number theory work or for calculations of extreme accuracy. In spite of the great number of formulas proposed for calculating B_n only a few actual calculations have been made. These may be given the tabular description:

Name	Range of n in B_{2n}	Date
J. Bernoulli	1–5	1712
L. Euler	1–15	1781
Dr. Rothe	1–31	1840
J. C. Adams	1–62	1877
S. E. Serebrennikov	1–92	1905, 1907
D. H. Lehmer	91–110	1936

J. W. L. Glaisher has given a 10-place table of the common logarithms of B_{2n} for $n \leqq 250$ together with their natural values to nine significant figures. This table, which was computed from (4), has been reprinted by H. T. Davis who gives also values of $B_n(x) - B_n$ for $2 \leqq n \leqq 8$ and for $0 \leqq x \leqq 1$ at intervals of .01 to ten decimals.

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(D. H. LR.; P. T. B.)

BERNSTEIN, EDUARD (1850–1932), German Social Democratic propagandist, political theorist and historian, was born in Berlin on Jan. 6, 1850, of a lower-middle-class Jewish family, his father being an engine driver. Going to work in a bank at the age of 16, Bernstein was encouraged to pursue his early interest in politics by his uncle Aaron Bernstein. In 1872 Bernstein joined the Social Democratic party (founded at Eisenach in 1869), and in 1878, shortly before the promulgation of the anti-Socialist emergency laws, he became secretary to the Socialist philanthropist Karl Höchberg, in Switzerland. From 1881 to 1890 he was the senior editor of the *Sozialdemokrat* (the organ of the party during the period of the anti-Socialist legislation), which he published in Zürich until 1888 and from then on in London.

Like many other Social Democrats, Bernstein was strongly influenced by the writings of the Berlin professor Eugen Dühring until Friedrich Engels' *Anti-Dühring* (1878) converted him to Marxism. During the '80s, together with his friend Karl Kautsky, he devoted his writings to the spreading of Marxist doctrines among German Social Democrats. His long exile in London (1888–1901) brought him into contact with the young Labour movement there and with the Fabian society. Meanwhile he enjoyed a close personal friendship with Engels until the latter's death in 1895.

Even Engels, in his introduction to a new edition of Marx's *Klassenkämpfe in Frankreich*, showed himself aware that new methods might be needed in the Socialist struggle under changed political and economic conditions, and such considerations formed the starting point of Bernstein's argument in the series of articles which he published, under the title "Probleme des Sozialismus," in the paper *Die Neue Zeit* from 1896 on (reprinted in 1901 under the title *Zur Geschichte und Theorie des Sozialismus*). These articles tended to the conclusion that Marxism could and should be revised, and Bernstein's divergence from Marxist orthodoxy became more pronounced with the publication of *Die Voraussetzungen des Sozialismus und die Aufgaben der Sozialdemokratie* (1899; Eng. trans., *Evolutionary Socialism*, 1909). According to Bernstein, Marx's theory of impoverishment and his thesis that the capitalist economy would, because of its intrinsic contradictions, inevitably collapse, had not been borne out by events. He therefore called on the Social Democrats to free themselves from stale revolutionary phraseology and to acknowledge themselves as a party of reform—"which in these days they in fact are." The consequences that he drew from the evident discrepancy between theory and practice let loose within the party disputes which raged for more than a decade.

Returned from exile, Bernstein was elected as member of the *Reichstag* for Breslau in 1902. He held this seat for four years and was again a member between 1912 and 1918 and between 1920 and 1928. Although reckoned as a leading member of his party's right wing, he joined the Independent Social Democratic party during World War I as a protest against the majority party's support of the war. He returned to the majority party, however, when revolution broke out in Germany. His strength of character, his warm humanity and his intellectual abilities, discernible in his many autobiographical writings, make Bernstein one of the most attractive personalities in his party's history. By nature he was inclined to the life of a scholar rather than to that of party leader and agitator. He died in Berlin on Dec. 18, 1932.

See P. Gay, *The Dilemma of Democratic Socialism* (1952).

(E. MA.)

BERNSTEIN, HENRY LÉON GUSTAVE CHARLES (1876–1953), French playwright, who dominated the "boulevard" drama for nearly half a century, was born in Paris, Jan. 20, 1876. Beginning with quick-moving, violent dramas such as *La Rafale* (1905) and *Samson* (1907), he passed on, with *Le Secret* (1913), to a more psychological type of play stressing subconscious motivation. The influence of both Freud and Pirandello is obvious in *La Galerie des glaces* (1924) and other plays written in the 1920s, which also reflect the spiritual unrest of the times. Experimenting with dramatic form, Bernstein copied the technique of the film in *Mélo* (1929) and that of the novel in *Le Voyage* (1937). During 1900–50 he wrote 28 plays. He died in Paris, Nov. 27, 1953.

See Pierre Bathille, *Henry Bernstein* (1932).

(D. KS.)

BERNSTEIN, LEONARD (1918–), U.S. conductor and composer, whose brilliant accomplishments in both serious and popular music made him one of the most spectacular figures on the American scene, was born Aug. 25, 1918, in Lawrence, Mass. He studied composition under Walter Piston at Harvard university and, later, the piano with Isabelle Vengerova and conducting with Fritz Reiner at the Curtis Institute of Music, Philadelphia. He perfected his conducting technique under Koussevitzky at the Berkshire Music Center at Tanglewood, Mass., in the summers of 1940 and 1941.

In 1943 Bernstein was appointed assistant conductor of the New York Philharmonic; his first signal success came on Nov. 14, 1943, when he was summoned unexpectedly to substitute for Bruno Walter, who was indisposed. His technical self-assurance under difficult circumstances and his interpretive excellence made an im-

mediate impression and marked the beginning of a brilliant career. He subsequently conducted the New York City Center orchestra (1945–47) and appeared as guest conductor in the United States, in Europe and in Israel. In 1958 Bernstein became permanent conductor of the New York Philharmonic, sometimes, as piano soloist, conducting from the keyboard. With this orchestra he made several international tours, in South and Central America (1958), in Europe, including the U.S.S.R. (1959), and in Japan (1961). His popularity increased through his appearances on television in special programs not only as conductor and pianist but also as commentator and all-round entertainer.

Bernstein's spectacular success as conductor has somewhat obscured his position as a serious composer of works in which he made a skilful use of diverse elements ranging from Jewish liturgical themes, as in the *Jeremiah Symphony* (1942), to jazz rhythms, as in the *Age of Anxiety* (after W. H. Auden) for piano and orchestra (1949). He also wrote the score for the ballet *Fancy Free* (1944) and several musical comedies for Broadway, of which *West Side Story* (1957) became enormously popular. He published a collection of lectures, *The Joy of Music* (1959).

See D. Ewen, *Leonard Bernstein* (1960); J. Briggs, *Leonard Bernstein* (1961). (N. Sy.)

BERNSTORFF, ANDREAS PETER, Count von (1735–1797), Danish statesman who maintained Denmark's neutrality during the last quarter of the 18th century, was born in Hanover on Aug. 28, 1735. His uncle, J. H. E. Bernstorff, sent him to German and Swiss universities, enabled him to travel in Italy, France, England and Holland and, in 1758, introduced him into the Danish foreign office. In 1767 Bernstorff was created count but was dismissed with his uncle in 1770 by order of Count Johann Struensee, the royal favourite under Christian VII of Denmark. After the fall of Struensee, Bernstorff returned to office as foreign minister and the director of the German chancery for Holstein-Gottorp, in 1773. His first official act was to conclude his uncle's negotiations with Russia over Holstein-Gottorp (*see* Bernstorff, Johann Hartwig Ernst), by the signing of the exchange treaty with the grand duke Paul on June 1, 1773. There followed the treaty of alliance between Denmark and Russia of Aug. 12, 1773, which was partly defensive and partly aimed against Gustavus III of Sweden, and was a further continuation of his uncle's policy whose anti-Swedish nature Bernstorff maintained for a time.

During the American Revolution Bernstorff inclined toward England despite the irritation in Denmark-Norway over Great Britain's assertion of her right to search for "contraband of war." In 1779 he favoured the triple alliance between Great Britain, Russia, and Denmark-Norway proposed by England to compel the Bourbon powers to accept peace terms, but this policy was unyieldingly opposed by the court which favoured the Russian chancellor Nikita Panin's proposal for an armed league of all the neutral powers to protect neutral shipping. This proposal was similar to one made by Bernstorff himself in Sept. 1778, but as now presented by Russia he rightly regarded it as directed exclusively against England. He acceded to it unwillingly (July 9, 1780) but had previously, on July 4, come to an agreement with England on what constituted "contraband of war"; on Nov. 13, however, Bernstorff was obliged to resign, it is thought by Frederick, the hereditary prince, who feared the Russian reaction to the agreement. Bernstorff retired to his Mecklenburg estates but was recalled to office in April 1784 after the fall of O. H. Guldberg. From then until his death, Bernstorff was the foreign minister in a moderate liberal government and beside his diplomatic activities did much for the liberation of the serfs. Moreover, he introduced in his own estates improvements which anticipated the agricultural reforms of the next generation.

Meanwhile, as Bernstorff had predicted, the Russian neutrality project had resulted in a breach between Great Britain and Russia. During the Russo-Swedish War of 1788, Bernstorff took care that the assistance rendered to Russia under treaty obligations should be as trifling as possible, to avoid offending Great Britain and Prussia. On the outbreak of the French Revolution, Bernstorff condemned on principle any interference in the domestic affairs of France, believing that Denmark's safest policy was to keep clear of every anti-French coalition. His neutrality treaty with Sweden (March 7, 1794), for protecting the merchant shipping of the two countries by combined squadrons, was valuable both commercially and politically. Bernstorff's great faculties appeared, indeed, to mature and increase with age, and his death on June 21, 1797, was regarded in Denmark as a national calamity.

See A. Friis, *A. P. Bernstorff og Ove Hoegh Guldberg* (1899), *Bernstorfferne og Danmark*, 2 vol. (1903–19); *Bernstorffske Papirer*, 3 vol. (1904–13). (F. Sk.)

BERNSTORFF, CHRISTIAN GÜNTHER, Count von (1769–1835), Danish and Prussian diplomat and an architect of the German customs union (*Zollverein*). The son of Count A. P. von Bernstorff, he was born in Copenhagen on April 3, 1769. He began his career in 1787 as an attaché to the Danish representative at the opening of the Swedish diet and by 1791 had become minister plenipotentiary at Stockholm. Ambassador at Stockholm from 1794 to May 1797, he was summoned to Copenhagen to act as substitute for his sick father on whose death (June 21) he succeeded as foreign minister, becoming a privy councilor in 1803.

In 1801 at the battle of Copenhagen and again in 1807 with the bombardment of the city and the capture of the Danish fleet, Denmark suffered from England's retaliatory measures against the second Armed Neutrality, and in May 1810 Bernstorff retired. In 1812 he was appointed Danish ambassador at Vienna and, probably in agreement with Metternich, strove to obtain favourable peace conditions for Denmark. He was present at the signature of the first peace of Paris (May 1814) and represented Denmark at the congress of Vienna where as a member for the commission on German affairs he was in part responsible for a further confusion of German and Danish interests in Schleswig and Holstein. In 1816 he was appointed Danish ambassador to Berlin and in 1818 at the invitation of Prince Mardenberg he entered the Prussian service.

Bernstorff attended the congress at Aix-la-Chapelle (Oct. 1818) as a Prussian diplomat and returned to Berlin as foreign minister. By nature opposed to the principles of the French Revolution, Bernstorff was initiated as a Prussian minister by the reactionary J. P. F. Ancillon. He is accused of having subordinated the interests of Prussia to the European policy of Metternich and the "Holy Alliance." But although he supported the Carlsbad decrees (1819), the Vienna Final act and Metternich's policy at the congresses of Laibach (Ljubljana, Yugos.), Troppau (Opava, Czech.) and Verona, he was also one of the founders of the *Zollverein* which became the basis of Prussian hegemony in Germany. He supported Russia's war against Turkey over the Greek question in 1828 and in the crisis of 1830 he did much to confine the troubles in Poland and Belgium to those countries. He resigned his ministry to Ancillon for reasons of health in 1832 and died at Berlin on March 28, 1835.

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BERNSTORFF, JOHANN HARTWIG ERNST, Count von (1712–1772), Danish foreign minister and his country's leading statesman between 1751 and 1770, was born at Hanover on May 13, 1712, of an ancient Mecklenburg family. His father was chamberlain to the elector of Hanover but in 1733 Bernstorff was introduced into the Danish service by his relations C. A. and C. L. Plessen, ministers under Christian VI of Denmark, and served first as Danish envoy to the Saxon court. He remained in Germany until 1744 when he became ambassador in Paris. In 1751 he became foreign minister and for the next 19 years his opinion was decisive in the council of state of Denmark.

Bernstorff preserved Denmark's neutrality during the Seven Years' War despite treaty obligations to Prussia and the suspicions of England and Sweden, and on May 4, 1758, concluded a treaty with France whereby in return for Denmark's securing Hamburg, Lüheck and Gottorp from invasion for the duration of the war, France and later Austria agreed to support Denmark in its negotiations with Russia over Holstein. However, with the accession of Tsar Peter III and his declaration of war against Den-

mark in Jan. 1762, Denmark's allies deserted and Bernstorff was obliged to send a well-equipped Danish army into Mecklenburg. Peter III's overthrow in June 1762 removed the Russian threat and in March 1765 the empress Catherine II and the Danish king, Frederick V, came to a provisional agreement over the Holstein estates. Bernstorff achieved the ratification of a treaty in April 1767, when Catherine renounced her claims on Gottorp and undertook to persuade her son, the grand duke Paul, on his coming of age, to cede Gottorp in exchange for Oldenburg and Delmenhorst. For his part in the treaty, Bernstorff was created a count. As the reign of Christian VII (1766–1808) progressed Bernstorff's position became precarious. His last act was the treaty with Russia of Dec. 13, 1769, which stated that any change in the Swedish constitution would be regarded by Denmark and Russia as a *causus belli* against Sweden. On Sept. 15, 1770, Bernstorff was dismissed by order of Count Johann Struensee, the royal favourite, and retired to his Holstein estates, where he died on Feb. 18, 1772.

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BEROSSUS (BEL-USUR?) (4th–3rd century B.C.), a Chaldean priest of Bel in Babylon, who wrote in Greek a work in three books describing the history and culture of Babylonia. This work has perished, but it was much used by later Greek compilers whose versions in turn were quoted by Eusebius, Abydenus, Josephus and others. Berossus is said to have migrated late in life to the island of Cos, where he founded a school of astronomy.

In his first book Berossus described the land of Babylonia, the bringing thither of civilization by the monster Oannes and other divinities coming out of the sea, and the story of the creation according to the native legend, which led to an account of Chaldean astrology. The second and third books contained the chronology and history of Babylonia and of later Assyria, beginning with the "ten kings before the Flood," then the story of the Flood itself, followed by the restoration of kingship with a long line of kings "after the Flood," then "five dynasties," and finally the late age of history under the Assyrians, the last Babylonian kingdom, and the Persians. Much of Berossus' account has been confirmed with the recovery of original literature in the cuneiform tablets. His scheme of chronology and history, though imperfectly preserved in quotations, has been elaborately investigated by modern scholars.

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BERRUGUETE, ALONSO (*c.* 1486–1561), Spanish sculptor, painter and architect, perhaps the most considerable artist of the Spanish Renaissance, was the son of the painter Pedro Berruguete. Alonso was born in Paredes de Nava about 1486. His paintings, if they are indeed correctly ascribed to him, were Italianate and Mannerist in style, and as an architect he was apparently merely the author of decorative retables and ornamental doorways. As a sculptor he was an able and indeed a favourite pupil of Michelangelo. He was a skilful wood carver. In his rather rich all-over delicate ornamentation he worked truly in the Spanish Plateresque style. In his figures he is a typical Mannerist. The retable of S. Benito in Valladolid is his first important work (1520) after his apprenticeship in Italy. Fragments from this altarpiece are now in the Museum of Valladolid. The carvings on the upper range of stalls (1539 ff.) in the Cathedral of Toledo are another good example of Berruguete's work and somewhat more moderated and classical in feeling. His last important commission and perhaps his masterpiece was the tomb of Cardinal Tavera in the Hospital de Afuera at Toledo. The recumbent figure alone, however, appears to be by his hand (1554–61). Berruguete died in Toledo at the end of Sept. 1561.

Alonso's father, PEDRO BERRUGUETE (fl. 1483–1503/4), was court painter to Ferdinand and Isabella. His major works were executed at Avila and Toledo.

See Ricardo de Orueta, *Berruguete y su obra* (1917). (A. K. McC.)

BERRY, the name of a family that acquired important properties in the newspaper and publishing business in England and large industrial interests in south Wales. There were three brothers, HENRY SEYMOUR BERRY (1877–1928), who was raised to the peerage as Lord Buckland; WILLIAM EWERT BERRY (1879–1954), created baronet in 1921 and Viscount Camrose in 1941; and JAMES GOMER BERRY (1883–), created baronet in 1928 and Viscount Kemsley in 1945. Lord Buckland, an industrial magnate, was chairman of Guest, Keen and Nettlefolds. William Ewert Berry founded the *Advertising World* in 1901, and thereafter he and James Gomer Berry worked together in acquiring large and important newspaper and publishing interests. Their holdings, which they divided in 1937, included the *Sunday Times*, *Daily Telegraph*, *Financial Times*, *Daily Graphic*, Kelly's directories, Cassell and Co., Ltd. (book publishers), the Amalgamated press and many provincial newspapers. Lord Kemsley became chairman of Allied Newspapers (the *Sunday Times* and the provincial groups), whose name was changed in 1943 to Kemsley Newspapers. In 1959 he retired and Kemsley Newspapers became Thomson Allied Newspapers, Ltd. (H. J. SG.)

BERRY, CHARLES FERDINAND DE BOURBON, DUC DE (1778–1820), a prince of the royal house of France, was born at Versailles on Jan. 24, 1778, the younger son of the comte d'Artois (afterward Charles X of France). Taken abroad by his father at the outbreak of the Revolution in 1789, he served in the prince de Condé's army from 1792 to 1797 and went with Condé to Russia, where the tsar Paul gave him a cavalry regiment. From 1801 to 1814, however, he lived in England. There he began a liaison with an Englishwoman, Emma (Amy) Brown, by whom he had two daughters (afterward baronne de Charette and comtesse de Faucigny-Lucinge). While much has been written on the question whether he married her or not, a judgment by the court of appeal at Chambéry (July 1, 1952) gives very cogent grounds for a negative answer. Returning to France in 1815, Berry retired to Ghent during the Hundred Days, but returned again to Paris at the second Restoration. On June 17, 1816, he was married to Caroline of the Two Sicilies (*see* below). On Feb. 13, 1820, as he was leaving the Paris opéra, he was mortally wounded by a saddler, Louis Pierre Louvel. He died next day. His and Caroline's daughter Louise (1819–64) later became duchess and regent of Parma. His posthumous son is known to history as the comte de Chambord (*q.v.*).

CAROLINE (Maria Carolina Ferdinanda Luisa; 1798–1870), duchesse de Berry from 1816, was born on Nov. 5, 1798, the eldest daughter of Francis I of the Two Sicilies. She followed Charles X into exile from France in 1830, but was determined to recover the throne for her son, then known as the duc de Bordeaux. From England she went to Italy, and she landed in France near Marseilles in April 1832. Receiving no support there, she made her way toward the loyal regions of Vendée and Brittany. Her followers were defeated, and after remaining concealed for five months in a house in Nantes she was betrayed and imprisoned at Blaye. There she gave birth to a daughter, allegedly the child of a secret marriage with an Italian count, Ettore Lucchesi-Palli (1806–64). Announcement of this marriage deprived the duchess of the sympathies of her supporters, and the French government released her in June 1833. She set sail for Sicily and, joining Lucchesi-Palli, lived in retirement until her death, at Brunsee, in Austria, on April 16, 1870.

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BERRY, JEAN DE FRANCE, DUC DE (1340–1416), French prince distinguished for his political role in France in the middle period of the Hundred Years' War (*q.v.*), for his wealth and power as a territorial magnate, for his building and for his patronage of the arts, was born at Vincennes on Nov. 30, 1340, the third son of John II the Good, king of France, and Bonne of Luxembourg. Created count of Poitiers and of Macon in 1356, he was made king's lieutenant for Languedoc, Auvergne, Périgord and Poitou in 1358, during his father's captivity in England, thus

gaining control of one-third of France despite the opposition of the dauphin. In 1360 Berry and Auvergne were raised to the rank of duchies and granted to him in appanage by his father. When his brother had succeeded to the throne as Charles V, Berry exploited the resources of his lands for the defense of the kingdom, but taxed them so oppressively that after Charles's death riots broke out in the towns of Languedoc and the peasants there revolted (rising of the Tuchins, 1381–84). As a member of the regency council for the young Charles VI, Berry advocated peace with England. He negotiated with the duke of Lancaster (John of Gaunt), solicited papal mediation and caused the planned attack on England to be postponed. When conflict developed between his brother Louis, duc d'Orléans, and John the Fearless, duke of Burgundy, Berry shifted between them and, as captain general of Paris, arranged a precarious reconciliation (1405). Sole master of the government after the assassination of Louis and John's temporary withdrawal (Nov. 1407), Berry tried at first to keep on good terms with the Burgundians, but as his influence waned he changed over to the Armagnac side (April 1410). After being besieged in Bourges by the Burgundians in 1412, he resumed his role of mediator (peace of Auxerre, 1412; of Pontoise, 1413). (*See* FRANCE: *History.*)

Berry lived sumptuously and when he died, in Paris, on June 15, 1416, there was no money to pay for his funeral. He had spent fortunes on the treasures that remain as his monument—paintings, tapestries, jewelry and illuminated manuscripts. His book of hours, the *Très riches heures* in the Chantilly museum, is an excellent pictorial record of his magnificent residences.

By Jeanne of Armagnac (d. 1387), whom he had married in 1360, Berry had three sons and two daughters, one of whom, Bonne, was married first to Amadeus VII of Savoy, then to Bernard VII of Armagnac, who gave his name to the Orléans party. Berry's second marriage (1389) was to Jeanne de Boulogne, whose father he had despoiled.

Bred in the bitterness after the battle of Crécy and dying in the mourning that followed that of Agincourt, Berry lived in a period of great public misfortunes. Rapacious and sensuous, an oppressor of his subjects and thirsty for power at the expense of the crown, he was often lacking in courage and in sense of duty, but deserves credit at least for his unremitting efforts to restore peace and for his enlightened protection of the arts and artists.

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BERRY (BERRI), an old province of France, absorbed in 1790 into the *départements* of Cher (corresponding roughly to Haut-Berry), Indre (Bas-Berry) and to a lesser extent adjoining *départements*. Under the Romans the territory of the Bituriges Cubi (*see* BITURIGES) was incorporated in Aquitania, with Bourges (*q.v.*) as the capital of the province. The county passed to the Visigoths in 475, then to the Franks about 507. The first count of Berry, Chunibert (d. 763), was created by Waifer, duke of Aquitaine, from whom the country was wrested by Pepin the Short. Pepin made it his residence and left it to his son Carloman, on whose death it fell to his brother Charlemagne. The chief authority in Berry eventually passed to the viscounts of Bourges who, while recognizing the royal suzerainty, preserved a certain independence until 1101, when the viscount Odo Arpin de Dun sold his fief to the crown. Other powerful feudatories, however, regarded themselves primarily as vassals of Aquitaine, so that when Aquitaine passed to Henry II of England the possession of Berry became a matter of dispute between the French and English kings until 1200, when Berry reverted by treaty with John of England to Philip II Augustus of France and the various fiefs of Berry were given as a dowry to John's niece, Blanche of Castile, on her marriage with Philip's son Louis (afterward Louis VIII). Philip Augustus established an effective control over the administration of the province by the appointment of a royal *bailli*. John II made it a duchy for his third son (*see* BERRY, JEAN DE FRANCE, DUC DE) in 1360. Thenceforward it was held as an appanage of the French crown, usually by a member of the royal family closely related to the king. In 1601, on the death of Henry III's widow, Louise of Lorraine, the country was finally reabsorbed into the royal domain. The title duc de Berry was subsequently granted to Louis XIV's grandson Charles (1686–1714) and to Louis XVI's nephew Charles Ferdinand (1778–1820).

See Marcel Marion, *Histoire du Berry et du Bourbonnais* (1933).

BERRYER, PIERRE ANTOINE (1790–1868), French advocate and parliamentarian who won distinction both for his championship of legitimism and for his defense of the freedom of the press, was born in Paris on Jan. 4, 1790. Called to the bar in 1811, he was associated with his father, Pierre Nicolas Berryer, and with André Dupin in the defense at the trial of Marshal Michel Ney and alone defended Gen. Pierre Cambronne (1816), securing his acquittal. On many occasions he acted on behalf of those accused of infringing the press laws of the Restoration: in 1826 he successfully defended F. R. de Lamennais against a charge of atheism. A staunch royalist and a devout Roman Catholic, Berryer was in Jan. 1830 elected to parliament, where he displayed his great gifts as an orator. After the July revolution he was the only legitimist representative to be re-elected. In 1832 he tried to dissuade the duchesse de Berry from her attempt to raise a revolt in southern France. Arrested as an accomplice, he was brought to trial, but was acquitted. He then made a memorable speech in defense of Chateaubriand's conduct in the same affair. In 1840 he defended Louis Napoleon after the failure of the Boulogne conspiracy. After the revolution of 1848 he was a member of the constituent assembly, where he continued to fight for the legitimist cause. He strongly opposed the *coup d'état* of Dec. 2, 1851, which put a stop to his parliamentary career for 12 years. He continued, however, to practise at the bar. In 1855 he was elected to the Académie Française. In 1863 he entered the *corps législatif* as an opposition member, still faithful to his royalist principles. He died at Augerville, Loiret, on Nov. 29, 1868.

See C. de Lacombe, *Vie de Berryer*, 3 vol. (1894–95); P. Jacomet, *Berryer au prétoire* (1938).

BERSAGLIERI, literally targeteers or marksmen, from *bersaglio,* "a target"; historically, the selected light infantry of the Italian army. Founded by Charles Albert in the old kingdom of Sardinia (Piedmont) under the inspiration of Alessandro Ferrero della Marmora in 1836, they played a worthy role in the campaigns of 1848 and 1849. By the Crimean War the corps was increased to ten battalions, and in the subsequent wars of the Risorgimento these troops distinguished themselves. Great emphasis was placed on their rigorous physical training and by 1914 they were famous not only for their beautiful plumed hats but also as some of the most rapid marchers in the world. After World War I the Bersaglieri were converted into cyclist units; after World War II they were mechanized and their function became that of armoured infantry. (H. M. SM.)

BERSERKER, in Scandinavian mythology, the name of the 12 sons of Berserk, grandson of the eight-handed Starkadder and Alfhilde (from the "sark" or shirt of bearskin worn by them). Berserk was famed for the reckless fury with which he fought, always going into battle without armour. In Old Norse the term "berserker" was later applied to the bodyguards of several of the Scandinavian heroes.

BERT, PAUL (1833–1886), French physiologist and politician who conducted important pioneer research into the effects of air pressure on humans, was born Oct. 17, 1833, at Auxerre, Yonne. He was appointed professor of physiology at Bordeaux in 1866 and at the Sorbonne in 1869. In 1878 he published *La Pression barométrique,* which has remained a classical work on the physiological effects of air pressure both above and below normal. This book was translated into English in 1943 and served as an important fundamental background for aviation medicine during World War II. Some of his earlier investigations were devoted to the grafting of animal tissues.

He was more distinguished as a scientist than as a politician or administrator. After being elected deputy from Yonne in 1872 he displayed leanings far to the left and anticlerical. In 1881–82 he was minister of education and welfare in Gambetta's short-

lived cabinet. In 1886 he was appointed governor-general in Annam and Tongking (Tonkin) and died of dysentery at Hanoi on Nov. 11 of that year.

See Aviation Medicine. (E. B. Bv.)

BERTANI, AGOSTINO (1812–1886), Italian patriot and social reformer, was born in Milan on Oct. 19, 1812. He took part in the March insurrection in Milan in 1848 and in the defense of Rome in 1849, when he organized the republicans' ambulance service. In Genoa, where he was working with Mazzini, he distinguished himself during the cholera epidemic of 1854. In the Austro-Sardinian War of 1859 he was a surgeon in Garibaldi's corps. In 1860 he was one of the organizers, with Garibaldi, of the March of the Thousand, but he disapproved of the annexation of the Two Sicilies before the occupation of Rome. On entering Naples (Sept. 1860), Garibaldi made Bertani his secretary-general, in which capacity he reorganized the police and planned the suppression of the religious orders and the sanitary reconstruction of the city. After the battle of Aspromonte (1862) he treated Garibaldi's wounds. In the war against Austria (1866), he organized the medical service for Garibaldi's 40,000, and in 1867 he fought at Mentana, although he disapproved of the march on Rome (*see* Italy: *History*). Bertani had entered the Italian parliament in 1861 and became the leader of the extreme left in the chamber. In 1866 he founded *La Riforma*, a journal advocating social reforms. When the left took office in 1876, Bertani remained in opposition, disliking the *trasformismo* of Agostino Depretis. He died in Rome on April 10, 1886.

See Leopoldo Marchetti, *Bertani* (1948). (N. S. J.)

BERTAUT, JEAN (1552–1611), French poet, notable as a writer of polished light verse, was born probably at Donnay in 1552. As a young man he became tutor to the children of a noble family and accompanied his pupils to court. There he began to write poetry which shows the influence of both Ronsard and Philippe Desportes. He composed love lyrics and poems celebrating the events of court life, turning in his later work to religious themes. His *Recueil des oeuvres poétiques* was published in 1601, and *Recueil de quelques vers amoureux* appeared in the following year. Bertaut held various official positions including those of councilor of the parliament of Grenoble, almoner to the queen and abbot of Aunay. In 1606 he was appointed bishop of Séez in Normandy, where he died on June 8, 1611.

See G. Grente, *Jean Bertaut* (1903).

BERTHELOT, PHILIPPE JOSEPH LOUIS (1866–1934), French diplomat, son of the great chemist Pierre Eugene Marcelin Berthelot (*q.v.*), was born on Oct. 9, 1866, at Sèvres. He began his career in the diplomatic service in 1889 and went into the ministry of foreign affairs in 1904. He became assistant director in its political and commercial department in 1913 and played an important part in the negotiations immediately preceding the outbreak of World War I. During that war he served as liaison officer between the Allied staffs. In 1919 he was promoted to be head of the political department of the ministry of foreign affairs. The next year he became its secretary-general, with the rank of ambassador. In 1921 he resigned, being accused of using his influence improperly in connection with the affairs of the Industrial Bank of China, of which his brother was a director. Reappointed secretary-general by Edouard Herriot in 1925, he accompanied Aristide Briand to Locarno and to London and conducted negotiations with G. V. Chicherin for resuming Franco-Russian relations. From then until 1932 he virtually controlled the internal organization of the ministry, following a policy which he described as that of "close union with England and of *rapprochement* with Germany." He died on Nov. 22, 1934.

BERTHELOT, PIERRE EUGÈNE MARCELIN (1827–1907), one of France's most distinguished chemists of the 19th century, who made significant contributions in organic chemistry and thermochemistry. He also held a number of important political posts. Berthelot was born at Paris on Oct. 27, 1827. In 1851 he became a member of the staff of the Collège de France as assistant to A. J. Balard, his former teacher. He made a reputation by his doctoral thesis, *Sur les combinaisons de la glycérine avec les acides*, which described a series of researches in continuation and amplification of M. E. Chevreul's classical work. In 1859 he was appointed professor of organic chemistry at the École Supérieure de Pharmacie, and in 1865 he accepted the new chair of organic chemistry, which was specially created for his benefit at the Collège de France. He became a member of the Academy of Medicine in 1863 and ten years afterward entered the Academy of Sciences, of which he became secretary in 1889 in succession to Louis Pasteur. He was appointed inspector-general of higher education in 1876, and after his election as life senator in 1881 he continued to take an active interest in educational questions, especially as affected by compulsory military service. In René Goblet's ministry of 1886–87 he was minister of public instruction, and in Léon Bourgeois's cabinet of 1895–96 he held the portfolio for foreign affairs. Berthelot died on March 18, 1907, at Paris.

He vigorously opposed the belief then generally accepted that the formation of organic substances requires the intervention of vital activity. His investigations on the synthesis of organic compounds were published in numerous papers and books, including *Chimie organique fondée sur la synthèse* (1860) and *Les Carbures d'hydrogène* (1901). Again he held that chemical phenomena are not governed by any peculiar laws special to themselves but are explicable in terms of the general laws of mechanics that are in operation throughout the universe; he developed this view, with the aid of thousands of experiments, in *Mécanique chimique* (1878) and *Thermochimie* (1897). Berthelot invented the terms "exothermic" and "endothermic." He investigated explosives, and on the theoretical side arrived at the results published in his work *Sur la force de la poudre et des matières explosives* (1872). On the practical side he was able to render important services to his country as president of the scientific defense committee during the siege of Paris in 1870–71 and subsequently as chief of the French explosives committee.

In 1883 he founded a botanical-chemical experiment station at Meudon, where he carried out many studies. He rediscovered the action of micro-organisms in the fixation of nitrogen in soils.

Berthelot's other works include: *Les Origines de l'alchimie* (1885); *Introduction à l'étude de la chimie des anciens et du moyen âge* (1889); translations of various old Greek, Syriac and Arabic treatises on alchemy and chemistry (*Collection des anciens alchimistes grecs*, 1887–88, and *La Chimie au moyen age*, 1893); *Chimie animale* (1899); *Science et philosophie* (1886); *La Révolution chimique, Lavoisier* (1890); *Science et morale* (1897), and numerous articles in *La Grande Encyclopédie*, which he helped to establish. (R. E. O.; X.)

BERTHIER, LOUIS ALEXANDRE, Prince de Wagram (1753–1815), French soldier, the first of Napoleon's marshals, chief of staff in the Grande Armée and sovereign prince of Neuchâtel, was born Nov. 20, 1753, at Versailles, the son of the court works surveyor, who was ennobled in 1756. Entering the army in 1770, he served during the American Revolution. In the French Revolution, being thoroughly trained as a survey and staff officer, he was chief of staff in one short-lived command after another in 1791–92, but was dismissed in Aug. 1792 because of his association with La Fayette. Requisitioned against the royalists in western France in March 1793, he was removed as a noble after four months' hard and dangerous service. He reappeared, however, as general of division and chief of staff in the army of the Alps and of Italy, first under F. C. Kellermann (1795), then under Napoleon Bonaparte (1796–97). A short, stout man who worked and rode untiringly and remembered what he was told, he was the perfect assistant to Napoleon. Commanding in Italy, he had to occupy Rome in Feb. 1798, but was with his chief again in Egypt.

Minister of war after the *coup d'état* of 18 Brumaire, commander in chief (with the first consul at his side) at the battle of Marengo, minister of war again (until 1807), Berthier was made marshal in 1804. In the Grande Armée from 1805 he was major-général (chief of staff) with a staff of six generals and eight colonels. This staff, executive rather than advisory, was the machinery of Napoleon's armies, and Berthier's fame rests on it. He said that he himself was "nothing," only the man who signed

the orders; but other marshals, especially when reprimanded, did not regard him as so impersonal, and the increase in the powers of the staff did not reduce friction between him and them. In 1806 Napoleon made him sovereign prince of Neuchâtel, declaring him to be "the man who has served me longest and has never failed me." In 1808 he married the duchess Marie, of the Bavarian Zweibrücken line. In 1809 he was given the French title of prince de Wagram.

Berthier seldom played a distinguishing role in Napoleon's battles. In 1809 he was for a week alone in command on the Danube while the Austrians developed their offensive, and he could not alter the prescribed dispositions even when the emperor's first plan was being falsified by events. It is hard to say what his influence was: reprimands and angry scenes became more frequent, and in Russia in 1812 he was more often silent. Yet at the end of the retreat from Russia and after Napoleon had gone he struggled devotedly to keep some kind of order in the army. After Napoleon's abdication he submitted to Louis XVIII and, as captain of his guards, escorted him out of France when Napoleon returned. He then joined his wife in Bavaria and they were at Bamberg when on June 1, 1815, Berthier fell from a window and died, while Russian cavalry were passing through the town. There were stories of suicide or murder; the accident was probably due to illness.

See NAPOLEONIC WARS.

See V. B. Derrécagaix, *Le Maréchol Berthier,* 2 vol. (1904–05); S. J. Watson, *By Command of the Emperor* (1957). (I. D. E.)

BERTHOLD VON HENNEBERG (1442–1504), elector and archbishop of Mainz, son of George, count of Henneberg, was made archbishop of Mainz in 1484. He was an enemy of clerical abuses and a careful administrator of his diocese. As archbishop he began to play a leading role in the empire and in 1486 was very active in securing the election of Maximilian I as Roman king. Under the emperor Frederick III he had brought the question of administrative reform before the diet, and after Frederick's death (1493), when he became imperial chancellor, he led the party which pressed the need for reform upon Maximilian at the diet of Worms in 1495. He continued the struggle and gained a temporary victory when the diet of Augsburg in 1500 established a council of regency (*Reichsregiment*). But while Berthold aimed at reform on the basis of an aristocratic council, Maximilian was intent upon re-establishing royal authority. In 1502 Maximilian dissolved the *Reichsregiment,* and Berthold's attempts to persuade the electors to form a union to uphold the reforms of 1495 and 1500 were of no effect. Berthold died on Dec. 21, 1504. His ideas for an ordered and united Germany were visionary but his methods conservative, and it was his tragedy to live in an age when the idea of a strong monarchy was everywhere triumphing.

See J. Weiss, *Berthold von Henneberg, Erzbischof von Mainz* (1889); E. Ziehen, *Mittelrhein und Reich im Zeitalter der Reichs-reform 1356–1504,* 2 vol. (1934–37). (A. LH.)

BERTHOLET, ALFRED (1868–1951), Swiss Protestant Old Testament scholar, who also wrote on the phenomenology of religion, was born on Nov. 9, 1868, in Basel, Switz. After serving as pastor of the German-Dutch church at Leghorn (Livorno) for 18 months he took his doctorate in Basel (1895) where he became *Privatdocent* (1896) and then professor (1899). Later he was made professor in Tübingen (1913), Göttingen (1914) and Berlin (1928–39). He died at Münsterlingen on Aug. 24, 1951.

Bertholet's work was dominated by a delight in the individual facets of religious experience, historical interests taking second place. This is already evident in his doctoral thesis, *Die Stellung der Israeliten und der Juden zu den Fremden* (1896) and in his *Kulturgeschichte Israels* (1919; Eng. trans. 1926). In spite of this, or perhaps because of it, his *Apokryphen und Pseudepigraphen* (1906) was an important contribution to Jewish literary history, and the second volume of *Biblische Theologie* (1911), conceived as a history of Old Testament religion, broke new ground. His works on the history of religion, such as *Dynamismus und Personalismus in der Seelenauffassung* (1930), *Götterspaltung und Göttervereinigung* (1933) and *Das Geschlecht der Gottheit* (1934), also are marked by immense care in the collection of material and by the skill with which problems are laid bare and solutions to them offered.

See L. Rost in *Theologische Literaturzeitung,* vol. 77 (1952); A. Staehelin (ed.), *Professoren der Universität Basel* (1960). (H. P. RU.)

BERTHOLLET, CLAUDE LOUIS (1748–1822), French chemist, was notable for being the first to claim that chemical reactions depend in part upon the masses of the reacting substances, thus coming close to formulating the law of mass action. However, he incorrectly concluded that elements unite in all proportions and published analyses to this effect. A controversy with Joseph Louis Proust over these claims led to the establishment of the law of definite proportions.

Berthollet was born at Talloires, near Annecy, Savoy, on Dec. 9, 1748. In early life he became associated with Antoine Lavoisier in the reform of chemical nomenclature. He disagreed with Lavoisier's idea that oxygen was an essential element in all acids, although he considered himself of the school of Lavoisier. His principal service to industry was the introduction of chlorine as a bleaching agent. He regarded chlorine not as an element but as oxygenated muriatic (hydrochloric) acid. In practical researches undertaken during the Napoleonic wars he determined how to obtain iron from ore and convert it into steel. His preparation of potassium chlorate did not provide the substitute for imported saltpetre for use in gunpowder that he intended but did make possible coloured fireworks (*q.v.*).

His career was varied and distinguished. Educated in medicine at Turin, he became physician in the household of the duc d'Orléans and spent much of his time in chemical research. During the French Revolution he served on many scientific committees, and in 1792 he became a commissioner of the national mint. In 1794 he was appointed commissioner of agriculture and professor at the polytechnic and normal schools. In 1795 he was active in reorganizing the academy as the Institut National; the following year he and Gaspard Monge were chosen chiefs of a commission sent to Italy to select the choicest specimens of ancient and modern art for the national galleries of Paris. He instructed Napoleon in chemistry and accompanied him on his expedition to Egypt in 1798. There he joined with scientific associates in forming the Institute of Egypt modeled on the Institut National, and first presented his ideas on the laws of chemical affinity later published in his book *Essai de Statique Chimie.*

On the fall of the Directory he became a senator and a grand officer of the Légion d'Honneur; under the empire he became a count. After the Restoration he took his seat as a peer. Ultimately he retired to Arcueil where he maintained a laboratory and sponsored meetings of distinguished scientists, whose discussions were published between 1807 and 1817 as the *Mémoires de la société d'Arcueil.* Berthollet died on Nov. 6, 1822, and was buried at Arcueil, where a statue was later erected.

Berthollet was forward looking; his disputes with Lavoisier and with Proust had a clarifying effect upon chemical theory that has earned him a prominent place in chemical history.

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BERTILLON, ALPHONSE (1853–1914), French anthropometrist, who invented the system of criminal identification known as *Bertillonage* described in his *La Photographie judiciaire* (1890), was born on April 23, 1853, in Paris. His system involved recording of bodily measurements and photographs, and was used in France and many other countries until superseded by the introduction of fingerprinting (*see* INVESTIGATION, CRIMINAL: *Identification*). He was appointed in 1894 to report on the handwriting evidence in the Dreyfus case, and was a witness for the prosecution before the court of appeal on Jan. 18, 1899. He died on Feb. 13, 1914, in Paris.

See R. W. McClaughay, *The Bertillon System of Identification* (1906).

LOUIS ADOLPHE BERTILLON (1821–1883), a statistician and the father of Alphonse, was born on April 1, 1821, in Paris. A doctor

by profession, he was one of the founders of the school of anthropology of Paris and was appointed professor of demography there in 1876; he also was director of the statistical office of Paris. His principal work was *Démographie figurée de la France* (1874). He died on Feb. 28, 1883, at Neuilly.

JACQUES BERTILLON (1851–1922), brother of Alphonse and a statistician, was born on Nov. 11, 1851, in Paris. He was principal of the office of statistics, and in 1885 the director of the "Annales de Démographie." He wrote *La Statistique humaine en France* (1880). He died on July 7, 1922.

BERTOLD VON REGENSBURG (*c.* 1220–1272), Franciscan preacher, was a native of Regensburg (Ratisbon). From about 1250 onward his fame as a preacher spread over all Germany, for the earnestness and straightforward eloquence with which he insisted that true repentance came from the heart, that pious pilgrimages and absolution were mere outward symbols, appealed to all classes. He died in Regensburg in Dec. 1272.

His German sermons, which reflect the life of the people, form the chief monuments of Middle High German prose; his Latin ones are written in a clear and direct style. The former were edited by F. Pfeiffer and J. Strobl (2 vol., 1862–80, reprinted 1906) and also exist in a modern German version by F. Göbel (4th ed., 1906); the latter were edited by G. Jakob (1880).

BERTRAND, HENRI GRATIEN, COMTE (1773–1844), French military engineer, the friend and confidant of Napoleon I and his most faithful companion in exile, was born at Châteauroux on March 28, 1773. He entered the army in 1792 as an engineer. After service in Italy (1797), where he first met Napoleon Bonaparte, he was sent on the expedition to Egypt, where he was wounded at the battle of Abukir and directed the fortification of Alexandria, being promoted brigadier general in 1800. Appointed aide-de-camp to Napoleon in 1804, he distinguished himself during the Austrian campaign. Promoted general of division in 1807, he was created *comte* in 1808. The bridges that he constructed for the French crossing of the Danube at Wagram in 1809 were described by Napoleon as the finest work since the Romans. Appointed grand marshal of the palace in 1813, he subsequently accompanied Napoleon to Elba and to St. Helena, where he shared his captivity for six years. The secret diary that he kept during this period, with its frank account of Napoleon's character and life in exile, is an invaluable document. After Napoleon's death in 1821 Bertrand returned to France, where the death sentence that had been passed on him *in absentia* in 1816 was annulled. He was elected deputy for Châteauroux in 1831. In 1840 he accompanied the prince de Joinville to St. Helena to bring Napoleon's body back to France. He died at Châteauroux on Jan. 31, 1844. In 1847 his remains were transferred to the crypt of the Invalides in Paris. His diary was deciphered and annotated by P. Fleuriot de Langle and published by him as *Cahiers de Sainte-Hélène*, 1816–21, three volumes (1949–59; Eng. trans. of vol. iii by F. Hume, *Napoleon at St. Helena*, 1952).

See J. de Vasson, *Le Grand Maréchal de Ste. Hélène* (1935).

(P. F. DE L.)

BERTRAND, JACQUES LOUIS NAPOLÉON (ALOYSIUS) (1807–1841), French writer, whose *Gaspard de la nuit*, dealing with medieval Dijon, introduced the prose-poem into French literature and inspired the Symbolists. Born in Ceva, Piedmont, on April 20, 1807, he is associated with Dijon, where his family lived after 1815 and where he was educated. It was as a member of the Société d'Études that he collected the historical material on Burgundy used in his early poems (*Volupté*) and in *Gaspard de la nuit*. In 1828 he became manager of the local paper, *Le Provincial*, and his contributions to it were favourably noticed by Charles Nodier, Victor Hugo and C. A. Sainte-Beuve. This enabled him to go to Paris, where he is heard of at the *salon* of Joseph Delorme. Sainte-Beuve, to whom he showed some of his prose-poems, encouraged him, but, unable to find congenial employment, he returned to Dijon, where he wrote for *Le Spectateur* until its suspension under the ordonnances of Charles X. After the revolution of 1830 he edited the revolutionary *Le Patriote de la Côte d'or*, until 1833 when, finding that his political activities made it impossible to remain, he returned to Paris. He struggled against poverty and ill-health, trying to live by casual journalism. In 1836 he sold *Gaspard de la nuit*, but taste was returning to classical inspiration and the publisher lost interest in it. When it was obvious that Bertrand had not long to live, his close friends—the sculptor David D'Angers and Sainte-Beuve—attempted to get it published, but he died of tuberculosis, aggravated by starvation, on April 29, 1841, and it did not appear until 1842. It aroused little interest but at the end of the century, during the Symbolist movement, it came into its own. Its admirers included Mallarmé, Ravel, whose pianoforte suite, *Gaspard de la nuit*, was inspired by it, and Baudelaire. Bertrand described his prose-poems as *"fantaisies à la manière de Rembrandt et de Callot,"* saying that he had tried to create a new form of poetry in rhythmic and picturesque prose. Many of them reach a high standard of artistry and originality, and Baudelaire, in the preface to his own prose-poems, *Spleen de Paris*, declared that he had wished to attempt for modern Paris what Bertrand had achieved for medieval Dijon.

See C. Sprietsma, *Louis Bertrand dit Aloysius Bertrand* (1926).

(E. ST.)

BERTRAND, LOUIS MARIE ÉMILE (1866–1941), French writer of novels and travel books mostly about North Africa, was born at Spincourt, Meuse, March 20, 1866. Educated at the École Normale Supérieure, he taught classics, spending nine years in Algiers. In 1926 he became a member of the Académie Française. His books express his preference for the Christian and Latin rather than the Muslim and Arab traditions of North Africa: through studying Spanish and North African religious history he regained his lost Catholic faith. His novels include *Le Sang des races* (1899), a study of the French pioneers in Algeria; other works are *Le Livre de la Méditerranée* (1911), *Saint Augustin* (1913), *Les Villes d' or* (1921), *Les Martyrs Africains* (1930), *Histoire d' Espagne* (1932, Eng. trans. 1934, 1952) and *Le Livre de consolation* (1933). He died at Cap d' Antibes, Dec. 6, 1941.

See Maurice Ricord, *Louis Bertrand l' Africain* (1947).

BERTRAND, MARCEL ALEXANDRE (1847–1907), French geologist who pioneered in the study of rock structures resulting from deformation of the earth's crust, was born in Paris on July 2, 1847. He was educated at the École Polytechnique and École Nationale Supérieure des Mines, where he became instructor and professor. During summers he carried on field work for the French geological survey. Several seasons in the Jura mountains made Bertrand familiar with relatively uniform symmetrical folds. Transferred to Provence, he proved the existence of overturned folds and thrust faults, modified by later compression which produced thrusts of great extent, often called sheets or nappes. In the coal basin of northern France he traced equally great thrust faults of post-Carboniferous age. His publications on these structures established modern tectonic research, especially in regions such as the Alps (*q.v.*).

In 1896 Bertrand wrote the preface to the French edition of Eduard Suess's *Das Antlitz der Erde* and became a member of the Académie des Sciences. Despite the significance of his work he produced few papers and no long ones; his chief influence was exercised through students. He died in Paris on Feb. 13, 1907.

(M. A. F.; C. L. FE.)

BÉRULLE, PIERRE DE (1575–1629), French cardinal and statesman, founder of the Oratory in France and one of the most important figures in French spiritual life in the 17th century, was born at Cérilly near Troyes on Feb. 4, 1575. He studied theology at the Collège de Clermont and at the Sorbonne. Prompted by his cousin Madame Acarie (Barbe Avrillot), the mystic whose house was the centre of the Catholic revival in France and who introduced him to the Carthusian Richard Beaucousin, to the Capuchin Benedict Canfield and to François de Sales, he went to Spain in 1604 and thence, after difficult negotiations, brought back the seven nuns who were to establish the Order of the Discalced Carmelites in France. Bérulle then became the official visitor of their monasteries, 30 of which had been founded by the time of his death. His main purpose, however, was to reform the clergy, and his greatest achievement was the foundation of the

Oratory (1611). This congregation of priests, who were bound only by an annual engagement, played an important part in the foundation of new seminaries, in the improvement of preaching, in the promotion of theological studies and also in education.

Bérulle always took a great interest in political affairs. At first his relations with Richelieu were excellent, but very soon he found himself in opposition to Richelieu's anti-Spanish policy and appears to have tried to prevent his being promoted cardinal in 1622. For some time, however, no rupture occurred between them. In 1624 Richelieu sent him to Rome to obtain the papal dispensation for the marriage of the French princess Henrietta Maria to the future Charles I of England; and in 1625 Bérulle accompanied the young queen to England. Returning to France, he kept up a correspondence with Henrietta Maria, encouraging her to be intransigent on religious matters—advice that was not in accordance with Richelieu's policy. His negotiations with the Spaniards about the Valtellina (*q.v.*) led to the treaty of Monzón (1626), which Richelieu was later to deprecate in his *Mémoires*. Richelieu presumably disapproved of Bérulle's elevation to the cardinalate (1627), but they still worked together during the operations against the Protestants in La Rochelle (1627–28). The definite breach came at the end of 1628. Bérulle was then the principal adviser of the queen mother, Marie de Médicis, and a leader of the extreme Catholic party whose policy was to destroy Protestantism throughout Europe, whereas Richelieu was ready to support the German Protestants in order to humble the Habsburgs. Bérulle was thus completely out of favour at the time of his death, which took place suddenly, while he was saying mass, on Oct. 2, 1629.

Bérulle's political activity came to nothing. In the revival of Catholicism, however, he had played an essential role. His Oratory served as a model for those new congregations of priests which characterize the religious history of 17th-century France—the Lazarists of St. Vincent de Paul, the Sulpicians of J. J. Olier and the Eudists of St. John Eudes. He also exercised a decisive influence on the religious development of the abbé de St. Cyran (*see* DUVERGIER DE HAURANNE, JEAN) and so, through him, on Port Royal (*q.v.*). Largely inspired by Plato, by the pseudo-Dionysius Areopagiticus and by the Florentine Platonists of the Renaissance, Bérulle represents that type of Augustinian piety of which Jansenism constitutes only one aspect. He stands at the head of the "French school" of spiritual thought.

Editions of his works appeared in 1644 (republished 1960), 1657 and 1665; there is also one by J. P. Migne (1856). (JE. DA.)

BERVIC, CHARLES CLÉMENT (1756–1822), French engraver, known for the brilliance and softness he achieved and for his striving for exactness and regularity, was born in Paris, on May 23, 1756. His family name was Balvay, but he preferred to use Bervic, his father's surname. He studied with Jean Baptiste le Prince and Jean Georges Wille. A full-length portrait of Louis XVI in coronation robes, after a painting by Antoine Callet, established his reputation. The Order of the Reunion was given him in 1813 and the Legion of Honour in 1819. So slowly did he work that in his lifetime he produced only about 15 plates. He died in Paris on March 23, 1822. (H. Es.)

BERWALD, FRANZ ADOLF (1796–1868), the most important Swedish composer of the 19th century. Born at Stockholm on July 23, 1796, of a renowned family of musicians, he studied the violin with his father and composition with J. B. E. Du Puy. After writing numerous concertos, orchestral and chamber works between 1818 and 1828, he lived in Berlin (1829–41) and Vienna (1842) where, as in Sweden, his music was received with respect rather than enthusiasm. His work includes five symphonies (1820–45), the opera *Estrella de Soria* (Stockholm, 1862, revived 1946) and many choral and chamber works. Harmonically resourceful and original in construction, Berwald's music has a northern character, the severity of which is often relieved by a light and capricious sense of rhythm. He died at Stockholm on April 3, 1868.

See R. Layton, *Franz Berwald* (1959).

BERWICK, JAMES FITZJAMES, DUKE OF (1670–1734), marshal of France, was born at Moulins, in Bourbonnais, on Aug. 21, 1670, the son of Arabella Churchill (sister of John Churchill, the future duke of Marlborough) by James, duke of York (later King James II of England). He was educated in France and gained some experience of war in the Holy Roman emperor's service against the Turks in Hungary. In England he was created duke of Berwick in 1687 and was made colonel of two regiments and governor of Portsmouth. After the battle of the Boyne (1690) he commanded the Jacobites for a time in southern Ireland, in ineffective opposition to his uncle Marlborough. Returning to France, Berwick organized the remnants of eight Irish infantry regiments for the French army and was in 1693 made a French lieutenant general. The Irish were a notable element in all his commands, and both his marriages (with Honora Sarsfield in 1695 and with Anne Bulkeley in 1700) linked him with the Irish Jacobite officers. In the battle of Neerwinden (1693) he was taken prisoner by another of his uncles, Gen. Charles Churchill. Released by exchange, he went secretly to England in 1695, but then turned definitely to France. In 1701–03, early in the War of the Spanish Succession (*q.v.*), he was with the marshal de Boufflers on the Rhine and Meuse and before Antwerp, facing Marlborough, with whom he maintained a secret correspondence.

In 1704 Berwick was sent by Louis XIV to be captain general in the Spanish army, but in spite of some successes on the Portuguese frontier he was soon recalled as the Spaniards preferred the marshal de Tessé (René de Froullay). He then commanded against the insurgent Camisards in Languedoc until he was required instead to capture Nice. For this service he was made marshal of France (Feb. 1706) and sent back to Spain. While King Philip V and Tessé were being worsted before Barcelona, Berwick retreated from Portugal to Burgos, where gradually all available Spanish and French troops passed under his orders. He recovered Madrid and had cleared a large area to the southeast before the earl of Galway attacked him with a much smaller force of Portuguese, English and Dutch. In the ensuing battle of Almansa (April 25, 1707), Berwick won a victory which confirmed King Philip on his throne and gave Berwick a European reputation. He was rewarded with the Spanish duchies of Liria and Xerica and with the government of a French province, the Limousin.

In France, however, Louis XIV would give Berwick only secondary commands and assigned him first to Dauphiné, then to the Rhine. In 1708 Berwick brought 27,000 men from the Rhine to support the duc de Vendôme in Flanders; but he would not serve under Vendôme and had his share in the disunion of counsel which enabled Marlborough to capture Lille. In 1710 he was created duc de FitzJames by Louis XIV. From 1710 to 1713, apart from intervals of service in northern France, he was in Dauphiné, where his scientific system of defending the Alpine passes was successful. In 1714 all troops in the south were sent with him into Catalonia to end the war in Spain. The storming of Barcelona (Sept. 11) was a triumph for him and for the Irish regiments.

Berwick was given charge of the French demonstrations across the Spanish frontier in 1718. Governor of Strasbourg from 1730, he received the command on the Rhine when the War of the Polish Succession broke out (1733). He was besieging Philippsburg when he was killed by a cannon shot on June 12, 1734. His *Mémoires*, with a supplement by L. J. Hooke, were published by his son, the marshal duc de FitzJames (1778; Eng. trans. 1779).

See Sir Charles Petrie, *The Marshal Duke of Berwick* (1953). (I. D. E.)

BERWICKSHIRE, a border county of southeastern Scotland, is bounded on the north by East Lothian, west by Midlothian, south by Roxburghshire, southeast along the Tweed by Northumberland and northeast by the North sea. Area 457 sq.mi.

Physical Features.—Lammermuir, the northern third of the county, consists of plateaus of 1,400–1,600 ft. in the north, above which residual heights swell gently (*e.g.*, Meikle Says Law [1,750 ft.]), and plateaus of about 700–900 ft. in the south and stretching east through Coldingham moor to the great sea cliffs around St. Abb's head. These plateaus are planed across slaty Silurian shales and grits, folded and metamorphosed in the Caledonian orogenesis, and in places across Old Red Sandstone sedi-

mentaries and igneous intrusions; there are also some felsites of Carboniferous age (Dirrington Laws, 1,191 ft. and 1,309 ft.). Rainfall is moderate and averages 35–40 in. annually. The vegetation is of heather and bent grass moorland (sheep runs, with grouse-shooting) upon poor acid soils, with rushes, cotton grass and sphagnum moss on damper flats, often over peat. There are occasional shelter belts of Scots pine on the moors, mixed woodland on steep slopes and some conifer plantations. Brawling trout streams like the Whiteadder, the haunt of water ousel and wagtail, wind between steep bluffs across flat moors of melt-water gravels, leaving curving haughs (meadows) clad in fescue and heather. The western tenth of Berwickshire is the widest of these valleys, Lauderdale, where the Leader and its tributaries have carved out a broad swathe of lowland.

The southern, lowland two-thirds of the county is the Merse (March or borderland, possibly marshland). This consists of glacially plastered low plateaus at about 200 ft. and 500 ft. cut across Old Red Sandstone and also Lower Carboniferous sandstones and shales, above which stand a few volcanic hills of basalt or trachyte. The Merse was transformed by glacial deposition of ground moraine drumlins (from the main southern upland glacier), aligned west–east to affect road and field patterns and settlement sites, and forming the basis of well-drained soils of good mineral content; while between the hummocks are innumerable ill-drained hollows and some considerable stretches of lowland peats. Melt-water deposits give occasional stretches of light sands and gravels. The mean annual rainfall is about 25–30 in.; the spring may be cool with dry easterly winds, but harvests are often sunny and early; locally there are severe winter frosts. Apart from some still unreclaimed birch, heather and mosses, this is a farming landscape varied by parks and woodlands, including beech. The fauna include fox. (A. T. A. L.)

History.—There are Roman marching camps at Channelkirk and at Belchester near Coldstream, while on Cockburnlaw near Duns is one of the few brochs in southern Scotland, known as Woden's or Edin's Hall. Many early British camps can be found in the north of the county (St. Abb's head, Duns law, Cockburnlaw). During the Saxon period the area formed part of Northumbria and in the 6th and 7th centuries Christianity was introduced by the saints Modan, Aidan, Oswald and Cuthbert. The Danes landed in 886 and destroyed the nunnery at Coldingham which had been founded by Ebba, daughter of King Aethelfrith, after whom St. Abb's head was named, and in 1098 King Edgar founded a Benedictine priory on the site. This became one of the wealthiest in Scotland and James III annexed its revenues for his personal gain, thus hastening the revolt of the nobles (1488). Burned by the earl of Hertford (1545) and blown up by Cromwell (1650), part of the chancel was repaired and is still used as the parish church. Dryburgh abbey, in the southwest, founded in 1150 for a colony of Premonstratensians, was at the height of its importance in 1296 when these canons swore fealty to Edward I, but it was burned and pillaged by Edward II in 1322 and finally ruined by Hertford in 1545. The church is a sandstone ruin retaining a rose window which measures 100 ft. by 30 ft. One of the few pre-Reformation churches still standing in its entirety is at Ladykirk, having been built by James IV in gratitude for his rescue from drowning in the river Tweed. In Lamberton church in 1502 was signed the contract for the marriage of James IV and Margaret Tudor.

In 1018, after the battle of Carham, the area was annexed to Scotland. At Birgham, near Coldstream, in 1188 William the Lion and the nobles and clergy refused the request of the bishop of Durham, made on behalf of Henry II, for funds for a new crusade against the sultan Saladin. There in 1289 a committee of estates consented to the marriage between Margaret, the maid of Norway, virtual heir to the Scottish throne, and Prince Edward of England; and there the following year was signed the treaty of Birgham, assuring Scotland's independence. In 1296 Edward I crossed the Tweed at Coldstream prior to the siege of Berwick, which, after years of border warfare, was finally ceded to England in 1482. Coldstream (*q.v.*) became the headquarters of the army in Scotland and it was there that General Monck's regiment of foot was organized and renamed his majesty's Coldstream regiment of footguards.

Besides ecclesiastical remains, Rhymer's tower near Earlston, the reputed abode of Thomas the Rhymer, and Greenknowe tower near Gordon are of great architectural value. The remains of Fast castle on the coast were the original "Wolf's Crag" of Sir Walter Scott's *Bride of Lammermoor.* Hume castle, near Greenlaw, scene of many battles, was once the seat of the earls of Home; while important examples of the work of William and Robert Adam are the houses of Mellerstain, near Eden Water and Paxton, west of Berwick-upon-Tweed. (W. R. EL.)

Population and Administration.—The population of Berwickshire in 1961 was 22,441, compared with 30,824 in 1901. There are four small burghs: Duns (*q.v.*), the county town (1,838), Eyemouth (2,160), Coldstream (1,227) and Lauder (597). A feature of the Merse are the "ferme towns" of up to a dozen cottages attached to a single farm. With East Lothian, the county returns one member to parliament. Berwickshire forms a sheriffdom with Roxburghshire and Selkirkshire. (A. H. C. S.)

Industries and Communications.—Farming dominates the economy. The Lammermuir heather grazings are occupied by extensive sheep farms, where Scotch Black-face ewes produce purebred lambs or Gray-faces by Border Leicester tups. Farm income is mainly from lambs and calves sold for fattening and breeding on better land, and from wool. Livestock-rearing farms cover most of the Lammermuir foothills and upper Lauderdale, their income being principally from half-bred (Border Leicester with Cheviot) lambs and beef calves, both sent widely over Scotland and England, and wool. A little cash cropping—oats, barley and potatoes—is possible.

Climate and soil in the Merse favour diversified farming. Barley, oats, wheat, potatoes and a little sugar beet are cash crops produced on a rotational basis. The farms, mostly large, carry big flocks of half-bred ewes replenished annually by young sheep from higher ground. Crossbred lambs sired by Down rams are bred and fattened on grass or roots, and additional purchased lambs are often fattened on roots. Traditionally, purchased bullocks are fattened on grass and in courts, but now beef cattle are often bred on the farms.

Large numbers of animals are sold at St. Boswells and Hawick in Roxburghshire and at Reston in Berwickshire. Sales of grain and other business are conducted at the weekly markets in Berwick and Edinburgh.

The forestry commission has established forests in Lauderdale and north of Duns. The Tweed salmon fisheries are famous and the lesser rivers of the Merse are esteemed by anglers. Eyemouth, Burnmouth and Cove are engaged in sea fisheries; haddock, herring, lobsters and crabs are chiefly taken. There is quarrying of the intrusive igneous rocks found in limited areas. Earlston produces woolen cloths and has a large sawmill, while at Cumledge (on Whiteadder Water) and Chirnside blankets and paper, respectively, are manufactured.

The Great North road (A1) passes through Berwick. The only railway services for passengers are to two or three stations on the main Berwick-Edinburgh line, though goods can be sent to Duns from Reston and to Greenlaw from St. Boswells. (W. A. Bu.)

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BERWICK-UPON-TWEED, a municipal borough and seaport of Northumberland, Eng., lies at the mouth of the Tweed about 337 mi. N.W. of London by road. Pop. (1961) 12,166. Both the east coast railway route from London to Scotland and the Great North road cross the border at the northern boundary of the borough. With long stretches of soft sands and fine country, the town attracts visitors from both north and south of the border.

In certain proclamations Berwick is still mentioned individually, after Wales, a custom dating from the time when the fluctuations of border warfare led it to be regarded as part of neither England nor Scotland. It was made a free town in 1551 and in 1836 was redeclared by act of parliament to be a county of itself. The

liberties of the borough, commonly called Berwick bounds, include the townships of Spittal and Tweedmouth, on the south bank of the river. Berwick was at first represented in the court of the four royal burghs and in 1326 in Robert Bruce's parliament. After being occupied by the English it remained unrepresented until it was retaken by the Scots, when it sent two members to the parliament in Edinburgh from 1476 until 1479. In 1482 the burgesses were allowed to send two members to the English parliament and were represented there until 1885, when the town was merged in the parliamentary division of Northumberland that bears its name.

Very little is known of the history of Berwick before the Norman Conquest. It was not until the Tweed became the boundary between England and Scotland in the 12th century that Berwick, as the chief border town, became important. After changing hands 13 times it was finally surrendered to England in 1482. After Edward I had conquered Berwick in 1302 he gave the burgesses a charter by which the town was made a free borough with a guild merchant, having two markets every week and a fair. James I granted the incorporation charter in 1604, but on his accession to the throne Berwick rapidly lost its importance as a bastion against the Scots. It is one of the few towns still surrounded by a complete set of ramparts. The original walls, built by Edward I, were rebuilt by Elizabeth I. The bell tower, from which alarms were given when border raiders were observed, is in fair condition. Adjoining the walls, between the windmill and the brass bastions, are the oldest occupied barracks (1719) in England. There are scanty remains of the Norman castle, which fell into disrepair after the union of England and Scotland and was despoiled when the railway station was built. Berwick has the only parish church (1648–52) built and completed during the Commonwealth. Three bridges connect the town with the south bank of the Tweed: the oldest, of 15 arches, was opened in 1624. In 1928 it was supplemented by the much larger and wider Royal Tweed bridge. The Royal Border bridge, a quarter of a mile up the river, was built by Robert Stephenson in 1847–50 and is a striking railway viaduct 126 ft. high with 28 arches.

The reach of the river from the old bridge to the mouth forms the harbour. The principal export is grain; imports are oil and timber. Fairs are held annually at the beginning of March and the end of May. Industries include a small shipyard, engineering, sawmills and joinery works, salmon fishing (for which the town has been noted from very early times), fertilizer factories, and tweed and hosiery mills. The weekly grain and livestock markets are important.

BERWYN, a city of Cook county, Ill., U.S., about 7 mi. W.S.W. of Chicago's loop on the Chicago Sanitary and Ship canal. Primarily a residential suburb, Berwyn also manufactures electrical equipment, machine tools, leather and tobacco products. Founded in 1890, Berwyn was incorporated as a village in 1891 and as a city in 1908. Pop. (1960) 54,224. For comparative population figures *see* table in ILLINOIS: *Population.*

BERYL, the commercial source of beryllium, is a mineral species of considerable interest because certain varieties have long been used as gem stones. Beryl, which is harder than quartz and will scratch glass, is commonly pale green, but it may be deep green, blue, yellow, brown, colourless or pink. Special names are given to the coloured gem varieties. Emerald (*q.v.*) is deep green, coloured by a small amount of chromium; aquamarine (*q.v.*) is pale blue-green; morganite is pink, probably coloured by cesium; golden beryl is yellow. The colour of many beryls used as gems has been induced by heat treatment. Greenish-yellow beryls turn to clear green at about 275° C.; green beryl turns blue between 300° C. and 400° C.; but the emerald does not change colour on heating.

Beryl occurs as an accessory mineral in many granitic rocks and associated pegmatite dikes and also is found in gneisses and mica schist. The usual occurrence of the gem varieties other than emerald is in cavities in pegmatites. The commonest gem beryl, aquamarine, has been found in Brazil, the chief source, and in Siberia and Madagascar; in the United States it has been found in Maine, New Hampshire, Connecticut, North Carolina and Colorado. Golden beryl is found in Maine, Connecticut and North Carolina, and also in Brazil, Siberia and Ceylon. Rose-coloured beryl comes chiefly from California and Madagascar. Emeralds are found in a mica schist in the Ural mountains east of Sverdlovsk, U.S.S.R., but the most important locality is at Muso, 65 mi. N.W. of Bogotá, Colombia. There emeralds of gem quality, found in veins in a dark bituminous limestone, have been mined almost continually since the middle of the 16th century.

Common beryl of nongem quality is found in many pegmatites, but usually in small disseminated crystals. However, crystals weighing many tons have been found. At Albany, Me., a single tapering crystal was found in 1949 that measured 27 ft. 7 in. in length with an average diameter of more than 2 ft.; from it approximately 15 tons of beryl were extracted. A crystal 7 ft. in diameter but of unknown length was found in a pegmatite in the Black hills of South Dakota.

Before 1925 beryl was of commercial interest only as a gem stone. Thereafter many important uses were found for beryllium, and common beryl has been widely sought as the ore of this rare element. No large deposits have been found, and much of the production is a by-product in the mining of feldspar and mica. Although the amount of beryl mined fluctuates from year to year, there was a rather steady increase after 1930. Brazil became the major producer. Other producers are Southern Rhodesia, the Union of South Africa, South-West Africa and the United States. The United States consumes more than 90% of the total production, mostly in the manufacture of beryllium copper alloys. (For other important uses *see* BERYLLIUM.)

Composition and Characters.—Beryl is essentially a beryllium aluminum silicate, $Be_3Al_2Si_6O_{18}$; but alkalis (sodium, potassium, lithium and cesium) may be present up to 7%. Small amounts of other elements give rise to the colour varieties. Beryl crystallizes in the dihexagonal-dipyramidal class of the hexagonal system (*see* CRYSTALLOGRAPHY) with crystals characteristically long six-sided prisms terminated by the basal plane. Pyramidal faces are present on some crystals. An imperfect cleavage is parallel to the base. The specific gravity is about 2.7 and the hardness 7.5 to 8.

Synthesis.—Because of the high value of the emerald, attempts were long made to manufacture it synthetically. These efforts finally met with success shortly before World War II when a German patent was issued to cover its synthesis. Beginning in 1946 emeralds of fine quality were manufactured in the United States by a secret process, probably in a water solution at elevated temperature and pressure. The crystals thus grown appeared very similar to those found in nature and rivaled natural stones in colour and beauty. A synthetic emerald observed under ultraviolet light fluoresces a deep red; the natural stones do not fluoresce. *See* also GEM. (C. S. H.)

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BERYLLIUM is a light, metallic element, some of its properties resembling those of magnesium, aluminum or zinc. It has assumed importance in the field of atomic energy. (See *Uses,* below.)

In this article various aspects of beryllium are treated under the following sections and subsections:

I. History
II. Occurrence
III. Industrial Production
IV. Uses
  1. Structural Parts
  2. Nuclear Applications
  3. Alloys
  4. Fabrication
V. Physical and Chemical Properties
  1. Extraction in the Laboratory
  2. Physical Properties
  3. Chemical Properties
  4. Inorganic Compounds
  5. Organic Compounds
  6. Toxicology
  7. Analysis

I. HISTORY

Beryllia (beryllium oxide) was first isolated in 1797 by L. N. Vauquelin from beryl, a silicate of beryllium and aluminum, from which came the name beryllium. (The alternate name, glucinum, reluctantly adopted by Vauquelin, was suggested by the editors of *Annales de Chimie*, publishers of Vauquelin's article, because of the pronounced sweetish taste of its salts.) Vauquelin's discovery of beryllium was aided by its having both basic and acidic properties; beryllium hydroxide precipitates from its boiling alkaline solution while aluminum hydroxide does not. The latter element was thought at that time to be the only metal in beryl.

BY COURTESY OF SMITHSONIAN INSTITUTION

GOLDEN BERYL WITH MUSCOVITE WEIGHING 1,800 G. FOUND IN THE MINAS GERAIS REGION OF BRAZIL

Friedrich Wöhler and A. A. B. Bussy, working independently, first isolated the element as an impure powder by the reduction of its chloride with potassium in 1828. In 1897 Paul Lebeau prepared alloys of copper, chromium, molybdenum and tungsten with as high as 10% of beryllium by reducing in an electric arc finely divided beryllium oxide intimately mixed with carbon and the other metal. In 1898 he obtained a finely divided beryllium powder by electrolyzing sodium beryllium fluoride in a nickel crucible at low red heat. In 1921 A. Stock and Hans Goldschmidt directly produced compact beryllium by electrolysis of mixtures of barium fluoride with beryllium fluorides at temperatures above the melting point of the metal.

II. OCCURRENCE

Beryllium is estimated to occur in earth's igneous rocks to the extent of 0.0006%, thus having slightly more abundance than arsenic but only one-seventh that of tin. Unfortunately, these rocks usually contain too little beryllium for the existence of its specific minerals and it therefore enters the structure of other minerals, without accompanying significant concentration.

Of 28 minerals in which beryllium is an essential constituent and 27 minerals in which beryllium is a minor accessory constituent only one, beryl, has been found in sufficient quantity to constitute a commercial ore. Beryl, a primary mineral, is widely distributed and most commonly found in granitic igneous rocks known as pegmatite (*q.v.*). These are dikelike bodies of rocks characterized by the relatively large crystal size attained by the component minerals. (Single crystals of beryl weighing 35 tons have been noted.) Pegmatites are formed in enclosing rock by the solidification and precipitation of minerals carried in emanations from deep-seated granitic magmas. Such deposition takes place at great depth. Pegmatites observable at the earth's surface have been exposed by erosional processes which, active over a great period of geologic time, have removed the original overlying rock cover. Although traces of beryl occur in many pegmatites, only in a relatively few are the amounts sufficient to be significant for production, even when aided by the presence of by-product minerals.

In the best beryl-producing pegmatites, 1 part beryl is generally associated with 50–100 parts of feldspar and quartz, together with lesser amounts of minor minerals, among which are tantalum, lithium, uranium, rare-earth minerals and mica. Large, low-grade deposits of beryl occur as disseminations (about 0.2%–0.4%) in granite, and in certain types of quartz veins in granite where beryl is associated with tungsten (wolframite) ore. For composition, appearance, occurrences, etc., *see* BERYL.

TABLE I.—*Some of the Minerals of Beryllium*

Mineral	Formula	Per cent BeO
Phenacite	Be_2SiO_4	45
Chrysoberyl	$BeAl_2O_4$	19
Beryllonite	$NaBePO_4$	19
Beryl	$Be_3Al_2Si_6O_{18}$	14
Helvite	$(Be\ Fe\ Mn)_8\ Si_6O_{12}S$	10

Mining of pegmatite minerals is usually done by open-pit or quarry methods although in some large, rich pegmatites underground mining methods are used. Because of its diffuse occurrence in the pegmatites, the mining of beryl remained expensive, for no really satisfactory deposit was known.

Spectrographic testing of mine tailings, industrial wastes, core drillings and natural concentrates has been recommended for discovering new sources of this element. A chemical spot test suitable for field use in testing individual minerals for beryllium is described based on the dye principle, *p*-nitrobenzene-azoorcinal.

III. INDUSTRIAL PRODUCTION

Industrially, beryllium hydroxide is extracted from beryl ore by two different methods. In one of these methods beryl ore is fused at 1,500°–1,600° C. and then quenched with water (without changing composition) to produce a reactive glass or frit. This material is heat-treated to increase its reactivity, ground to a fine powder, mixed and heated with a small excess of concentrated sulfuric acid, leached with water and from the resulting solution of beryllium and aluminum sulfates, the bulk of aluminum is separated as crystallized ammonium alum. The remaining aluminum content is eliminated as sodium aluminate in subsequent operations. Following the alum crystallization, chelating compounds are added to the mother liquor so as to hold undesirable impurities, such as iron, etc., in the solution. Excess sodium hydroxide is then added to convert the aluminum and beryllium to aluminate and beryllate respectively, both of which are quite soluble in cold alkaline solution but different in the respect that the beryllate decomposes on boiling to precipitate beryllium hydroxide, whereas the aluminate is unaffected. The beryllium hydroxide is separated by filtration and if required is ignited to oxide. One plant in the United States uses this method industrially.

In the second of these methods, finely ground beryl ore is mixed with sodium fluosilicate, sodium fluoride or sodium carbonate and heated to 750° C. At this temperature, sodium beryllium fluoride (Na_2BeF_4) is formed. This compound is water soluble and leached out with water to form a dilute solution. Beryllium hydroxide is precipitated from this solution with sodium hydroxide, separated by filtration and, if required, ignited to oxide. One plant in the United States, one in England and one in France use this method industrially.

The reduction of beryllium fluoride by means of magnesium (see *Extraction in the Laboratory*, below) is employed for industrial production of pure metal by two plants in the United States. One plant in England and one in France convert beryllium oxide to anhydrous beryllium chloride which is electrolyzed in the presence of sodium chloride to produce pure beryllium in flake form. Generally a nickel pot serves as the cathode and a graphite electrode as the anode. The temperature maintained is well below the melting point of beryllium (730° C. at the start, increased to 820° C. at the finish). The remaining melt is poured or siphoned off, and the beryllium flake left cemented to the cathode walls is freed with large quantities of ice water and dried at low temperature to prevent oxidation.

By far the largest use of metallic beryllium has been in beryllium copper, although the utilization of pure beryllium is increasing rapidly. For this purpose a master alloy of 4% beryllium in copper is produced by a modification of Lebeau's arc furnace process described above. Copper chips, beryllium oxide and carbon are mixed together in a ball mill and charged into a three-phase graphite-lined arc furnace constricted toward the top and protected from the atmosphere. The furnace temperature is maintained at 1,900°–2,000° C.; when the content has progressively accumulated to a sufficient extent, it is poured into a normalizing furnace where carbide and dross contained in the melt are rejected as the melt stands slightly above solidification. The carbide and dross in the form of thick metal are skimmed off for reuse in the arc furnace, and the remaining clean metal poured into pigs. A typical analysis is: Be 4%, Fe 0.10%, Si 0.1%, Al 0.06%, Cu substantially to balance.

IV. USES

Beryllium is the only stable light metal with a relatively high melting point. These properties, coupled with its excellent electrical conductivity, high heat absorption, good mechanical properties at elevated temperature, oxidation resistance and very high modulus of elasticity, make it of interest for structural and thermal applications, as well as for nuclear reactors. The principal use in the past has been as X-ray windows for transmission of rays and to filter out electrons. Beryllium transmits 17 times as well as aluminum and is particularly useful when longer and more easily absorbed X-rays are present. For principal uses of inorganic compounds see *Inorganic Compounds*, below.

1. Structural Parts.—Beryllium is machined to very close tolerances into gyroscopes, accelerometers and computer parts for inertial guidance instruments as well as other types of missile hardware. The combination of properties is also of interest for the development of rolled, forged, extruded and machined products for missile, aircraft and space-vehicle structures. The combination of high heat conductivity and specific heat coupled with high-temperature mechanical properties are utilized in heavy-duty brake drums and in other applications where the use of beryllium as a heat sink is important.

2. Nuclear Applications.—Nuclear applications are primarily for machined parts as moderators and reflectors in compact high-flux nuclear reactors and test reactors. Beryllium has been used in the Materials Testing reactor, Engineering Testing reactor and certain mobile reactors, such as the Submarine Intermediate reactor, in the United States, and for other test reactors built in Europe. In high-temperature gas-cooled reactors, especially where natural uranium or slightly enriched uranium is desired as fuel, considerable experimental work has been done particularly in Europe on using beryllium as a canning material for fuel elements. Beryllium is used as a neutron source mixed with radium or with deuterons in the cyclotron or with neutrons in nuclear reactors for neutron generation. (*See* also *Physical Properties*, below.)

3. Alloys.—Alloying with aluminum confers some ductility but at the loss of high melting point and electrical conductivity. Ternary beryllium-aluminum alloys containing 25% of beryllium were developed with tensile strengths as high as 89,000 lb. per square inch (p.s.i.) but, because they are difficult to fabricate, were not applied successfully for pistons for airplane engines where their use was indicated.

The industrial application of beryllium as a low percentage component of alloys wherein it produces precipitation hardening far exceeds all others. The most important alloys are those with copper as the main constituent, but the effect is used also in nickel- and iron-base alloys. This action of beryllium as a powerful precipitation hardener is probably rather general, the amount employed ranging from 0.1% to perhaps 3%. The hardening action is frequently modulated by adding 0.3%–2.5% of a third component such as iron, nickel, cobalt or chromium. In such applications the alloys are first heated to temperatures approaching their melting points and quickly cooled as by quenching in water. They are then in a soft ductile condition, capable of withstanding cold working. When, after cold shaping, it is desired to harden the alloys, they are reheated to lower temperatures ranging from 250° to 500° C. This reheating not only causes metallic beryllides to precipitate within the metal but also reaches temperatures high enough to relieve internal strains and thus place the metal in the best possible condition to develop maximum elastic limit, endurance limit and tensile strength. Maximum hardnesses ranging from 350 Brinell in 2% beryllium copper to more than 600 Brinell in 2% beryllium nickel can be obtained. One per cent of beryllium added to stainless steel is capable of producing precipitation-hardened springs said to hold their temper at red heat.

Beryllium copper alloys are used where spring qualities are required in combination with corrosion resistance. The soft ductile state of the quenched alloys permits cold-drawing and -forming operations which may then be followed by low-temperature heat hardening to maximum strengths and elasticity. In this respect beryllium copper alloys possess an important advantage over ordinary bronzes whose final hardness is produced in foundry or mill.

The unusual hardness of beryllium copper has resulted in its use for tools where sparking might be dangerous, as in powder factories. Beryllium contributes nothing to the reduction of sparking but merely strengthens the copper which is of low-sparking characteristic.

Metallic beryllium has the additional property, useful in oxidizable alloys up to about 825° C., of forming powerful self-generating protective surface films, even when present in the alloy in small quantities ranging from 0.001% to 0.20%. The effect is particularly marked in magnesium where only 0.005% reduces inflammability to an extraordinary degree, although associated with some grain coarsening. This protective effect is not limited to minimizing inflammability but extends even in nonflammable alloys to the preservation from loss of easily oxidizable alloy components such as magnesium. A corollary of this protective action is the clean, bright surface frequently found on castings containing beryllium. In certain silver alloys, beryllium has the effect of reducing tarnishing.

Related to its use as a protective film-forming component is the use of beryllium as a deoxidant to promote fluidity and soundness in castings whose main constituent ranges from copper to aluminum and magnesium.

4. Fabrication.—Unlike most metals, beryllium is not usually fabricated by foundry techniques, inasmuch as casting has a strong tendency to produce very coarse grains with associated brittleness and low tensile strength; *i.e.*, 19,000 p.s.i. In the cast form it is also difficult to machine. When encased in strong steel jackets for hot working, cast beryllium may be extruded, forged and rolled, but the strength of these products is only about one-half of what is achieved using beryllium powder billets.

The primary method of fabrication for commercially pure beryllium is through various powder-metallurgical processes, of which hot pressing is employed the most. Conventional cold pressing and sintering, and sintering the powder as a slip without pressure are also used. Hot pressings up to 2,000 lb. have been made without substantial porosity by pressing beryllium at about 1,050° C. *in vacuo*. Such compacts may contain from 0.6% to 2% beryllium oxide, depending on the particle size and exposure to oxidizing influences. The beryllium oxide serves to act as a barrier at grain boundaries to help the retention of fine grains even at elevated temperatures. Because of the random packing of the powder and the limited grain growth, the sintered compacts produced are substantially nondirectional and may exhibit ultimate strengths up to 50,000 p.s.i. with elongations up to 3%.

Either low-density sintered metal, powder compacts, cold-pressed and sintered, or hot-pressed billets can serve as material for further working into sheet, extrusions or forgings. Hot pressings also are machined into various thermal, nuclear or mechanical products. Unlike cast beryllium, it can be readily machined to extremely high tolerances.

Methods have been developed for rolling, extruding, forging, welding by arc and resistance methods, brazing, soldering and surface finishing by electroplating and chemical treatment. Working of beryllium is carried out from 400° to 700° C. without protection inasmuch as little oxidation takes place at these temperatures. Hot working at 1,000°–1,100° C. is carried out under the protection of a steel jacket.

In the fabrication of beryllium, precautions must be taken to avoid scratching or notching, as it is quite notch sensitive. In annealing, care must be taken not to overheat, especially after working, inasmuch as the tendency to grow grains is greater after the oxide barriers have been broken by hot or warm working, and poor mechanical properties result with increased grain size (see *Physical Properties*, below). Beryllium should not be fabricated or worked below 400° C., as it is quite brittle at low temperatures. Above 850° C. it has a tendency to become hot short (brittle when worked) and it should be worked very carefully or under protection of a steel sheath at elevated temperatures.

V. PHYSICAL AND CHEMICAL PROPERTIES

Beryllium has the symbol Be, valence +2, atomic number 4 and atomic weight 9.013. The only stable isotope has a mass num-

ber of 9. There are no other naturally occurring isotopes, but isotopes of mass numbers 6, 7, 8, 10 and 11, all peculiarly radioactive, have been artificially produced. Beryllium has an electron arrangement as follows: $1s^2$, $2s^2$.

1. Extraction in the Laboratory.—For the laboratory extraction of beryllium oxide (for precautions see *Toxicology*, below) beryl is fused with its own weight of potassium hydroxide at low red heat in a nickel crucible. The fused mass is then just covered with water, concentrated sulfuric acid added to slight excess and the resulting mass heated with accompanying pulverization until fumes of sulfuric acid appear and the whole is a fine white powder. This residue is extracted with hot water and evaporated to separate out as much alum as possible in the cold. The iron is then oxidized and the solution is neutralized with ammonia and saturated with sodium bicarbonate. After about 24 hours, during which time the solution is warmed and stirred, most of the beryllium hydroxide dissolves and may be filtered off from the insoluble aluminum and iron hydroxides. Upon dilution and boiling, basic beryllium carbonate precipitates and may be ignited to beryllium oxide.

For producing the metal in the laboratory, beryllium oxide is dissolved in aqueous ammonium bifluoride to form ammonium beryllium fluoride. This salt is then crystallized out and heated under a hood to bright redness in a protected graphite, platinum or nickel crucible to drive off the ammonium fluoride. The residual melted beryllium fluoride is then poured into a graphite mold or allowed to solidify in the crucible.

The laboratory reduction of the fluoride to beryllium is carried out in a graphite crucible about 2 in. in diameter and 6 in. in length placed under a strong-draft hood and inside a high-frequency, insulated furnace coil. The crucible may be covered and heated empty to about 900° C. A small amount of beryllium fluoride is introduced into the crucible to coat its bottom and sides by means of the vapour. Ten grams of pure magnesium metal are introduced; and, just as the metal comes to the melting point, it is covered with 30 g. of solid beryllium fluoride and heated for five minutes or until the reaction has been completed. This operation may be repeated until the crucible is three-quarters full. The reduced beryllium will be distributed throughout the semiliquid melt as a fine powder. The introduction of beryllium fluoride in solid form prevents the reaction from proceeding violently, and its 50% excess lowers the slag melting point to about 1,100° C. To cause the beryllium powder to coalesce, the temperature of the melt is raised to about 1,350° C. and maintained for one hour. After cooling, the coherent beryllium may be removed from the top of the melt.

This method may be modified for the direct production of beryllium copper or other beryllium alloys by introducing the other element of the desired beryllium alloy with the magnesium. The latter will then be replaced in the alloy by beryllium, which it reduces. This reaction proceeds without violence because of the dilution of the magnesium.

2. Physical Properties.—Some general physical properties of beryllium are indicated in Table II. The peculiar nuclear behaviour of stable beryllium (atomic weight 9.013) and its artificially produced isotopes (mass numbers 6, 7, 8, 10 and 11) deserves some special comment. Naturally occurring Be^9 is stable and has a small capture cross section for thermal neutrons. It emits neutrons under proton, neutron, deuteron, alpha-particle and gamma-ray bombardment.

Because of the small mass of its nucleus and its low affinity for slow neutrons it is more efficient than graphite for slowing down neutrons in atomic energy devices and, in addition, has little tendency to absorb them. (*See* also NEUTRON: *Neutron Production.*)

Be^{10} has a long half life of about 2,700,000 years. Its now established radioactivity escaped observation for some time. The short-lived isotope Be^8 is unstable and, when produced in nuclear reactions, splits into two alpha particles in less than 10^{-15} sec. In the case of Be^7, gamma radiation has been observed and is thought to be associated with the capture by the nucleus of one of its orbital electrons. It is possible that chemical combination may affect its radioactivity. For example, in the oxide, the interaction of the 1s and 2s electrons of beryllium may be strong enough to alter the position of the 1s electrons and thus produce a slight change in the observed radioactivity.

TABLE II.—*Physical Properties of Beryllium*

Colour	Steel gray
Taste	Sweetish
Solubility	Soluble in acids and strong bases with evolution of H_2
Density, grams per millilitre (X-ray)	1.8445
Melting point	1,285° C.
Boiling point (vapour pressure 1 atm.)	2,507° C.
(" " 0.1 atm.)	2,100° C.
(" " 0.01 atm.)	1,797° C.
(" " 0.001 atm.)	1,557° C.
Specific heat, calories per gram per° C.	0.425
Latent heat of fusion, calories per gram	250
Thermal conductivity, calories per sq.cm. per ° C. per cm.	0.34
Electrical conductivity (per cent of Cu)	38.9–43.1
Electrical resistivity (annealed) ohm-ceotimetres	3.95×10^{-6}
Hardness (Brinell) 1,000 kg load	90–120
Linear coefficient of thermal expansion (per ° C.) (20° C.)	
(parallel hexagonal axis)	12×10^{-6}
(perpendicular hexagonal axis)	9×10^{-6}
Thermoelectric power (platinum), millivolts	0.16
Electrode potential, volts	+1.69–1.9
Reflectivity (white light), per cent	52–55
Velocity of sound, metres per second	12,600
Lattice	
Type	Hexagonal close packed
Constant (Å·10^{-8} cm.) 20° C.	$a_0 = 2.2854$ $c_0 = 3.5829$ $\frac{c_0}{a_0} = 1.5677$
Closest approach of atoms Å	2.22
Atomic radius in Å	1.123
Co-ordination number	12
Allotropy	None
Magnetic mass susceptibility, c.g.s. electromagnetic units, 20° C.	-1.0×10^{-6}

The mechanical properties of beryllium depend largely on its structure, which is that of a close-packed hexagonal crystal having a high degree of anisotropy (directionality). At room temperature, beryllium has a fracture stress in the basal plane lower than slip stresses, essentially failing in this plane even though it has substantial elongation in the prismatic planes of all degrees of purity (up to about 2% nonberyllium additives).

However, at elevated temperature, about 200°–300° C., a brittle-ductile transition takes place wherein metal having a tensile elongation of 0.5%–3% at room temperature develops from 25% to 50% at 400°–450° C. Beyond this temperature, failure takes place principally at grain boundaries, with the metal becoming hot short at about 850° C. Dispersed-phase alloys containing beryllium oxide or intermetallics of other metals can substantially increase mechanical properties, especially strength, at the higher temperatures.

The properties of beryllium, therefore, depend upon the grain size, purity content and directionality. For instance, in working along preferential planes, such as by extrusion, substantial elongation can be obtained in the direction of extrusion at room temperature. By cross rolling, uniaxial ductility in the plane of the sheet can be obtained. However, unless working can take place in all directions, at least one plane of brittleness remains,

TABLE III.—*Some Tensile Properties of Beryllium*

Type	Temp. (° C.)	Ultimate tensile strength (p.s.i. in 000's)	Tensile yield (p.s.i. in 000's)	Per cent eloog. in 2 in.
Vacuum hot pressed*	R.T.†	35–45	25–40	1–3
	315	25–42	20–37	10–35
	430	25–40	18–34	20–35
	535	22–35	15–28	15–20
Hot extruded*	R.T.†	60–100	40–55	8–20
	315	40–60	38–45	15–30
	430	35–45	25–35	20–40
	535	25–37	20–35	10–30
Warm extruded*	R.T.†	60–90	45–55	2–10
	315	40–60	35–45	25–45
	430	35–45	25–35	25–45
	535	25–37	20–30	10–30
Sheet 0.060" thick	R.T.†	80	65	5
	315	65	57	25
	430	55	50	20
	650	15	15	15

*Elevated temperature properties improve with increasing BeO content. The ranges of properties shown indicate variation in properties with changes in BeO content over the range of BeO content from about 0.75% to 2.5%.

†Room temperature.

giving unfavourable properties under biaxial loading and notch sensitivity with triaxial stresses.

Some tensile properties are shown in Table III. The compression properties are similar to these and shear strengths are somewhat lower. However, the shear properties for beryllium are excellent compared with other metals. The poorest values are in tension although its tensile modulus, 42,000,000 p.s.i., is one of the highest of all elements.

3. Chemical Properties.—The position of beryllium at the head of group II in the periodic chart indicates a valence of two. In chemical properties it resembles both magnesium, which is number 2 of its own group, and aluminum, which is number 2 of the next succeeding group. As would be expected, beryllium is less basic than magnesium but more basic than aluminum. This is particularly evident upon attempting to dissolve samples of these three light metals in concentrated sodium or potassium hydroxide solutions. Aluminum readily forms the aluminate with evolution of hydrogen; the formation of the beryllate proceeds more slowly and requires greater concentration of the hydroxide but may be carried to completion; magnesium is not attacked at all.

Like aluminum, beryllium forms a protective skin of oxide and to this owes its stability in air up to red heat. It is attacked by most acids, but its aqueous solutions show a great tendency to hydrolyze and with few exceptions form sticky basic masses upon evaporation in an effort to crystallize. Beryllium hydroxide is readily dissolved in large amounts by solutions of its salts such as the sulfate, nitrate, chloride, etc. Consequently, a surprisingly large amount of ammonium hydroxide must be added to beryllium solutions before the resulting beryllium hydroxide precipitate becomes permanent.

The halogens and their hydroacids react directly with beryllium when heated with it. At temperatures of 1,200° C. or above, beryllium metal reacts slowly with nitrogen and carbon to form the nitride and carbide. With sulfur it reacts slowly if at all.

The inorganic compounds of beryllium are mostly colourless.

4. Inorganic Compounds.—Beryllium oxide, BeO, melting point 2,530° C., density 3.009, is refractory and difficult to reduce. It is prepared as a fluffy white powder which serves as a base for most beryllium compounds. It has two uses in the lighting industry, namely, in Welsbach mantles where it exists in a small percentage in the luminous mixture of oxides and in certain fluorescent lamps as beryllium zinc silicate, the active "phosphor" which produces an ivory-coloured bank of light. It may be fused and ground to form into crucibles for high-temperature applications requiring chemical inertness, strength, resistance to thermal shock and high thermal conductivity (about ten times that of alumina). Reports show successful service at temperatures as high as 2,000° C. and a plurality of melts. It retains its electrical insulation well at high temperatures and so is uniquely adapted to certain melting operations, especially those above the temperature limits for alumina.

High density beryllium oxide ware has one of the best combinations of thermal, electrical and nuclear properties found in ceramic oxides.

It can be used in high-temperature nuclear devices, operating above the melting point of beryllium, for the same applications as the metal. These bodies are produced by hot pressing, extrusion and firing, as well as dust pressing and firing. Other uses are found in electronics such as low-loss dielectrics and wave-guide windows as well as a component in high-modulus structural glass fibres.

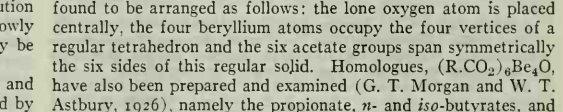
Beryllium carbide, Be_2C, density 2.44, decomposes at temperatures above 2,100° C. and is slowly attacked by water vapour even at room temperatures. But both beryllium carbide and oxide are of much potential value for high-temperature moderators in nuclear-power equipment where the oxygen or carbon atoms add to the action of beryllium.

Beryllium chloride, $BeCl_2$, is formed by passing dry hydrogen chloride over the heated metal. It is prepared by the action of the phosphorus chlorides, sulfur chloride or preferably carbon tetrachloride on beryllia at 700°–800° C. (C. Matignon and M. Piettre). It is a white, crystalline, hygroscopic solid melting at about 400° C. and is soluble in water with formation of hydrochloric acid.

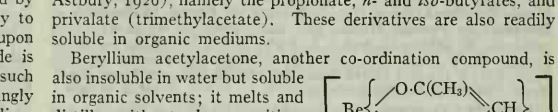
Beryllium fluoride remains as a glassy transparent mass on heating the double fluoride of beryllium and ammonium, and is less hygroscopic than beryllium chloride. The beryllium halides cannot be crystallized from aqueous solutions, nor can they conduct electricity in the pure molten state.

5. Organic Compounds.—Basic beryllium acetate, $(CH_3.CO_2)_6Be_4O$, produced by dissolving beryllium hydroxide or basic carbonate in acetic acid, is insoluble as such in water but soluble in such organic solvents as glacial acetic acid, chloroform, ether and alcohol. From these solutions the compound separates in well-defined crystals belonging to the cubic system. These crystals have a definite melting point and can be distilled unchanged under normal or reduced pressure. When subjected to X-ray examination, the component parts of the basic acetate molecule are found to be arranged as follows: the lone oxygen atom is placed centrally, the four beryllium atoms occupy the four vertices of a regular tetrahedron and the six acetate groups span symmetrically the six sides of this regular solid. Homologues, $(R.CO_2)_6Be_4O$, have also been prepared and examined (G. T. Morgan and W. T. Astbury, 1926), namely the propionate, *n*- and *iso*-butyrates, and privalate (trimethylacetate). These derivatives are also readily soluble in organic mediums.

Beryllium acetylacetone, another co-ordination compound, is also insoluble in water but soluble in organic solvents; it melts and distills without decomposition. In this substance beryllium is in fourfold association with two ring-forming radicals (chelate groups).



Beryllium benzoylpyruvate, a similar co-ordination compound, has been shown by W. H. Mills and R. A. Gotts (1926) to exist in two optically active forms, thus establishing the fact that these arrangements of four associating units around beryllium are not uniplanar but tetrahedral. (*See* STEREOCHEMISTRY.)



In the foregoing co-ordination compounds, beryllium is not combined directly with carbon but only indirectly through oxygen. True organometallic derivatives have, however, been obtained in which the metal is attached directly to one or two organic radicals. Earlier workers (A. Cahours, 1860, and V. Lavroff, 1884) indicated the probable existence of such beryllium compounds, and Gilman and Schulze (1927), by using anhydrous beryllium chloride with the appropriate Grignard reagent, definitely identified beryllium dimethyl as a snow-white solid subliming at 200° C., and beryllium diethyl as a colourless liquid, melting point 12° C., boiling point 110° C./15 mm., both being spontaneously inflammable in air. These observers also obtained beryllium di-*n*-butyl and the corresponding diphenyl together with compounds of the type R.Be.X, where R is an alkyl or aryl group and X is bromine or iodine. (*See* ORGANOMETALLIC COMPOUNDS.)

6. Toxicology.—Soluble compounds of beryllium in the form of solutions, dry dusts, vapours or fumes can produce dermatitis varying in intensity of response with the individual. When brought into contact with the mucous membranes through inhalation or otherwise, these same dusts, mists or fumes may affect them and the respiratory tract, producing acute effects not unlike those of phosgene and sometimes having consequences as serious though slower in progress. The halides of beryllium appear to be more virulent than the sulfates.

A delayed pulmonary effect attracted attention after World War II, particularly among workers in the fluorescent lamp industry employing beryllium zinc silicate. Numerous lawsuits followed and resulted in the abandonment, a few years later, of the general use of beryllium zinc silicate. However, increasing knowledge as to what constitutes, in most instances, harmful exposure, together with increased experience in controlling atmospheric pollution, demonstrated that all beryllium processing can be adequately controlled and that some processing steps, particularly those not involving the production of finely divided beryllium or beryllium

compounds, could apparently be carried out without the need for controls of the kind observed with respect to most of the processing.

7. Analysis.—For primary determination of beryllium the method employed is the weighing of beryllium oxide from the precipitated hydroxide or from the ignition of such salts as the sulfate, nitrate or carbonate. To obtain the hydroxide in a pure form it is ordinarily precipitated with ammonia after other special separations have been completed. The most important of these is the hydroxyquinoline separation with careful hydrogen-ion control. This separates out aluminum and numerous heavy metal ions. For quicker determination in control laboratories, field use, etc., a reliable colorimetric method employing *p*-nitrobenzeneazoorcinol has been developed. Where accuracy is necessary a photoelectric colorimeter is required.

See also Index references under "Beryllium" in the Index volume.

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BERYLLONITE, a rare beryllium mineral, is a phosphate of beryllium and sodium found as highly complex crystals in granite pegmatite veins at Stoneham and Newry, Me., where it is associated with herderite, feldspar, smoky quartz, beryl and columbite. The crystals vary from colourless to white or pale yellowish, and are transparent with a vitreous lustre. Crystallization is orthorhombic and there is a perfect cleavage in one direction. The formula is $NaBePO_4$. Its hardness is 5.5 to 6; specific gravity 2.84. (CL. F.)

BERZELIUS, JÖNS JACOB (1779–1848), Swedish chemist, was one of the founders of modern chemistry. Particularly notable were his determinations of atomic weights; his development of the modern system of chemical symbols; and his isolation of many of the elements for the first time. He was born at Väversunda Sörgård, near Linköping, on Aug. 20, 1779, studied chemistry and medicine, and graduated as M.D. in 1802 at Uppsala. Appointed assistant professor of botany and pharmacy at Stockholm in the same year, he became full professor in 1807, and from 1815 to 1832 was professor of chemistry in the Caroline medico-chirurgical institution of that city. The Stockholm Royal Academy of Sciences elected him a member in 1808, and in 1818 he became its perpetual secretary. He was made a baron by Charles XIV in 1835. He died at Stockholm on Aug. 7, 1848. An extensive collection of his apparatus is preserved by the academy at Freskati, near Stockholm.

During the first few years of his scientific career, Berzelius was mainly engaged on questions of physiological chemistry, but about 1807 he began to devote himself to the elucidation of the composition of chemical compounds through study of the law of multiple proportions and the atomic theory. Perceiving the determination of the exact composition to be of fundamental importance, he spent ten years in analyzing about 2,000 simple and compound bodies, and the results he published in 1818 attained a remarkable standard of accuracy, which was still further improved in a second table of combining proportions and atomic weights that appeared in 1826. He used oxygen—in his view the pivot around which the whole of chemistry revolves—as the basis of reference for the atomic weights of other substances, and the data on which he chiefly relied were the proportions of oxygen in oxygen compounds, the doctrines of isomorphism, and Gay-Lussac's law of volumes. When Alessandro Volta's discovery of the electric cell became known, Berzelius, with W. Hisinger (1766–1852), began experiments on the electrolysis of salt solutions, ammonia, sulfuric acid, etc., and later this work led him to his electrochemical theory, a full exposition of which he gave in his memoir on the *Theory of Chemical Proportions and the Chemical Action of Electricity* (1814). This theory was founded on the supposition that the atoms of the elements are electrically polarized, the positive charge predominating in some and the negative in others, and from it followed his dualistic hypothesis, according to which compounds are made up of two electrically different components.

At first this hypothesis was confined to inorganic chemistry, but later he extended it to organic compounds which he saw might similarly be regarded as containing a group or groups of atoms—a compound radical—in place of simple elements. Although his conception of the nature of compound radicals did not long retain general favour—indeed, he himself changed it more than once—he is entitled to rank as one of the chief founders of the radical theory. He continued and extended the efforts of Antoine Lavoisier and his associates to establish a convenient system of chemical nomenclature. By using the initial letters of the Latin (occasionally Greek) names of the elements as symbols for them, and adding a small numeral subscript to show the number of atoms of each present in a compound, he introduced the present system of chemical formulation (*see* CHEMISTRY). Each symbol had a definite weight and volume connotation. He effected improvements in analytical methods and the technique of the blowpipe (*Über die Anwendung des Löthrohrs,* 1820). He is often referred to as the father of gravimetric analysis; he introduced the use of rubber tubing, the water bath, desiccator, wash bottle, filter paper, etc. He classified minerals on a chemical basis and carried out many individual researches such as those on tellurium, selenium, silicon, thorium, titanium, zirconium and molybdenum, most of which he isolated for the first time. He invented the term catalysis and did considerable work in this field. Berzelius was interested in and wrote on geology.

Apart from his original memoirs, of which he published more than 250, mostly in Swedish in the *Transactions* of the Stockholm academy, he published a *Lehrbuch der Chemie,* which went through five editions (first, 1803–18; fifth, 1843–48) and was translated into the principal European languages. A critical annual report on the progress of physics and chemistry, the *Jahresbericht* (1821–48), was prepared by him at the instance of the Stockholm academy. For many years he was the leading figure in the chemical world.

See also Index references under "Berzelius, Jöns Jacob" in the Index volume.

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BERZSENYI, DÁNIEL (1776–1836), Hungarian poet born in Egyházashetye on May 7, 1776, was a country squire who spent his life far from any town, unconnected for many years—the really productive ones—with any literary circle. He wrote for himself, and his literary activity was discovered by chance. Ferenc Kazinczy, a leading figure in Hungarian letters, took an interest in the works of the solitary poet and through his efforts Berzsenyi's poems became known and his fame established well before the publication of his first, and only, volume of poetry (1813). In 1817 Ferenc Kölcsey, another great poet of the period, passed an unduly severe judgment on Berzsenyi's work. The poet, deeply hurt, withdrew, and thereafter wrote a few essays in defense of his ideas, but virtually ceased to write poetry. This was a loss to Hungarian literature which Kölcsey himself—in a most moving funeral oration on Berzsenyi—deplored bitterly.

Berzsenyi was imbued with the spirit of the classics. The influence of Latin poetry, that of Horace in particular, can be noticed not only in the form of his poems, most of which were written in classical metres, but also in his vocabulary, his choice of subjects and his philosophy. His many allusions to antiquity often seem burdensome to the modern reader but the grandeur of his thought and the concise vigour of his expression are moving. His love of his country and his attachment to the ideals dictated by an uncompromising moral rectitude inspired some splendid odes. One of these, *Magyarokhoz* ("To the Hungarians") castigates bitterly the decadence of his compatriots. Some of his tender, restrained elegies and his *Fohász* ("Prayer") are among the

purest gems of Hungarian poetry. Berzsenyi died at Nikla on Feb. 24, 1836. (Ds. Sr.)

BES, the Egyptian god of recreation, represented as a dwarf with large head, goggle eyes, protruding tongue, shaggy beard, bowlegs, bushy tail (sometimes clearly part of a skin girdle) and usually a large crown of feathers on his head. A Beslike mask was found among remains of the 12th dynasty. In the temple of the queen Hatshepsut at Deir el-Bahri (*c.* 1500 B.C.), he is figured along with the hippopotamus goddess as present at the queen's birth. His figure is that of a grotesque mountebank, intended to inspire joy or drive away pain and sorrow, his hideousness being perhaps supposed actually to scare away the evil spirits. In his joyous aspect Bes plays the harp or flute, dances, etc. He is figured on mirrors, ointment vases and other articles of the toilet. Amulets and ornaments in the form of the figure or mask of Bes are common after the New Kingdom; he is often associated with children and with childbirth and is figured in the "birth houses" devoted to the cult of the child god. Perhaps his earliest-known appearance in large-size temple sculptures is that at Jebel Barkal, Nubia, dating from the beginning of the 7th century B.C. As the protector of children and others he is the enemy of noxious beasts, such as lions, crocodiles, serpents and scorpions. Large wooden figures of Bes are generally found to contain the remains of a human fetus. In the first centuries of the Christian era an oracle of Besas was consulted at Abydos, and prescriptions exist for consulting him in dreams. Bes may be of non-Egyptian origin, African, Arabian or even Babylonian; he is often named "coming from the Divine Land" (*i.e.*, the east or Arabia), or "Lord of Puoni" (Punt; *i.e.*, the African coast of the Red sea), and his effigy is found on Greek coins of Arabia. Contrary to the usual rule, he is commonly represented in Egyptian sculptures and paintings full faced instead of in profile. (F. Ll. G.; X.)

BESANÇON, a city in the Franche-Comté region of eastern France, capital of the *département* of Doubs, is 122 km. (76 mi.) E. of Dijon on the main railway line from Basel to Lyons. Pop. (1954) 61,139. It lies on the Doubs river which almost surrounds the city proper, and beyond the river are the hills of the western Jura. The limestone plateau of the Jura, with its open stretches and salt springs, was a centre of population in the Hallstatt period (Early Iron Age) and the site of the present city was soon recognized as of strategic importance. As Vesontio it was the chief town of the Sequani (*q.v.*), and in 58 B.C. was occupied by Julius Caesar. Marcus Aurelius raised it to the rank of a *colonia*. The neck of the peninsula formed by the encircling river rises to 1,205 ft., and on it stood the Roman castrum, replaced in the 17th century by a citadel. Forts crowned the surrounding heights. Other Roman remains include a triumphal arch (the Porte Noire, partly rebuilt in 1820) decorated with bas-reliefs, thought to have been built in commemoration of the victories of Marcus Aurelius in 167, and the remains of a theatre or amphitheatre, of an aqueduct and of a bridge which now forms part of a modern bridge. During succeeding centuries the city was several times destroyed and rebuilt. The archbishopric dates from the end of the 2nd century, and the archbishops gradually acquired considerable temporal power. In 1184 Frederick Barbarossa made Besançon a free imperial city. During the 14th century it fell to the dukes of Burgundy, from whom it passed to the emperor Maximilian I, through his marriage with Mary of Burgundy. Under the Austro-Spanish domination it became very prosperous, and superseded Dôle as the real capital of Franche-Comté (*q.v.*). During the 17th century it was several times attacked by the French, to whom it was ceded by the treaty of Nijmegen in 1678. It was then fortified by Sebastien le Prestre de Vauban (*q.v.*). Until 1789 it was the seat of a parliament. It was invested and bombarded by the Austrians in 1814 and was important during the Franco-German War (1870–71). It was damaged in World War II.

The river is bordered by fine quays and by the shady promenades which are a feature of the city. The cathedral of St. Jean, founded in the 4th century and often reconstructed since, resembles the churches of the Rhine basin and also Nevers cathedral in having apses at both ends. The main parts date from the 11th, 12th and 13th centuries, the eastern apse and the tower being 18th-century work, as is the archbishop's palace which adjoins the cathedral. In the latter are a number of medieval and modern works of art. The Palais Granvelle, which was built from 1534 to 1540 by Nicolas Perrenot de Granvella, chancellor to Charles V, centres on an arcaded courtyard in the heart of the town and is occupied by Besançon's learned societies. The *hôtel de ville* (town hall), like much of the town, dates from the 16th century. The law court preserves a Renaissance façade and an 18th-century audience hall. A 15th-century round tower and the 16th-century Porte Rivotte are relics of fortifications. The seat of a university (founded 1422 in Dôle and moved to Besançon in 1691), the city acquired collections of pictures, antiquities and specimens of natural history. On the right bank of the river (to the north) are populous industrial suburbs, including the spa of Besançon-la-Mouillère. Watch- and clock-making were introduced from the district of Neuchâtel, Switz., in the 18th century and the artificial silk industry also grew. Besançon is at the crossroad of the routes running between Paris and Switzerland and from Alsace to the Canal du Midi.

BESANT, ANNIE (née Wood) (1847–1933), British social reformer, sometime Fabian socialist, theosophist and Indian independence leader, was born in London on Oct. 1, 1847, daughter of William Wood. She was educated privately and in 1867 married Frank Besant (d. 1917), an Anglican clergyman from whom, after she had passed from Anglicanism through theism to atheism, she was separated legally in 1873. She became closely associated with Charles Bradlaugh (*q.v.*) as a Freethought writer, lecturer and officer in the National Secular society, an editor of the *National Reformer* and a helper in his notable campaign to gain his seat in parliament, denied to him because of his atheism. She became the first prominent woman in England to accept Neo-Malthusianism and advocate birth control; with Bradlaugh she was prosecuted by the government for obscenity in a legal *cause célèbre* arising from their publication of Charles Knowlton's *The Fruits of Philosophy: or, The Private Companion of Young Married People*, and her children were taken from her (*see* also Knowlton, Charles). Through the instrumentality of Bernard Shaw, with whom she was intimate for several years, she was converted from radicalism to Fabian socialism in 1885; for some time she devoted her magazine, *Our Corner*, largely to this cause, and wrote one of the famed *Fabian Essays* in 1889. She eventually joined the more Marxist Social Democratic federation.

Then suddenly, at the height of her fame and influence as a leading materialist, reformer, strike leader, union organizer and member of the London school board, Mrs. Besant underwent another of her remarkable changes in orientation and was converted to theosophy (*q.v.*) through the reading of Madame H. P. Blavatsky's *The Secret Doctrine* in 1889. On Madame Blavatsky's death in 1891 Mrs. Besant became the most prominent member of the Theosophical society, and in 1907, in spite of many sensations and scandals, none of which tainted her personally, was elected international president of the society, an office which she held to her death. Her genius as a propagandist and organizer brought this mystical and occult society an influence for many years far out of proportion to its actual size.

An inveterate world traveler, Mrs. Besant went to India for the first time in 1893. When she discovered that in most of her previous reincarnations she had been an Indian (as well as Hypatia and Giordano Bruno), she adopted Hinduism as her basic religion, and thereafter played a major role in reviving the Indians' damaged pride in their ancient traditions, history and culture. Vitally interested in education also, she founded the Central Hindu college at Benares. Just before World War I she entered into Indian politics, and through her influential Madras newspaper, *New India*, threw herself headlong into the home rule movement, the first league of which she started. Because of her refusal to cease her agitation during the war, she was interned in 1917. On her release she was elected president of the Indian National congress in recognition of her services. Her influence began to

deteriorate, however, when she aligned herself against the extreme nationalists and when she rejected the methods of passive resistance and civil disobedience advocated by her former admirers Motilal and Jawaharlal Nehru and by Gandhi, because she believed that these methods paradoxically resulted in violence and bloodshed. Mrs. Besant's old age was rendered more unhappy by the defection of J. Krishnamurti, a young Hindu whom she had helped to "discover" in 1909; after a sensational guardianship trial in Madras, he had been offered to the world as the world teacher and the vehicle of the new Messiah, but by 1929 he renounced the claim of messiahship and went off on his own spiritual course, after dissolving the Order of the Star in the East which Mrs. Besant and others had developed for him.

She died at Adyar, Madras, on Sept. 20, 1933, confident that she would soon be reincarnated and return to the mission which had been assigned her by the occult hierarchy.

See A. Besant, *Autobiography* (1885, 1893); Gertrude M. Williams, *The Passionate Pilgrim* (1931); A. H. Nethercot, *The Strange Lives of Annie Besant* (1960). (A. H. N.)

BESANT, SIR WALTER (1836–1901), English novelist and philanthropist, whose best work describes life in London's East End, was born at Portsmouth on Aug. 14, 1836. He studied at King's college, London, and Christ's college, Cambridge, and, after teaching in Mauritius, became secretary to the Palestine Exploration fund (1868). In 1871 he began a literary collaboration with James Rice, editor of *Once a Week*, which lasted until Rice's death (1882). Besant's account of this partnership, which produced 14 romantic, improbable and verbose novels, prefaces the 1887 edition of the first, *Ready-Money Mortiboy* (1872).

In 1882 Besant published his first independent novel, *All Sorts and Conditions of Men*, based on impressions of the East London slums, which he saw as joyless rather than vicious. Its "Palace of Delights" became a reality when the People's palace was founded in Mile End road in 1887. Besant co-operated in its establishment. The *Children of Gibeon* (1886) also described slum life. Besant wrote 32 novels after Rice's death, including *Dorothy Forster* (1884) and *Amorel of Lyonesse* (1890). His biographies include *Rabelais* (1879), and he also wrote critical and topographical studies, the chief of which, his *Survey of London*, 10 vol. (1902–12) was never finished. He helped to found the Society of Authors in 1884 and edited its journal until his death at Hampstead on June 9, 1901. He was knighted in 1895.

The Autobiography of Sir Walter Besant, edited by S. S. Sprigge, was published in 1902.

See G. Godwin, *Queen Mary College* (1939); F. W. Boege, "Sir Walter Besant," in *19th Century Fiction*, vol. 10 (1955). (P. M. Y.)

BESNARD, (PAUL) ALBERT (1849–1934), French painter and etcher, whose works reveal an adherence to French academic tradition mingled with contemporary influences, especially English, was born in Paris on June 2, 1849. He was a pupil of J. Brémond and, at the École des Beaux-Arts, of A. Cabanel. Brémond had been a pupil of Ingres, as had Besnard's father, and Albert Besnard's earlier works, such as "Procession des Seigneurs de Vauhallan," display a romanticized classicism derived from Ingres. Besnard was in Rome, 1874–78, and in England, 1881–83, where meetings with Alphonse Legros and Anders Zorn turned his attention to etching. He seems to have originated the technique of suggesting form by coarse crosshatching while omitting any enclosing line, a practice adopted by Zorn in his later plates. "Le Remords" (oil) and "Le Viol" (etching) show how Besnard was affected by English Pre-Raphaelitism, while Constable's landscapes and the portraits of Vandyke and Sargent also clearly impressed him ("Portrait de Theatre: Mme. Rejane"). After 1883 Besnard came under the influence of Impressionism; but he overpassed Impressionism's informal, snapshot character and presently his style again became tighter, more linear and decorative. He made many impressive portraits in oils, etching and pastels, and executed frescoes in the École de Pharmacie and the Nouvelle Sorbonne, neobaroque cupolas for the Théâtre Français and the Petit Palais, and 12 almost surrealist allegories of the Cross for the hospital chapel at Berck, Pas-de-Calais. Besnard was director of the French Academy in Rome, 1913–21, in succession to Carolus Duran, and of the École des Beaux-Arts, Paris, after 1922. He died in Paris on Dec. 4, 1934.

BESSARABIA, a region of eastern Europe, 17,151 sq.mi. in area, bounded on the west by the Prut river, which separates it from Bukovina and from Moldavia proper; on the north and on the east by the Dniester river, which separates it from the Ukraine; on the southeast by the Black sea; and on the south by the Kiliya (Chilia) arm of the Danube delta, which separates it from northern Dobruja. In the 1940s the Moldavian Soviet Socialist Republic was formed out of the greater part of Bessarabia, with the addition of a strip of territory east of the Dniester, but the extreme north of Bessarabia (*i.e.*, the district of Khotin) and the whole coastal plain from the Danube to the Dniester were attached to the Ukrainian Soviet Socialist Republic.

The soil in the northeast is Ukrainian black earth; in the centre there are low hills, dissected by tributaries of the Prut and of the Dniester, formerly thickly afforested with hardwoods; the southern steppe, known as the Budzhak, with a light soil, merges into salt marshes and lagoons (limans). Bessarabia is a favoured region for agricultural production, chiefly cereals, fruit and wine. Because of exploitation in the 19th century little of the land is under forest, and soil erosion has proceeded far in many districts. Animal husbandry was formerly extensive in the steppe region; the limans are rich fishing grounds. There are some stone quarries and lignite deposits; clay is worked. The chief town is Kishinev (Chişinău), centrally situated on the small Byk river. Other towns are Khotin (Hotin), Soroki (Soroca), Bendery (Bender, Tighina) and Belgorod-Dnestrovski (called Akkerman under Turkey and Cetatea Albă under Rumania) on the Dniester; Beltsy (Bălți) and Orgeyev (Orheiu) in the north, on the Reut; and Kiliya (Chilia), Izmail (Ismail) and Reni on the Danube.

History.—The early history of Bessarabia (Basarabia) is obscure. Greek colonies on the Black sea coast of what is now Moldavia date from the 7th century B.C.; in the 2nd century A.D. the territory probably formed part of the kingdom of Dacia, conquered by Trajan. The Slavs began to appear in the 6th century, but settlement was interrupted by successive invasions of nomads from the east, the last being that of the Mongols in the 13th century.

Moldavia.—The Genoese, founding fortified commercial outposts on the Dniester in the 14th century, paved the way for contact with western civilization, but Bessarabia's history did not take shape until the end of that century with the rise of the principalities of Moldavia and Walachia, which soon expanded to include the territory (*see* RUMANIA: *History*). The southern area, which fell originally into the Walachian sphere, probably took its name from the Basarab dynasty. The whole province became part of Moldavia in the 15th century, but was soon exposed to the Turkish onslaught; the key points of Akkerman and Chilia were captured in 1484 and this was ratified by treaty (1503, 1513). The southern part of Bessarabia was again detached and organized by the Turks into two sanjaks of the Ottoman empire.

Russia entered the scene with the rise of Peter the Great, and Moldavian princes more than once sought Russian support against Turkey. Russia, in its drive toward the mouths of the Danube, occupied Moldavia five times between 1711 and 1812 and finally secured the cession of Bessarabia proper, with half of Moldavia, by the Porte in the treaty of Bucharest of the latter year. The name of Bessarabia was then extended to the whole area.

The Russian Administration, 1812–1917.—In 1829 in the treaty of Adrianople, Russia pushed the frontier south to include the Danube delta. After the Crimean War the treaty of Paris in 1856 restored Danubian Bessarabia (at that time divided into three districts, namely Izmail, Kagul, and Bolgrad) to Moldavia; but in 1878, despite Rumania's having fought on the Russian side against Turkey, the treaty of Berlin assigned these three districts once more to Russia, giving Rumania the inadequate compensation of Dobruja (*q.v.*).

The Russian administration was at first liberal. Autonomy

was granted in 1818 and remained in force until 1828; a Moldavian boyar was made governor and a Moldavian archbishop installed. Nevertheless many Moldavian peasants fled across the Prut fearing the introduction of serfdom. The introduction of the zemstvo system in 1869 provided a measure of local autonomy, but a policy of russification in both civil and ecclesiastical administration was thereafter pursued, with little effect on the largely illiterate peasantry. The founding of the kingdom of Rumania (1881) formed a centre of attraction for Moldavian nationalism, but no lively movement developed in Bessarabia until after the Russian revolution of 1905. Its strength was drawn, not from the boyars (largely russified), but from schoolteachers and parish priests. Bessarabia achieved some prosperity under Russian rule, the empire forming a good market for its agricultural produce, which was dispatched by river or by the railway system built to link the country with the north-south main line to Odessa. Kishinev was a relatively flourishing town, though its large Jewish population suffered severely in the pogrom of 1903.

World War I and the Russian Revolution.—In World War I the Central Powers tempted Rumania to their side with offers to restore Bessarabia; but the scales were tipped in favour of the entente by counteroffers of Transylvania and Bukovina, as well as by the francophile sentiment of the Rumanian people, so that by 1916 Rumania was fighting as Russia's ally. The revolutionary and nationalist ferment in the Russian empire spread quickly to Bessarabia, which proclaimed support for A. F. Kerenski in March 1917. In April a National Moldavian committee demanded autonomy, land reform and the use of the Rumanian language; similar rights were claimed for the Moldavians, about 400,000 in number, settled east of the Dniester. A move toward complete independence was encouraged by events in the Ukraine, and in Nov. 1917 a council known as *sfatul ţărei* was set up on the model of the Kiev rada. It had originally 84 Moldavian deputies and 36 from the minorities chosen by military and professional organizations and a peasants' congress. On Dec. 2, 1917, the *sfat* proclaimed Bessarabia an autonomous constituent republic of the Federation of Russian Republics. Disorders caused by the revolutionary Russian soldiery led the *sfat* to appeal to the entente's representatives and to the Rumanian government at Iaşi for military help, whereupon the Bolsheviks occupied Kishinev on Jan. 5, 1918. They were driven out by a Rumanian division on Jan. 13; and on Jan. 24 the *sfat*, again following Kiev, proclaimed Bessarabia an independent Moldavian republic, renouncing all ties with Soviet Russia. Realizing the economic impossibility of isolation and alarmed by the pretensions of the German-sponsored Ukrainian government, the *sfat* voted for conditional union with Rumania on March 27, 1918. With the defeat of the Central Powers and the creation of greater Rumania, reservations were abandoned and unconditional union voted at the final session of the *sfat* on Dec. 9, 1918. The union of Bessarabia with Rumania was recognized by the Paris treaty of Oct. 28, 1920, signed by Great Britain, France, Italy and Japan. Great Britain ratified this treaty in 1922 and France in 1924; Italy delayed ratification until 1927; and Japan never ratified it. The U.S.S.R. never recognized Rumania's right to the province. The frontier along the Dniester was closed; but the railway bridge at Tighina was opened in 1936, two years after the resumption of diplomatic relations.

The Rumanian Administration, 1918–40.—The Rumanian government immediately put through a drastic land reform, initiated by *sfatul ţărei*, whereby the maximum holding allowed was 100 ha. Despite this, the province languished economically. The uncertainty caused by the continued pretensions of the U.S.S.R. hindered development; Rumania had little need of Bessarabia's fruit, corn and wine; roads were inadequate; the railway system was geared to that of Russia; and the closing of the Dniester and the loss of the natural outlet, Odessa, had a disastrous effect. The province was put under a centralized regime, at times military in character; in 1938 King Carol attempted to break up the historic unity by dividing it among newly created regions. Some tardy concessions to the minorities were made in 1939.

World War II.—After the German-Soviet pact of Aug. 1939, the U.S.S.R. revived claims to Bessarabia; and the collapse of the western front in 1940 precipitated action. On June 27 a Soviet ultimatum to Rumania demanded the cession of Bessarabia and of northern Bukovina as "compensation for Rumanian misrule in Bessarabia." The Rumanian government had to submit, and Russian troops marched in (June 28). On July 11 the districts of central Bessarabia inhabited predominantly by Moldavians were joined to part of the Moldavian Autonomous Soviet Socialist Republic across the Dniester (an autonomous republic of the Ukraine set up in 1924) to form, in August, a Moldavian Soviet Socialist Republic, with Kishinev as capital. The Khotin district in the north was incorporated in the Ukrainian Soviet Socialist Republic as were the southern districts of Cetatea Albă and Izmail. Further land was expropriated, and collectivization launched. Many Moldavians left, some Jews entered and the whole German population was removed to western Poland under an agreement between Germany and the U.S.S.R. In July 1941 Rumania, having entered the war as Germany's ally against the U.S.S.R., reoccupied Bessarabia, and by Dec. 1942 it was fully governed as Rumanian territory, though a formal decree of annexation was postponed until the end of hostilities. Some Moldavian peasants from Transnistria, the newly organized Rumanian province between the Dniester and the Bug, were settled on the farms of departed Germans, and many Jews were killed or deported.

Reincorporation in the U.S.S.R.—The Russians reoccupied Bessarabia in the course of 1944, and by the peace treaty of Feb. 1947 (ratified in September), Rumania had once more to yield Bessarabia and northern Bukovina to the Soviet Union. The Soviet territorial arrangements of Aug. 1940 were restored; the Communist system was introduced; and Bessarabia lost its administrative identity.

Population includes Moldavians, Ukrainians, Armenians, Rumanians, Russians, Jews and Bulgarians. (*See* also MOLDAVIA.)

Antiquities.—Bessarabia contains much of archaeological interest, notably many mounds and barrows of different early epochs. Remains of earthworks, probably of a wall built by Trajan, can be traced from Leovo on the Prut almost to the junction of the Botna river with the Dniester; and there is another similar line farther south. There are few traces of the old Greek and Roman towns known to have existed except at Belgorod-Dnestrovski (the Tyras of the Greeks). The most striking monuments are the great forts along the Dniester at Khotin, Soroki, Belgorod-Dnestrovski and Bendery, mostly begun by the Genoese. There are some old churches, both monastic and parochial, one of the most interesting being the 15th-century Armenian church at Belgorod-Dnestrovski.

See also Index references under "Bessarabia" in the Index volume.

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BESSARION, JOHN (afterward BASIL) (*c.* 1400–1472), Byzantine humanist and theologian, and later Roman cardinal, who contributed to the revival of letters in the 15th century, was born at Trebizond. He was educated at Constantinople and took the name of Bessarion on becoming a monk in 1423. He studied under the Neoplatonist Gemistus Pletho and in 1437 was made archbishop of Nicaea by John VIII Palaeologus, whom he accompanied to Italy in order to bring about a union between the Byzantine and western churches, with the object of obtaining help against the Turks. At the councils held in Ferrara and Florence, Bessarion supported union, but this was not accepted by the Byzantine church. Bessarion, however, remained in communion with Rome and gained the favour of Pope Eugenius IV, who made him a cardinal (1439). From that time he resided in Italy, doing much, by his patronage of scholars, by his collection of books and manuscripts and by his writing to spread knowledge of Greek language and learning. In 1463 he received the title of Latin patri-

arch of Constantinople. For five years (1450–55) he was legate at Bologna, and he was engaged on embassies to foreign princes, including Louis XI of France in 1471. He died on Nov. 19, 1472, at Ravenna.

Bessarion was one of the most learned scholars of his time. Besides his translations of Aristotle's *Metaphysics* and Xenophon's *Memorabilia*, his most important work is a treatise against George of Trebizond, a violent Aristotelian, entitled *In calumniatorem Platonis*. Bessarion sought to reconcile the two philosophies. His library, containing a large collection of Greek manuscripts, was presented by him to the senate of Venice, and formed the nucleus of the library of St. Mark.

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(J. M. Hy.)

BESSEL, FRIEDRICH WILHELM (1784–1846), German astronomer and mathematician, made fundamental contributions to accurate positional astronomy, to geodesy and to celestial mechanics. He was born at Minden near Hanover on July 22, 1784. In 1804 he calculated the orbit of Halley's comet from observations of 1607; H. W. M. Olbers secured publication of the results (*Monatliche Correspondenz* x., 1804) and recommended his appointment as assistant to J. H. Schröter at Lilienthal observatory. In 1810 he was appointed professor of astronomy at Königsberg, East Prussia, directing the observatory from its completion in 1813 until his death. His work there inaugurated the era of accurate positional astronomy. To improve star places, he reduced James Bradley's Greenwich observations, deriving the mean places of 3,222 stars (*Fundamenta astronomiae*, 1818). The uniform system of reduction he established in *Tabulae Regiomontanae* (1830) is still standard. During 1821–33 he observed all stars to the ninth magnitude in zones from declination −15° to +45°, increasing the number observed to about 50,000. In 1826 he corrected the seconds pendulum (in a discussion republished by H. Bruns in 1889); during 1831–32 he directed geodetical measurements of meridian arcs in East Prussia; and in 1841 deduced a value 1/299 for the ellipticity of the earth. In 1838 he made the first definite parallax measurement for a fixed star, 0".31 for 61 Cygni (*Astronomische Nachrichten*, xvi, no. 365–366). In 1844 he inferred from their varying proper motions the binary nature of Sirius and Procyon. Shortly before his death he had begun the study of the irregular motion of Uranus, which problem at the hands of others later led to the discovery of Neptune. He was first to make effective use of the heliometer, to introduce corrections for personal equation (1823), and to study instrumental errors systematically. He issued a multi-volume series *Astronomische Beobachtungen auf der Sternwarte zu Königsberg* (1815–44). Of special interest are his *Astronomische Untersuchungen* (1841–42), *Populäre Vorlesungen wissenschaftliche Gegenstände* (1848) and the collection *Abhandlungen* (1875–82). His minor papers numbered over 350. He enlarged the resources of pure mathematics by the introduction of what are now termed Bessel functions, making preliminary use of them in 1817 to study Kepler's problem (*Transactions, Berlin Academy*, p. 49 [1816–17]), fully developing them seven years later for application to planetary perturbations (*Transactions, Berlin Academy*, pp. 1–52 [1824]). He died at Königsberg on March 17, 1846.

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(R. A. L.)

BESSEMER, SIR HENRY (1813–1898), English inventor and engineer, who discovered and developed the first process for making inexpensive and plentiful steel, was born at Charlton, near Hitchin, Hertfordshire, on Jan. 19, 1813, the son of a type founder. His engineering education was self-acquired and was applied first to the development of electrotyping, and to the improvement of a typesetting machine. A casual inquiry about the cost of "gold" paint led him to work out and operate in secret a process for the manufacture of "gold" powder which made him a small fortune.

At the time of the Crimean War he designed a rotating artillery shell and, finding the cast-iron cannon of the day too weak for it, set out to discover a stronger material. He hit upon a process (announced in 1856) in which air was blown through molten pig iron to decarburize it, sufficient heat being generated by the reactions to keep the charge hot and liquid. The result was an extremely malleable mild steel. Early success, however, was followed by relative failure as it had not been understood that, in a converter lined with siliceous (acid) refractories, harmful phosphorus was not removed. Bessemer, however, developed his own source of nonphosphoric pig iron and, with some assistance from his Swedish licensee Göran Göransson, brought it to commercial success, and it was widely adopted from 1864 onward. Modification to enable the use of phosphoric pig irons was made by Sidney Gilchrist Thomas, in 1878, by employing magnesian (basic) refractories. By this time the use of the open-hearth process invented by Sir William Siemens was extending. Nevertheless, the Bessemer process, both acid and basic, produced enormous quantities of steel used in bridges, railway construction and shipbuilding. In his later years Bessemer, while still interested in steel, devoted his energies to other matters, such as an only partly successful stabilized cross-channel steamer, a solar furnace and a large telescope. He was made a fellow of the Royal society, was knighted in 1879 and received many other honours. He died at Bessemer Grange, Denmark Hill, London, on March 15, 1898.

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(J. P. Sa.)

BESSEMER, a city of Jefferson county, Ala., U.S., 13 mi. S.W. of the centre of Birmingham, in the heart of the iron, coal and limestone region of the state. It is a part of the Birmingham industrial district and has large iron and steel industries and coal-mining operations, and also manufactures brick, clay pipes, coal-tar derivatives, fertilizer, high explosives, lumber and meat products. Under the influence of Henry F. DeBardeleben, Bessemer was laid out in 1887 and incorporated in 1888. It was named after Sir Henry Bessemer, inventor of a steelmaking process. For comparative population figures *see* table in ALABAMA: *Population*.

(H. T. Sh.)

BESSEMER STEEL: *see* CONVERTER STEEL.

BESSEY, CHARLES EDWIN (1845–1915), U.S. botanist, an outstanding teacher and author of a classification of plants, was born near Milton, O., on May 21, 1845, and studied with Asa Gray at Harvard (1872–73 and 1875–76).

At Iowa State Agricultural college (now Iowa State college), Ames, he was professor of botany (1870–84), and was acting president in 1882. At the University of Nebraska, Lincoln, he was professor of botany after 1884, acting chancellor (1888–91, 1899–1900 and 1907) and head dean after 1909.

With the publication of *Botany for High Schools and Colleges* (1880), he introduced morphology to the United States. This book was the first in the series of "Bessey's textbooks," which set a standard for modern work. Bessey also wrote a number of other textbooks and reference works on botany.

BESSIÈRES, JEAN BAPTISTE, DUC D'ISTRIE (1768–1813), French soldier, one of Napoleon's marshals, was born at Prayssac, near Cahors, on Aug. 6, 1768, a surgeon's son. Educated at Cahors college, he joined the army and was for a time in Louis XVI's constitutional guard with Joachim Murat. After service with Jean Lannes in Catalonia, he was in 1796 chosen to command Napoleon's escort of guides in Italy. He fought bravely in Egypt at Aboukir (1798) and, in Italy again, commanded 800 men of the consular guard at Marengo (1800). In 1804, only four years after becoming general of brigade, he was made a marshal. While Napoleon followed the example of many kings

of France in making his personal friend a marshal, this also marked a decision to develop the imperial guard.

In 1805 Bessières had 9,000 guards, both infantry and cavalry, under his orders and led a famous charge against the Russian guard cavalry at Austerlitz. In 1806 he had 12,000 men. The guard cavalry saved the day at Eylau, but the guard infantry had little fighting. Bessières went to Spain in 1808 to gain experience, and his victory at Medina de Rioseco enabled Joseph Bonaparte to reach Madrid. In command of the cavalry corps against Austria in 1809, he led charges to cover the retreat in the battle of Aspern-Essling and to gain time at Wagram, where he was severely wounded. Even so he was very soon sent to end the British Walcheren expedition in Flanders. In 1809 also he was created duc d'Istrie. Sent back to Spain to hold the north, he had 50,000 men under his orders in 1811, yet when he joined André Masséna for the battle of Fuentes de Oñoro he brought only a few cavalry; he could not concentrate a field force. In 1812 he led the guard cavalry to Russia and lost them there almost without fighting. Few cavalry were ready for his command in the new army in Germany in 1813. On May 1 of that year he was riding out on reconnaissance near Lützen and was killed by a chance shot. His loss was a real sorrow to Napoleon, one of whose few intimate friends he had been—a calm, steady man never spoiled by his success.

See A. Bessières, *Le Maréchal Bessières* (1952). (I. D. E.)

BEST, CHARLES HERBERT (1899–), professor of physiology at the University of Toronto and the first, along with Frederick G. Banting, to extract insulin from the pancreatic gland. Born at West Pembroke, Me., on Feb. 27, 1899, he received his higher education in Canada. During World War I he enlisted in the Canadian army, thereby acquiring Canadian citizenship. After service overseas he resumed his studies at the University of Toronto.

In May 1921, while still an undergraduate, he became a laboratory assistant to Banting, who had come to the university to test his idea that insulin, a hormone secreted by certain cells within the pancreas, would cure diabetes. After several months, Banting and Best proved that insulin was present in the pancreas and that extracts made from pancreases of healthy dogs would control diabetes in dogs that had been made diabetic by surgical removal of this gland. Insulin also proved effective on humans, and at long last an effective treatment for diabetes was available.

A department of medical research was created at the university in 1923 in honor of Banting and Best. Best, who received his medical degree in 1925, became research associate in 1923 and director on July 1, 1941, following the death of Banting. He was appointed professor and head of the department of physiology at the University of Toronto in 1929. (M. C. L.)

BESTIARY, the name of a medieval collection of stories containing pseudoscientific descriptions of animals, plants and stones, etc., which drew parallels between the world of natural history and that of religion, thus giving moral instruction. There was no one standard text for the various stories. They were translated from the Greek *Physiologus,* whose origin is obscure. The supposed author of the book was "Physiologus" (*i.e.,* "the Naturalist"), who is often mentioned as the source of the descriptions. The *Physiologus* seems to have originated in Egypt, where animal symbolism in religion was common in about the 2nd century A.D., and to have been early taken over by Christian interpreters who favoured the allegorical and typological exegesis of the Bible. Some of its information can be traced back to Aristotle. Each description of an animal, plant, etc., and each lesson drawn from it is usually linked to a biblical text; the popularity of such descriptions can be seen from the commentaries by Basil and Ambrose on the hexameron (the six days of creation in Genesis), which have much in common with descriptions found in the *Physiologus.*

The Greek text of the *Physiologus* is extant in several versions, dating from the 4th century onward, some being ascribed to church fathers such as Epiphanius and Basil. A Latin version of the *Physiologus* is first mentioned in the 5th or 6th century as circulating under the name of Ambrose. The application of Christian moralizations to traditional lore was doubtless assisted by the many zoological metaphors found in the Bible—"the lion of the house of Judah," "the deaf adder that stoppeth her ears," etc. In the 12th century especially, bestiaries in Latin prose were greatly expanded and their material classified into sections under beasts, birds, reptiles and fishes, with the addition, in a few manuscripts, of trees and stones.

The *Physiologus,* or "Bestiary" as it was later called, was a popular book in the middle ages, both Byzantine and western, being translated into oriental as well as into modern European languages. Anglo-Saxon poems in the Exeter Book on the panther, the whale and a bird which may be the partridge show that the *Physiologus* was known in England before the Norman conquest. In the 11th century a certain Thetbaldus wrote a text in Latin verse which was the main source of the unique Middle English metrical version in the 13th-century manuscript Arundel 292 (in the British museum, London). The Bestiary was illustrated not only in the manuscripts but also in carvings and frescoes. It fell into disfavour after the realization that it was not based on true natural science.

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BESTUZHEV-RYUMIN, ALEKSEI PETROVICH, COUNT (1693–1766), grand chancellor of Russia, notable for his conduct of foreign affairs under the empress Elizabeth, was born in Moscow on June 1 (new style; May 22, old style), 1693, the younger brother of Mikhail Petrovich Bestuzhev-Ryumin (*q.v.*), with whom he was educated in Copenhagen and Berlin. He served his apprenticeship to diplomacy at the congress of Utrecht (1712) under Prince B. I. Kurakin and in the service of the elector of Hanover, whom he followed to London when he became George I of England. After a short service at the court of Anna, duchess of Courland, he was sent to Copenhagen in 1721 as a Russian minister. The death of Peter the Great in 1725 prevented his advancement, and it was only in 1740, at 47 years of age, that he was recalled to Russia by E. J. Biron (*q.v.*). After Biron's fall, he was for a short time imprisoned at Schlüsselburg.

His chance came in 1741 with the accession of the empress Elizabeth, who appointed him vice-chancellor. For the next 16 years, during a period of exceptional difficulty, he controlled the foreign policy of Russia. In the War of the Austrian Succession, which had just broken out, France and Prussia were on one side, Austria and Great Britain on the other. Bestuzhev rightly recognized that the interests of France and Russia in Turkey, Poland and Sweden were diametrically opposed; that Russia could never hope to be safe from French influence in these countries; and that Prussia, under Frederick the Great, was also a danger. His basic policy, therefore, was to bring about a quadruple alliance between Russia, Austria, Great Britain and Saxony to counterpoise the Franco-Prussian league. The empress, however, was adverse to an alliance with Great Britain and Austria, whose representatives had striven to prevent her accession; and many of her personal friends, in the pay of France and Prussia, took part in conspiracies to overthrow Bestuzhev. Nevertheless Bestuzhev, aided by his brother Mikhail, carried out his policy. In Dec. 1742 a defensive alliance was concluded between Great Britain and Russia. Bestuzhev had previously rejected the French proposals to mediate between Russia and Sweden on the basis of a territorial

surrender by Russia, and he conducted the war against Sweden so vigorously that at the peace congress of Åbo (Jan.–Aug. 1743) he could insist on the cession of the whole of Finland to Russia. The French party, however, contrived to get better terms for Sweden by appealing to the empress's fondness for the house of Holstein. The Swedes accepted Adolphus Frederick, duke of Holstein, as their future king and, in return, received back most of the duchy of Finland.

Bestuzhev could not prevent the signing of a Russo-Prussian defensive alliance (March 1743), but he deprived it of all significance by excluding the proposed guarantee of Frederick the Great's Silesian conquests. Moreover, through Bestuzhev's efforts, the credit of Frederick (whom he regarded as more dangerous than France) at the Russian court fell steadily, and the vice-chancellor prepared the way for an alliance with Austria by acceding (Nov. 1, 1743) to the treaty of Breslau. A bogus conspiracy, however, started by the Holstein faction, aided by France and Prussia, who persuaded Elizabeth that the Austrian ambassador was intriguing to put Ivan VI back on the throne, alienated the empress from Austria; and Bestuzhev's ruin was regarded as certain when, in 1743, the French ambassador, J. J. Trotti, marquis de La Chétardie, arrived to reinforce his other enemies. Though Bestuzhev found a friend in M. I. Vorontsov, the empress's confidant, his position remained delicate, especially when the betrothal between the grand duke Peter and Sophia of Anhalt-Zerbst (afterward Catherine II) was carried through against his will, and Elizabeth of Holstein, the bride's mother, arrived in the Prussian interest to spy upon him. Frederick of Prussia, conscious of the instability of his French ally, was now anxious to contract an alliance with Russia and so was eager to see Bestuzhev overthrown. Bestuzhev, however, convinced the empress that La Chétardie was an intriguer. In June 1744 La Chétardie was expelled from Russia; in July Bestuzhev was made grand chancellor; and before the end of the year Elizabeth of Holstein was also expelled.

Bestuzhev's offer to attack Prussia if Great Britain would guarantee subsidies was rejected by the British in 1745. Then he turned to Austria and on May 22, 1746, an alliance was concluded between the two powers against Prussia. Alliances were also concluded with Denmark (1746) and with Turkey (1747), and a closer agreement was reached with Great Britain by the treaty of St. Petersburg (Dec. 9, 1747).

Bestuzhev's triumph coincided with the peace congress of Aix-la-Chapelle (1748), which ended the War of the Austrian Succession. Subsequently the diplomatic revolution changed the alignment of the European powers: Prussia broke with France and made a *rapprochement* with Great Britain; France and Prussia's enemies allied themselves. Bestuzhev's political prejudices at first prevented him from properly recognizing this change. His anglomania also misled him. His enemies, this time headed by his brother Mikhail and the vice-chancellor, Vorontsov, quickly took advantage of his mistakes. The Anglo-Prussian alliance of Jan. 1756 made nonsense of a subsidy treaty that Bestuzhev had made with Great Britain in Sept. 1755 (ratified, against the empress's wishes, on Feb. 1, 1756) and justified the arguments of his enemies that Great Britain was impossible, while his hatred of France prevented him from adopting the only alternative. To prevent underground intrigues he secured the erection of a council of ministers and at its first session, in March 1756, an alliance with Austria, France and Poland against Prussia was proposed, though Bestuzhev opposed any composition with France. Elizabeth maintained that the conclusion of the Anglo-Prussian treaty nullified Russian engagements with Great Britain. Bestuzhev tried to support his failing credit by a secret alliance with the grand duchess Catherine, whom he hoped after Elizabeth's death to make regent for her son, passing over Peter, from whom Bestuzhev expected nothing good either for himself or for Russia. These machinations later helped Bestuzhev's enemies ruin him. Meanwhile his anti-Prussian policy was being completed over his head and on Dec. 31, 1756, Russia acceded to the Franco-Austrian coalition of May 1756 against Prussia in spite of Bestuzhev's aversion for any alliance with France. The pretext for ousting him definitely presented itself when, after defeating the Prussians at Gross-Jägerndorf (Aug. 1757), his friend the Russian commander in chief S. F. Apraksin refrained from active operations. Accused of having launched a plot, Bestuzhev was arrested (Feb. 1758) and condemned to death, which was commuted to banishment to his estate at Goretovo (April 1759). Immediately after her accession (1762) Catherine II recalled him and made him a field marshal. He was also publicly exonerated, but he took no leading part in affairs. He died on April 21 (N.S., April 10, O.S.), 1766. (R. N. B.; Lo. L.)

BESTUZHEV-RYUMIN, MIKHAIL PETROVICH, Count (1688–1760), Russian diplomat, the elder brother of the great Aleksei Petrovich Bestuzhev-Ryumin (*q.v.*), was the son of the empress Anna's early favourite, Count Petr Mikhailovich Bestuzhev. Sent abroad with his brother in 1708, he was attached to the Russian embassy in Copenhagen. After having served in the Turkish campaign of 1711, he was for some years employed by Peter the Great in various capacities. In March 1720 he was appointed resident in London, at a time when the British court was greatly inflamed against Peter, who was regarded as a dangerous rival in the Baltic. Bestuzhev protested sharply against the lately formed Anglo-Swedish alliance and in November was forced to leave the country within eight days. On the conclusion of the peace of Nystad between Russia and Sweden in 1721, he was sent as ambassador to Stockholm, where in 1724 he managed to conclude a 12-year defensive alliance. He was successively transferred to Warsaw (1726) and to Berlin (1730), but returned to Stockholm in 1732 and succeeded in renewing the Swedish-Russian alliance for an additional 12 years.

In 1739, however, Bestuzhev's work was wrecked through the advice that he had himself given to the Russian government concerning the Swedish agent Malkolm Sinclair, whose mission to Istanbul was supposed to be hostile to Russia and who was murdered at Grünberg, in Silesia, on his journey home (June 28). The news of the murder aroused a storm of public indignation against Bestuzhev, who nevertheless tried to stick to his post. After the outbreak of the Swedish-Russian War (1741) Bestuzhev was transferred first to Hamburg and subsequently to Hanover, where he endeavoured to conclude an alliance between Great Britain and Russia. On his return to Russia in 1743, he was made grand marshal and married Anna Gavrilovna Yaguzhinskaya, a widow. A few months later, however, his wife was implicated in a political intrigue that Bestuzhev's enemies, including the marquis de La Chétardie (J. J. Trotti), the French ambassador, had hoped would ruin both brothers. Although his wife was publicly whipped, had her tongue cut out and was banished to Siberia, Bestuzhev was able to resume his diplomatic career. He served in Berlin (1743), in Warsaw (1744) and in Vienna (1748). His last mission was to Versailles, where he arrived in 1757, shortly after Russia's adhesion to the Franco-Austrian coalition against Prussia.

Bestuzhev died in Paris on March 8 (new style; Feb. 26, old style), 1760. (Lo. L.)

BETA RAYS, a term applied to streams of electrons (*see* Electron) from whatever source (*see* Cathode Rays; Electricity, Conduction of: *Conduction in Gases* and Radioactivity). Since the discovery of the positron or positive electron, the term "beta emitter," *i.e.*, emitter of beta rays, is used for substances that emit, or methods that produce, streams of either negative or positive electrons.

See Nucleus: *Description and History* and *Constituents of the Nucleus; see* also references under "Beta Rays" in the Index. (H. B. Lm.)

BETATRON: *see* Accelerators, Particle: *Betatrons.*

BETELGEUSE, α Orionis, a bright supergiant star in the constellation Orion. It is yellowish-red, and is thus easily distinguished from the other important stars in the constellation, which are white. Betelgeuse is an irregular variable, sometimes above and sometimes below the first magnitude. It was the first star whose apparent diameter was measured, in 1920, by Michelson's stellar interferometer. (*See* Interferometer.) The approximate distance of Betelgeuse from the sun is about 500 light years. It is of spectral type M, its spectrum showing the char-

acteristics of titanium oxide. *See* SPECTROSCOPY, ASTRONOMICAL; STAR.

BETEL NUT. The name betel is applied to two different plants which in the east are very closely associated in the purposes to which they are applied. The betel nut is the fruit of the areca or betel palm (*Areca catechu*) and the betel leaf is the produce of the betel pepper or pan (*Piper betle*), a plant allied to that which yields black pepper.

The areca palm is a native of Malaya and is extensively cultivated in the south of India, Ceylon, Thailand, the Malay archipelago and the Philippines. It is a graceful tree with a straight, slender, unbranched stem reaching 40 or 50 ft. in height and about 1½ ft. in circumference, and bearing a crown of six to nine very large spreading pinnate fronds. The fruit is about the size of a small hen's egg, and within its fibrous rind is the seed or so-called nut, the albumen of which is hard, and has a mottled gray and brown appearance. The chief purpose for which betel nuts are cultivated and collected is for chewing, their use in this form being so widespread among oriental nations that it has been estimated that one-tenth of the world population indulges in betel chewing.

For chewing, the fruits are annually gathered between the months of August and November, before they are quite ripe, and deprived of their husks. They are prepared by boiling in water, cutting up into slices and drying in the sun, by which treatment the slices assume a dark brown or black colour. In chewing, a small piece is wrapped in a leaf of the betel pepper, with a pellet of shell lime or chunam; in some cases a little cardamom, tumeric or other aromatic is added. Chewing of the material causes a copious flow of brick-red saliva, which may temporarily dye the mouth, lips and gums an orange-brown colour. Contrary to general belief, the teeth of habitual chewers are not blackened by the betel juice, though chewers often artificially stain the teeth a black colour. Betel nuts are used as a source of inferior catechu (*q.v.*); its chief alkaloid is arecoline, to which anthelmintic properties are attributed. The drug finds some use in veterinary medicine as an anthelmintic.

BETHANY (Arabic AL 'AYZARIYAH; Hebrew BEIT HANIYA), a small village 1¾ mi. from Jerusalem in Jordan, set among fruit trees on the eastern foot of the Mount of Olives along the Jericho highway. Pop. (1959 est.) 2,909. It figures prominently in the Gospels as the home of Lazarus and his sisters Mary and Martha, as the home of Simon the leper (Matt. xxvi, 6; Mark xiv, 3), and as the lodging place of Jesus during Holy Week. An ancient tower marks the site of a convent of Benedictine nuns, founded by Queen Millicent in 1147 and abandoned when Saladin took Jerusalem in 1187. A church was shown at this spot in the 4th century. Underneath is a vault opening on to a tomb chamber claimed to be that of Lazarus. The original entrance was through the church, but when the church was converted to a mosque in the 16th century a separate entrance was excavated. The so-called house of Mary and Martha is about 30 yd. east of the tower. (J. S. I.)

BETHEL ("house of God"), an ancient city of Palestine, 11 mi. N. of Jerusalem. Lying 2,900 ft. above sea level on the watershed of the Judaean hill country, the site is occupied by the modern village of Beitin (in the Jerusalem district of Jordan). Bethel (originally called Luz) was a place of importance in Old Testament times. It is frequently associated with Abraham and Jacob. Archaeological evidence suggests that Bethel may have been the actual scene of the events described in the Old Testament as having taken place at Ai (*q.v.*) during Joshua's campaign against Canaan. During the period of the Judges (*c.* 13th–11th centuries B.C.), Bethel was destroyed several times. The ark of the covenant (Judg. xx, 27) was there at one time, and Samuel visited the city regularly in his judging circuit (I Sam. vii, 16). After the division of Israel, Jeroboam I (10th century B.C.) made Bethel the northern kingdom's chief sanctuary. Bethel was the centre for the prophetic ministry of Amos. The city apparently escaped destruction by the Assyrians at the time of the fall of Samaria (722 or 721 B.C.), but was occupied by Josiah of Judah (reigned *c.* 640–609 B.C.). Bethel was one of the strong places of Judah fortified by Bacchides (1 Macc. ix, 50). The New Testament does not mention Bethel, although the city was flourishing at that time. It reached its population climax in the Byzantine period. The site had no military advantages, but there are many nearby springs, so that cisterns were not needed until New Testament times. The site has been excavated in part, work being done jointly by the American School of Oriental Research and the Pittsburgh-Xenia Theological seminary in 1934, 1954, 1957 and 1960. (E. D. GR.)

BETHEL, a borough of Allegheny county, Pa., U.S., 6 mi. S. of Pittsburgh. For many years a coal mining community, Bethel later became one of the fastest growing residential communities in Allegheny county; many of its residents are employed in nearby Pittsburgh. Bethel's industrial products include plastics, soft-water tanks and concrete septic tanks.

Bethel township, named after the pioneer Presbyterian Church of Western Pennsylvania (1779), was organized in 1886 and incorporated as a borough in 1950. For comparative population figures *see* table in PENNSYLVANIA: *Population.* (M. R. Wo.)

BÉTHENCOURT, JEAN DE (*c.* 1360–1422), Norman-French explorer, renowned as the conqueror of the Canary Islands. He set out for the Canaries from La Rochelle on May 1, 1402, in a joint expedition with Gadifer de la Salle (*q.v.*). Soon after their arrival (June), Béthencourt, by agreement with Gadifer, departed for Spain to seek help. He returned after about 18 months, with the title of king, bestowed upon him by Henry III of Castile, and with a bull from the antipope Benedict XIII recognizing the conquest. Béthencourt's title caused a quarrel with Gadifer, who had meanwhile explored and taken possession of the islands. The associates sought the arbitration of the king of Castile; he decided in Béthencourt's favour and Gadifer returned to France. Béthencourt then profited from Gadifer's work to undertake, with Norman peasants, the first colonization of the Canaries. He entrusted the kingdom to his nephew, Maciot de Béthencourt, and returned to France in 1406. He died in his castle at Grainville in 1422. *See* also CANARY ISLANDS.

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BETHESDA, an urban district 5 mi. S.E. of Bangor by road, Caernarvonshire, Wales. Pop. (1961) 4,151. Area 1.4 sq.mi. The district stands at the entrance to the famous Nant Ffrancon pass and is a gateway to the Snowdonia national park surrounded by an amphitheatre of mountain peaks of 2,500 ft. and over. It is a centre for fresh-water fishing and mountain climbing and there is a mountaineering instructional centre at Ogwen, at the head of the Nant Ffrancon pass. Developed after 1850, Bethesda was named after a Congregational church in the main street. It is reached by bus from Bangor, railway facilities being confined to freight. The majority of the inhabitants are employed at the slate quarries. There are also small factories producing cellulose, enamels and metal goods. (E. H. Ow.)

BETHESDA–CHEVY CHASE, a suburban area adjoining Washington, D.C., to the northwest in Montgomery county, Md. Not an incorporated entity but a group of communities, the area before 1949 was governed by county commissioners appointed by Maryland's governor; thereafter it came under the jurisdiction of a newly chartered, popularly elected seven-man county council. The Washington Suburban Sanitary commission and the Maryland-National Capital Park and Planning commission, created in 1918 and 1927 respectively, also exercise some

authority. Each neighbourhood maintains a volunteer fire department, supports its own civic association and, through representation in the county-wide civic federation, has a voice in formulating public policy. The first of these neighbourhoods arose in the 1890s when a Washington real estate syndicate acquired farm lands along the District of Columbia's northwest line and sponsored the founding of the Chevy Chase country club. Bethesda, farther west, remained largely rural until Washington's metropolitan growth in the mid-1930s gradually inspired residential developments. By 1960 the area, solidly built up, had a population of about 82,000.

Government installations accounted for much of that expansion. In 1935 the U.S. public health service located the National Cancer institute in Bethesda; in 1937 it erected an administration building there and later added other units to what became the National Institutes of Health. The U.S. navy opened a large research hospital nearby in 1942. After World War II the program at the National institutes was widened further. By 1960 it included basic research in microbiology, neurology, heart ailments, mental health and several other special fields. Bethesda thus became the foremost centre of medical research in the United States.

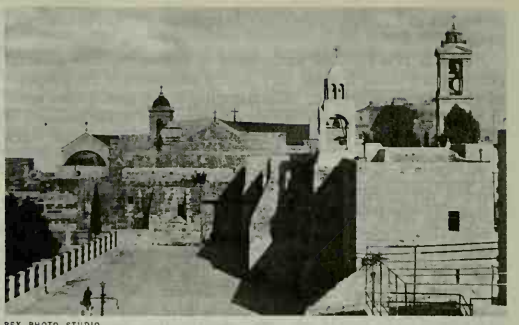
(C. McL. G.)

BETHLEHEM (Hebrew BEIT LÉHEM, Arabic BAYT LAHM, "house of bread"), a town in Jordan regarded by Christendom as the birthplace of Jesus Christ, is situated 5 mi. S. of Jerusalem on an eastern spur of the Judaean watershed at an altitude of 2,500 ft., overlooking the wilderness of Judaea. (There is a village of the same name in Galilee, 7 mi. N. of Nazareth.)

Modern Town.—Bethlehem had an estimated population in 1959 of 23,559, the majority Christian, the minority Muslim. It is a well-built town, the market of a country district rich in olive groves and vineyards as well as flocks. Apart from husbandry, its people specialize in the manufacture and sale of religious mementos made from olivewood, mother-of-pearl or "Dead sea stone." Various Christian missions maintain schools and charitable institutions that help give the town its marked Christian character.

History.—Called in Hebrew either Bethlehem, Ephrath or Bethlehem Ephrathah, it is known from early in the 2nd millennium B.C. through the story of Rachel's death, her traditional tomb lying about ½ mi. to the north (Gen. xxxv, 19). During the period of the Judges, late in the 2nd millennium, it was the residence of Boaz (Booz) and Ruth, and hence the ancestral home of Jesse and his son David, who as leader of the Bethlehemites overcame the Philistines and became king of Israel and Judah (Ruth; I Sam. xvi ff.). Already fortified, it seems (II Sam. xxiii, 14), it was one of the towns garrisoned under Rehoboam, grandson of David (II Chron. xi, 6). After the Babylonian captivity it was reoccupied about 450 B.C. (Ezra ii, 21). As the birthplace of David it became in late Jewish times the expected birthplace of a new national leader, the Messiah (Mic. v; Matt. ii, 5). According to the Gospel of Luke (ii, 4) because of his descent from David, Joseph came to Bethlehem with Mary for the Roman provincial census and so Jesus came to be born there.

In A.D. 315 Bethlehem was little more than a wilderness. Justinian I rebuilt and fortified the little town and its monasteries (531). The Persians spared it in their invasion (614), and the Arabs in theirs (after 634). The crusaders (*q.v.*) under Godfrey of Bouillon occupied it at the invitation of the inhabitants before attacking Jerusalem (1099); Baldwin I was crowned in the church as king of Jerusalem (Christmas day, 1100); and a Latin bishopric was set up (1110). With the other Christian holy places it passed to the Muslims again in 1187, except for a brief restoration through treaty (1229–44). In 1263 its wall and towers were demolished and the moat filled in by order of the sultan Baybars. Repairs to the church were carried out in 1480 through the Franciscans, through the Greek Orthodox patriarch in 1671, and again in 1842. In 1834 Ibrahim Pasha of Egypt laid waste the Muslim quarter as punishment for insurrection. During World War I the British took the district from the Turks when advancing on Jerusalem (1917). It became part of the Hashemite Kingdom of Jordan after the British mandate for Palestine ended in 1948.



REX PHOTO STUDIO

CHURCH OF THE NATIVITY, BETHLEHEM; BEGUN IN 326 A.D.

The Church of the Nativity.—That the birth of Jesus took place in a cave is a Christian tradition that first became explicit about A.D. 150 in St. Justin's *Dialogue* with the Jew Trypho and in the Book of James (*see* M. R. James, *The Apocryphal New Testament*, 1953). Like other Jewish and Christian holy places it was desecrated under the Roman emperor Hadrian and planted as a grove sacred to Adonis. Two centuries later the emperor Constantine the Great, "paying due honours to the cave of the first Theophany," began (in 326) to erect a great church over what is now one of Christianity's principal shrines, the Grotto of the Nativity. It was that cave to which local tradition pointed as the site of the manger according to Palestinian contemporaries, Origen and Eusebius of Caesarea. As excavations by the British administration showed in 1934, Constantine's church was of basilican form with an octagonal sanctuary around a well showing the grotto, one of a series of caves which underlie the church, another being associated with St. Jerome and his translation of the Bible into Latin as the Vulgate. The excavations showed that this church was wholly rebuilt in the 6th century under the emperor Justinian I, its rich but damaged mosaic floor covered over, its stately colonnades reset, and its sanctuary enlarged. It still stands in this form, almost alone of its age, though without the cloistered forecourt which once occupied the present broad parvis or pavement in front. Muslim conquerors of Palestine always respected this church because of Mary's place in the Koran (ch. xix).

The church interior retains something of its decoration dating from the crusades (*q.v.*) of the 12th and 13th centuries. In 1169 Amalric I, the French king of Jerusalem, and Manuel I Comnenus, the Byzantine emperor, dedicated jointly a series of wall mosaics which are known to have ranged from the story of the incarnation in the choir and transepts (as illustrated by scenes from the Gospels) to the descent of Joseph from Jesse in the nave (as represented by a gallery of portraits). Above these was a series of texts, some of which remain, giving the consensus of councils and synods of Christendom on those aspects of Christ's nature, divine as well as human, which the pictures themselves symbolized. On many of the pillars in the nave and aisles are votive paintings of saints honoured likewise in the east or the west. From their subjects, style and mixture of Latin with Greek titles, these paintings must have been added during the crusaders' occupation. Generally they are in the statuesque Byzantine style. But among them is a "Madonna and Child" which at this period is remarkable for its very human treatment, more comparable to the Italian Primitives than the stylized eastern icon; its Latin invocation and the costume of the kneeling donors at the foot alike evince its western inspiration. Among the western European nations represented by patron saints are Italy and Spain, Norway and Denmark, and also the Normans of France and Sicily. The Normans are most notably symbolized by St. Catald, an Irish bishop of Tarentum (modern Taranto), in their principality of Otranto (south Italy), but an Anglo-Norman was bishop there when the mosaics were put up. Beside such western saints are the fathers of eastern asceticism and monasticism, including those particularly associated with the

Judaean wilderness, that region east of Bethlehem now famous for the Dead sea scrolls.

To the north of the church is the modern Franciscan church and convent, built around a cloister of the 12th century, and to the south the Armenian convent, also dating from the 12th century but largely of the 18th century. The clergy of both and of the Greek Orthodox Church serve the sanctuary in turn according to a strict routine which is jealously guarded by each rite.

See also PALESTINE: *The Holy Places.*

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(C. N. J.)

BETHLEHEM, a city of Pennsylvania, U.S., in Northampton and Lehigh counties, on the Lehigh river, 50 mi. N.W. of Philadelphia. Pop. (1960) city, 75,408; Allentown-Bethlehem-Easton standard metropolitan statistical area (Lehigh, Northampton counties, Pa.; Warren county, N.J.), 492,168. (For comparative population figures *see* table in PENNSYLVANIA: *Population.*) The city is built on hills on both sides of the river and commands views as far as the Blue mountains, 20 mi. to the north.

Bethlehem is the centre of industrial activity of the Lehigh valley. It is one of the most important U.S. centres of steel production; the area also produces a large amount of the world's cement supply. Other local manufactures include foundry and machine products, metal products, electrical apparatus, oil burners, silk and textiles, clothing, candy, furniture, pumps, paints, plumbing fixtures, paper boxes, chemicals, spark plugs, heating appliances, ornamental iron, millwork, shoes, mattresses, cigars, brick, tar products and many food products.

The first Moravian arrivals to Pennsylvania were unable to agree upon the location of their permanent home. Finally, in Feb. 1741, they decided by lot upon the site at the forks of the Monocacy creek and the Lehigh river. With Henry Antes as agent, William Allen and his wife signed, on April 2, 1741, the deed which conveyed to the Moravian Church its first real estate in Pennsylvania.

Even before this date, the Moravians began building their first house, which was completed in March 1741. The building was divided into two sections, the smaller to house the cattle, the larger to serve as a common dwelling and as a place of worship. The Moravians next concentrated their efforts on preparing land for cultivation and on the construction of a large community house.

These first settlers, who lived under a communal system which lasted for several years, came from Bohemia and Moravia in search of religious freedom and to do missionary work among the Indians. On Christmas eve, when they assembled in the log house to observe the vigil of Christmas, Count Nicolaus Zinzendorf, their recently arrived patron, led the worshipers into that portion of the building occupied by the cattle, singing a German Epiphany hymn, which emphasized the little town of Bethlehem. This suggested to them the name of their settlement, Bethlehem.

During the American Revolution Bethlehem was a thoroughfare for troops, and in 1776–77 one of the Moravian buildings was used as a military hospital. For a short time the Sun inn there was the refuge of a part of the continental congress.

The water supply system was one of the first in North America, beginning regular operations June 27, 1755. With the completion of the Lehigh canal in 1829, traffic in coal began and in 1855 the Lehigh Valley railroad began operating trains through Bethlehem. In 1845 the north bank borough of Bethlehem was incorporated and people other than Moravians were allowed to own land. In 1865 South Bethlehem was incorporated and was united with the mother town in 1917. In the same year other boroughs on both sides of the river were incorporated. With the annexation in 1920 of Northampton Heights, the consolidated city encompassed an area of 18.89 sq.mi.

The first steel enterprise at Bethlehem, the Saucona Iron company, was formed April 8, 1857. In 1904 the Bethlehem Steel company was incorporated, and later became the second largest steel producer in the U.S. and the world's largest shipbuilding organization.

Bethlehem has a certain distinction as a music centre. An orchestra of strings, wind and brass was used in the church services before 1750. From 1754 a choir of trombones has played at funerals, and from the belfry of the church has announced festival days and national holidays and the deaths of members of the church. An orchestra and a chorus (first the Collegium Musicum, which gave the first performance in America of Franz Joseph Haydn's *Creation,* and later the Philharmonic society) were in existence almost continuously until 1885.

Choral music was revived a few years later in Bethlehem by the organist J. F. Wolle, and under his direction a national reputation was gained for the rendering of the works of Johann Sebastian Bach. From 1895, except for the period 1906–12, an annual Bach festival has been held in May attracting music lovers from all parts of the world.

The Moravian seminary, the first boarding school for girls in the 13 colonies, was founded in 1742. Moravian College and Theological seminary was founded in 1807. These institutions merged in 1953–54 under the name of Moravian college, which enrolls more than 750 students annually. Lehigh university, which enrolls more than 3,000 students annually, was established in Bethlehem in 1865. It offers courses in arts and sciences, business administration and engineering at both undergraduate and graduate levels.

(G. D. H.)

BETHLEN, GABRIEL (GÁBOR) (1580–1629), prince of Transylvania and for a brief period king of Hungary, was a member of a leading Protestant family of northern Hungary which had extensive estates in Transylvania. As a young man he was sent to the court of Prince Sigismund Báthory, whom he accompanied on his campaign of 1600. Subsequently he assisted István Bocskay to obtain the throne of Transylvania (1605) and then supported Bocskay's successor, Gabriel Báthory, from 1608 to 1613. Báthory's jealousy of Bethlen's superior ability, however, forced him to take refuge with the Turks. The sultan Ahmed I, as suzerain of the principality, proclaimed Bethlen prince of Transylvania and provided him with an army. On the murder of Báthory, the diet of Kolozsvár (Cluj) confirmed the sultan's choice (Oct. 13, 1613), and Bethlen was also recognized by the Holy Roman emperor Matthias, the Habsburg king of Hungary, in 1615.

Bethlen had hardly consolidated his power in Transylvania when the Thirty Years' War broke out, presenting him with the opportunity to enter the war in defense of the Hungarian constitution and freedom of religion. While Matthias' successor Ferdinand II was occupied with the Bohemian revolt in 1618, Bethlen led his troops into northern Hungary and, supported by the population, occupied most of upper Hungary and captured Pozsony (Czech. Bratislava; Ger. Pressburg), where he seized the crown of St. Stephen. Ferdinand, anxious to settle the Hungarian problem, entered into negotiations with Bethlen. When the negotiations collapsed because Ferdinand would not agree to including Bethlen's ally Frederick, king of Bohemia, in the treaty, the diet at Besztercebánya elected Bethlen king of Hungary (Aug. 20, 1620). He accepted the title, but refused to be crowned because he knew that a Protestant king would never be accepted by the Catholic nobility. Thereupon the war was renewed and continued until the defeat of the Bohemians at the battle of the White Mountain (1620) gave a new turn to the events. Bethlen saw the futility of continuing the war and on Dec. 31, 1621, concluded peace with Ferdinand at Nikolsburg (Mikulov). In the treaty Bethlen renounced the royal title and returned the crown of St. Stephen; Ferdinand II in return reaffirmed the treaty of Vienna (1606), which had guaranteed liberty of worship to the Protestants, and promised to summon the national diet within six months. Bethlen secured for himself the title of prince of the Holy Roman empire and seven counties in northeastern Hungary, together with the fortresses of Tokaj, Munkács (Mukačevo) and Ecsed. Even so, he considered the treaty only an armistice and secretly planned the expulsion of Ferdinand from Hungary, the occupation of Bo-

hemia and the restoration of his friend Frederick to the Bohemian throne.

After securing Turkish support and receiving the invitation of the German Protestant princes to join their anti-Catholic and anti-Habsburg alliance, Bethlen re-entered the war against Ferdinand in 1623. Though he won military successes in Bohemia, the defeat of the Protestant forces in Germany convinced him that he could not carry on the war against Ferdinand alone. He therefore concluded the treaty of Vienna in 1624, which essentially reaffirmed the provisions of Nikolsburg. Bethlen then turned to planning an eastern European alliance in order to attack the Turkish empire, to liberate and reunite Hungary and to expel the Turks from Europe. To carry out this plan he hoped to marry one of Ferdinand's daughters and to form an alliance with the emperor, but in Vienna his sincerity was doubted and his overtures were rejected. Thereupon he married Catherine, sister of the elector George William of Brandenburg, and joined the German Protestant princes once more; the overwhelming victories of the Catholic and imperial forces, however, obliged him to come to terms with Ferdinand again (treaty of Pozsony, 1626). Although the terms of the new treaty were set by Ferdinand, its main provisions reaffirmed the treaty of Vienna of 1624.

Thereafter, Bethlen was involved in negotiations with some Polish nobles, who offered him the crown of Poland for his help against the emperor. He also reached agreement with Gustavus Adolphus of Sweden, who invited him to join the Lutheran princes and lend military assistance against Ferdinand, but his rapidly declining health prevented Bethlen from further action. He died on Nov. 15, 1629, at Gyula-Fehérvár (Alba Iulia) in Transylvania.

Bethlen is considered the greatest Hungarian of his time. His extensive correspondence with the rulers and leaders of Europe reveals an original thinker. Although an ardent Calvinist, he was free of prejudice and even helped the Jesuit György Káldy to translate the Scriptures into Hungarian. (T. K.)

BETHLEN, ISTVÁN, Count (1874–1947?), Hungarian statesman, prime minister of his country from 1921 to 1931, was born at Gérnyeszeg (Cornești) in Transylvania on Oct. 8, 1874, of a family belonging to the inner circle of the Transylvanian aristocracy. He entered the Hungarian parliament in 1901, first as a Liberal, but soon joined the national opposition. He was a leading figure of the counterrevolutionary emigration during Béla Kun's Communist regime, on the fall of which he returned to Hungary and re-entered parliament. His aim from the first was to establish an impregnable Conservative political regime, and he put the finishing touches to this on becoming prime minister on April 14, 1921. The "Bethlen system" was essentially one of government through a single party, itself entirely subservient to its leader, an opposition being allowed to voice its views (to which some heed was paid), but never to gain control. Bethlen's domestic policy was one of authoritarian, but not totalitarian, conservatism, which did not deny necessary concessions to changing conditions, but limited them to the minimum. In foreign policy, his ultimate aim was reversal of the treaty of Trianon, but he saw this to be impracticable until Hungary had regained internal strength and made the right friends abroad. Accordingly, while evading commitments which would tie his hands, he eschewed "policies of adventure" (this involved him in repressing right-wing extremism, which was also repugnant to his spirit), contracted no dangerous alliances (his treaty of friendship with Italy, of April 1927, was essentially defensive) and devoted himself to a long-term operation of consolidation and reconstruction. He negotiated Hungary's admission to the League of Nations, obtained a reconstruction loan and facilitated the influx of private capital from abroad. Under his guidance Hungary really achieved a large measure of internal pacification and economic recovery, but this was shattered by the world economic depression which set in in 1929. Bethlen resigned on Aug. 19, 1931. He hoped to return to office later, but opportunity never recurred. Although still regarded as their leader by all forces antagonistic to the new right-wing radicalism, he could do no more than play the oracle. He went into hiding on the German occupation of Hungary (March 1944) and evaded the Germans, but was taken by the Russians in 1945 to Moscow, where he was reported to have died in 1947.

Bethlen was undoubtedly a politician of extreme sagacity and a statesman of European format and vision. His gifts were regarded with awe by most of his countrymen. The Hungary of the 1920s, for good or for ill, was largely his handiwork.

See C. A. Macartney, *October 15th: a History of Modern Hungary, 1929–1945* (1956). (C. A. M.)

BETHMANN HOLLWEG, THEOBALD VON (1856–1921), the German imperial chancellor before and during World War I, was born on Nov. 29, 1856, at Hohenfinow, in Brandenburg, of a family of Frankfurt bankers which acquired wealth and repute in the 19th century. Belonging to the "aristocracy of officials," Bethmann received a good humanistic education at Schulpforta, studied law at Strassburg, Leipzig and Berlin, and entered the civil service. Moderately conservative, he became *Oberpräsident* ("senior president") in Potsdam (1896) and *Regierungspräsident* ("president of the administration") in Bromberg (1899). He was appointed Prussian minister of the interior in March 1905 and state secretary in the imperial office of the interior in June 1907. An advocate of a cautious conservative approach to reform, he was chosen to succeed Prince von Bülow as imperial chancellor in July 1909, as he seemed suited to collaborate with the coalition of conservatives and centre which was to remain in power until 1914, both in the *Reich* and in Prussia.

Bethmann Hollweg was the first chancellor to be appointed from the merely administrative grade. He was a true bureaucrat without strong ambition for political power and typified his class in his conscientiousness, in his efforts to maintain the existing state of affairs (even where he tried to introduce necessary reforms), in his conviction of superiority (which the emperor William II termed "schoolmasterish") and in his avoidance of violent controversy. These characteristics persistently detracted from the undisputed sincerity of his intentions, and from 1909 to 1914 he was unable to resolve the internal political and social tensions of the empire. A conservative servant of the monarchy and a supporter of the traditional authoritarian state, he did not think of abandoning the dualism of *Reich* and Prussia or of introducing parliamentarianism into the *Reich*. In Prussia he sought, cautiously and inadequately, to undertake the reform of the three-class electoral laws, but yielded, in 1906 and again in 1909, to the strong resistance of the conservatives. The enactment of further social legislation in the *Reich* was held up by fear of the decisive step of giving equal political rights to the workers and of social democracy. Though in 1911 he granted universal suffrage with equal electoral rights and a secret ballot in Alsace-Lorraine as well as limited internal autonomy, he remained powerless against the military influences which, through the Saverne (Zabern) affair of Nov. 1913 (*see* Alsace-Lorraine), destroyed every effect of this measure. This affair also gave rise to a vote of no confidence in the *Reichstag* against the chancellor, who himself felt "unequal to the situation." He believed, however, that he must remain in office to prevent worse things from happening—as he was to do, with some justification, after the outbreak of World War I.

Even the greatest success of Bethmann's home policy, the bill introduced in April 1913 for increasing the strength of the army, did not fully achieve its aim, namely that of reducing anxiety about Germany's international situation. Sharing the conviction that Germany was menaced by the formation of the entente between France and Great Britain, he had tried to reduce tension by diplomatic means through the Potsdam agreement with Russia (1910) and through more sustained overtures to Great Britain, which however in the end proved equally fruitless. Powerless against the emperor and Adm. Alfred von Tirpitz, he was unable, either in 1909 or on the occasion of Lord Haldane's visit in 1912, to obtain a renunciation or any essential modification of the naval program; nor could he persuade the British to diminish their obligations to the entente to any acceptable degree.

Personally without any desire for war, Bethmann in fact opened the July crisis of 1914 with the disastrous blank check to Austria-Hungary for measures against Serbia. His belated admonitions for peace to Vienna could not undo the effect of this. Once the race to mobilization had started, he capitulated helplessly to the

military experts, the rightness of whose opinions he did not venture to question, either then or after World War I had broken out. This capitulation accelerated the subordination of politics to strategy—the catastrophic consequences of which he sought to combat during the war.

It is no longer possible to maintain the view that Bethmann in World War I simply worked for a negotiated peace, without any idea of German annexations. He made more concessions to the nationalism of public opinion and to the demands of the military than was once supposed. Admittedly, it remains in doubt how far he may merely have yielded to superior pressure (particularly from 1916) in the hope that the force of events would expose the unreality of claims with which he identified himself against his will. This applies not only to the extension of German territorial claims, but also to the proclamation of the kingdom of Poland in Nov. 1916. It is nevertheless certain that he would personally have welcomed a peace based on the *status quo* as adequate, even though he could not point the way to it. He toughly resisted the advocates of unlimited U-boat warfare, as he fully recognized that the entry of the United States into the war would be decisive. It is all the more characteristic that he remained in office even after the fatal rejection of his point of view on Jan. 9, 1917.

Bethmann Hollweg also recognized the necessity of radical internal reforms, though up to the Russian Revolution of 1917 he wanted to postpone them until the end of the war. When, however, he seriously took up the struggle for electoral reform in Prussia (with the Easter message of April 7, 1917), his position not only in relation to the military high command, which was striving for dictatorship, and the Prussian conservatives but also in relation to the parties of the centre and the left became so precarious that he was unable to maintain his policy. He fell from power in the debates on the Peace resolution (July 1917), because despite the sincerity of his intentions he no longer enjoyed solid support from any quarter.

A man of missed opportunities, Bethmann's figure is none the less historically memorable and tragic because though he understood more and more fully the disastrous turn of German history, he was unable successfully to oppose it, tied as he was to tradition and to the existing state of affairs. Bethmann Hollweg died at Hohenfinow on Jan. 1, 1921. His memoirs of World War I were published as *Betrachtungen zum Weltkriege*, 2 pt. (1919–22), with Eng. trans. of pt. i, *Reflections on the World War* (1920).

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(HA. H.)

BETHNAL GREEN, a metropolitan borough (1900) of London, Eng., which under the London Government Act 1963 was joined on April 1, 1965, with Poplar and Stepney to form the new London borough of Tower Hamlets (*see* LONDON). Bethnal Green metropolitan borough had a population (1961) of 47,078 and an area of 1.2 sq.mi. It is a parliamentary constituency. Persistent in legend, play and verse, the "blind beggar of Bethnal Green" shown on the borough seal is supposed to have been Henry, son of Simon de Montfort (*q.v.*). According to history Henry was killed at the Battle of Evesham (1265) but in the legend he was rescued from the battlefield, wounded and blind, by a baron's daughter who married him. Disguised as a beggar he lived at Bethnal Green with his wife and their daughter "pretty Bessee." Her beauty attracted many suitors, supposedly far above her in rank, but at her wedding her father revealed her identity. Several fine residences at Bethnal Green included Bethnall House where Pepys' diary was lodged during the Great Fire of London (1666) and Bishop's Hall, a residence of the bishops of London for centuries. The district, one of the ancient Tower Hamlets, had its cottage silk weavers in the 17th century. During the first half of the 18th century industrialization began and by 1740 the population had reached about 15,000 (by 1847 it was 82,000).

The Bethnal Green museum (1872) is a branch of the Victoria and Albert museum, Kensington. The Regent's canal crosses the borough and there are about 100 ac. of open spaces, including 70 of Victoria park. In World War II the mother parish church, St. Matthew's (1746, rebuilt 1861), was destroyed; a temporary church was completed within its walls in 1952 and a full restoration in 1960–61. The chief industries are furniture making, tailoring and brewing. Weekday and Sunday markets, selling a wide variety of goods including pets and flowers, are a feature of the borough.

BÉTHUNE, the name of a great French family descended from the seigneurs de Béthune (in Picardy), who were *avoués* (*advocati*) of the great abbey of St. Vaast at Arras from the 11th century. By the end of the *ancien régime* its members had held the titles of ducs de Sully, de Charost, d'Orval and d'Ancenis; marquis de Rosny, de Courville and de Chabris; comte de Selles; and princes de Boisbelle and de Henrichemont. The most illustrious member of the family was Maximilien, baron de Rosny and afterward duc de Sully (*q.v.*), minister of Henry IV.

Maximilien's brother Philippe (1561–1649), comte de Selles and comte de Charost, was ambassador to Scotland, Rome, Savoy and Germany. His son Hippolyte (1603–65), comte de Selles and marquis de Chabris, bequeathed to Louis XIV a magnificent collection of historical documents and works of art. Louis de Béthune (1605–81), another son of Philippe, was created duc de Charost in 1651. The last duc de Charost was Armand Joseph (1738–1800), in the fifth generation from Louis. After serving in the army during the Seven Years' War, he retired to his estates and distinguished himself as a philanthropist and economist, trying to improve the lot of his peasants by abolishing feudal dues and introducing reforms in agriculture. Louis XV said of him, "Look at this man, his appearance is insignificant, but he has put new life into three of my provinces." His only son, Armand Louis (1770–94), marquis de Charost, was guillotined during the French Revolution.

BETHUNE, MARY McLEOD (1875–1955), U.S. educator, was born at Mayesville, S.C., on July 10, 1875. Her parents had been slaves before the American Civil War. She graduated from Scotia seminary (later Barber-Scotia college) at Concord, N.C., in 1893, and attended the Moody Bible institute in Chicago.

In 1904 she opened an institute for girls at Daytona Beach, Fla., which was merged in 1923 with Cookman institute for men, Jacksonville, Fla., to form Bethune-Cookman college at Daytona Beach. She served as president of the college until she retired in 1942 and again from 1946 to 1947.

She was director of the Division of Negro Affairs of the National Youth administration, 1936–44, and during World War II assisted the secretary of war in selecting officer candidates for the women's army auxiliary corps. She was also an observer for the U.S. state department at the founding conference of the United Nations in San Francisco, Calif. (1945). A vice-president of the National Association for the Advancement of Colored People, she received various awards for her public service. She died at Daytona Beach on May 18, 1955. For portrait *see* NEGRO, AMERICAN.

BETROTHAL. Betrothal was anciently a formal ceremony which in most cases preceded the actual marriage service, usually by a period of some weeks, but the marriage might be delayed for years. The canon law distinguished two types of betrothal: (1) *sponsalia de praesenti;* (2) *sponsalia de futuro.* The first was a true though irregular marriage and was abolished by the Council of Trent as inimical to morality. The second was a promise to marry at a future date.

The church never determined the form of the ceremony, but demanded that it should be entered into freely and at a legal age. The church further declared that females between the ages of 7 and 12, and males between 7 and 14, could be betrothed, but not married. The ill-defined laws as to betrothals tended to encourage abuses, especially in the rural districts. Betrothal consisted of the "interchange of rings—the kiss—the joining of hands, to which is to be added the testimony of witnesses." In France the presence of a priest was essential, and it was customary elsewhere for the couple to get their parish priest to witness their promise. Among the peasantry the place of rings was taken by a coin which was broken between the pair, each taking a part. But almost any

gift sufficed. Sometimes the bride-elect received a bent or crooked sixpence. At the conclusion of the ceremony it was usual for the couple to pledge each other in a cup of wine. Gifts given at betrothal could be recovered by the parties if the marriage did not take place.

The church jealously watched over the fulfillment of such contracts and punished their violation. Betrothal, validly contracted, could be dissolved either by mutual consent or by the failure to fulfill one of the conditions of the contract. But there the church stepped in to override such law as existed by decreeing that whoever, after betrothal, refused to marry *in facie ecclesiae* was liable to excommunication. In England the law was settled by an act of 1753, which enacted that an aggrieved party could obtain redress only by an action at common law for breach of promise of marriage. Among the ancient Jews betrothal was formal and as binding as marriage. Formal betrothal still retains much of its former importance on the European continent.

See also BRIDE.

BIBLIOGRAPHY.—For betrothal customs in China, the east and elsewhere, consult L. J. Miln, *Wooings and Weddings in Many Climes* (1900) and H. N. Hutchinson, *Marriage Customs in Many Lands* (1897). On early English law as to betrothals *see* Sir F. Pollock and F. W. Maitland, *History of English Law Before the Time of Edward I*, 2nd ed. (1898). *See* also R. H. Lowie, *Social Organization* (1948).

BETTER BUSINESS BUREAUS, organizations formed in the United States and Canada to protect both business and the community from unfair, misleading or fraudulent advertising and selling practices. Early in the 20th century it became clear to advertising men that fraudulent practices in advertising tended to bring advertising in general into public disfavour. They established a National Vigilance committee to police their own industry, and local communities also formed such associations.

The local organizations became known as Better Business bureaus, and co-ordinated their functions through the National Association of Better Business Bureaus, with the bureau in New York city assuming direct responsibility for problems concerned with national advertising. Though the original purpose of the organization was confined to fraudulent practices in advertising, the association later investigated misleading advertising and questionable selling practices. Better Business bureaus distribute educational literature and reports to alert the public as to methods of deceit and fraud, investigate business practices and take other action to protect the public. They promote the slogan, "Before you invest —investigate."

BETTERMENT denotes an improvement upon real property which enhances its value more than mere repairs, particularly the increased value resulting from causes for which a tenant or the public, but not the owner, is responsible. Thus, when real property acquires additional value because of some public improvement such as widening or paving a street, statutes may require that any owner of the property who derives direct pecuniary benefit from the public improvement contribute a fair proportion of the total cost through a "special assessment" imposed on the property. In the United States, statutes often provide that a bona fide occupant and claimant of real estate who in good faith makes lasting improvements, should the true owner recover it, has a lien upon the real estate and may obtain reimbursement from the owner to the extent that the improvements have increased the value of the property. (RT. K.)

BETTERTON, THOMAS (*c.* 1635–1710), leading English actor of the Restoration period and author of several adaptations which were popular in their day. He made his debut in 1660 at the Cockpit in Drury lane and in the following year was hired by Sir William Davenant for the Duke's company, which played successively at the Lincoln's Inn Fields theatre and at Dorset Garden. After the collapse of the rival King's Men, the two companies merged (1682), and the joint companies, with Betterton as the artistic leader, played at Drury Lane until 1695 when Betterton and the older players revolted against Christopher Rich, the spokesman for the patentees.

Betterton led the secession of the players who moved into Lincoln's Inn Fields theatre and later into the new Haymarket. Betterton died on April 28, 1710, survived by his widow, the former Mary Saunderson (d. 1712), an actress who had made her mark in Shakespearean parts.

Betterton's range of characters was extremely wide. He created about 130 new roles, aside from the leading parts which he played in the older dramas: Hamlet, Macbeth, Henry VIII, Mercutio, King Lear, Othello, Brutus and Hotspur.

Contemporary observers agree that Betterton used restraint in his acting. Colley Cibber, in his *Apology*, credited him with preserving a medium "between mouthing and meaning too little," and quoted the actor as having said "that there were many ways of deceiving an Audience into a loud one; but to keep them husht and quiet, was an Applause which only Truth and Merit could arrive at." Yet Betterton could turn on the full trumpet notes when occasion called for them, as in Nathaniel Lee's *Alexander*, where the "Flights of the false Sublime" had to be drowned in music by the perfect elocutionist.

BIBLIOGRAPHY.—R. W. Lowe, *Thomas Betterton* (1891); *An Apology for the Life of Mr. Colley Cibber* (1740); G. C. D. Odell, *Shakespeare From Betterton to Irving*, vol. i (1921); A. C. Sprague, *Shakespearian Players and Performances*, pp. 9–20 (on Betterton's Hamlet) (1953). (A. M. N.)

BETTI, ENRICO (1823–1892), Italian mathematician, one of the founders of the later Italian school, who counted among his pupils U. Dini, L. Bianchi and V. Volterra, was born near Pistoia on Oct. 21, 1823. He studied at Pisa university where, at the age of 34, he obtained a chair which he held until his death.

The first phase of his research was concerned with algebra and elliptic functions; in particular he extended and clarified the work of E. Galois on the theory of equations, furnishing proofs of results which had hitherto remained mere enunciations. Betti was the first to resolve integral (entire) functions of a complex variable into their primary factors, an achievement with which he is seldom credited. His later work was decisively affected by the arrival of G. F. B. Riemann at Pisa in 1863. Riemann awakened his interest in mathematical physics, in particular potential theory and elasticity; in the latter field he produced fundamental work. Riemann likewise inspired the pioneer memoir (1871) on topology, which remained neglected for 30 years; here there first appear the celebrated Betti numbers of a manifold. Betti died on Aug. 11, 1892. (L. R.)

BETTI, UGO (1892–1953), the foremost Italian playwright, after Pirandello, of the first half of the 20th century, was born at Camerino, Marche, on Feb. 4, 1892, and educated for the law. After army service in World War I, during which he was for a time a prisoner of war, he rose to a judgeship in Rome (1930) and was later appointed librarian at the ministry of justice (1944). He died in Rome on June 9, 1953.

Betti's first publication was a book of poems, *Il Re pensieroso* (1922), followed by more poems in *Canzonette—La Morte* (1932) and *Uomo e donna* (1937). He also wrote some books of short stories (1928, 1933). From *La Padrona* (1927) to *L'Aiuola bruciata* (1953) he wrote 27 plays, of which 24 were produced in his lifetime. The most important of these were *Frana allo scalo Nord* (1936), about a landslide that caused the death of some workmen and the subsequent inquiry; *Il Vento notturno* (1945); *Ispezione* (1947); *Corruzione al palazzo di giustizia* (1949), also about a judicial inquiry; *Lotta fino all'alba* (1949); *Delitto all'isola delle capre* (1950), outstanding as a treatment of passionate love and pitiless revenge; *Il Giocatore* (1951); and *La Regina e gli insorti* (1951). Chiefly concerned with problems of human responsibility and guilt, moral freedom and expiation, Betti is inclined to propose a solution in terms of Christian forgiveness and mercy. Abstract moralization, however, sometimes mars the effect of his genuinely dramatic inventiveness.

BIBLIOGRAPHY.—Ugo Betti, *Teatro* (1955), *Three Plays*, Eng. trans. by H. Reed (1958). *See* also A. Fiocco, *Ugo Betti* (1954). (F. DI.)

BETTING: *see* GAMBLING.

BETTY, WILLIAM HENRY WEST (1791–1874), English boy actor, known as "the young Roscius," was born on Sept. 13, 1791, at Shrewsbury, Eng. He first appeared on the stage at Belfast before he was 12 in an English version of Voltaire's *Zaire*. He afterward played with success in Dublin, Glasgow and Edinburgh. In 1804 when he first appeared at Covent Garden, London, troops

had to be called out to preserve order, so great was the crush to obtain admittance. At Drury Lane he played for the unprecedented salary of over 75 guineas a night. George III presented him to the queen, and William Pitt on one occasion adjourned the house of commons that members might be in time for his performance as Hamlet. In 1808 he made his final appearance as a boy actor, and entered Christ's college, Cambridge. He reappeared some years later, but the public would have none of him. He died in London on Aug. 24, 1874.

BETUL, town and district in Madhya Pradesh, India. The town is 103 mi. S.S.E. of Bhopal, the state capital. Pop. (1951) 15,563. It is the seat of a pre-university arts college affiliated to Saugar university, and is on the main central railway, Delhi-Nagpur, 65 mi. S. of Itarsi by rail, the junction of the Allahabad-Bombay line.

Betul District (3,884 sq.mi.; pop. [1961] 560,356) is on the elevated tract which divides the Narbada valley on the north from the Berar plain on the south. The northern part of the district is well wooded and resembles parkland, but the population is sparse and the cultivation poor. The central tract has the best soil in the Machna and Sampna valleys. It is well cultivated and studded with villages.

In the south lies a rolling plateau of basaltic formation forming the watershed of the Tapti (*q.v.*), Karhan, Machna and Wardha rivers. The richer soils produce wheat, pulses and some sugar cane, irrigated from wells; the poorer, oilseeds and small millets. The poorer tracts in the north are mainly inhabited by aboriginal tribes, Gonds and Korkus, but the fertile areas in the centre and south of the district are occupied by Hindu immigrants.

The climate is comparatively temperate. Forests produce bamboos, teak and other timber. Agriculture and forestry provide the population's chief employment and there are no major industries.

Twenty-five miles southeast of Betul is the town of Multai, sacred to some religious adherents because it contains a tank or pool reputed to be the source of the Tapti.

The district passed by conquest from Gond chieftains to the Marathas in 1743 and came under British rule in 1818.

(D. G. Na.)

BETULACEAE (or Corylaceae), the birch family, includes six genera and over 100 species of deciduous trees and shrubs, found predominantly in the northern hemisphere (less than 30 species occur in the United States). The simple, serrate leaves are alternate. Male and female flowers are borne on the same plant: the former are grouped in long, drooping catkins, whereas the latter are borne in short catkins or clusters. The fruit is usually a small samara. Many species of birch (*Betula*), alder (*Alnus*), hazelnut (*Corylus*), hornbeam (*Carpinus*) and hop hornbeam (*Ostrya*) are widely cultivated. Birchwood is used for lumber and the manufacture of high-grade charcoal, the bark is peeled for canoe making or for writing paper, and the twigs furnish oil of betula (similar to wintergreen). Hazelnuts are edible. The Betulaceae are also known from fossils dating from the Upper Cretaceous period (about 70,000,000 years ago).

See also Alder; Birch; Filbert; Hazel; etc. (T. K. J.)

BETWA (anc. Vetravati, "containing canes"), an unnavigable river of India, rises about 2,000 ft. above sea level in the Vindhya hills about 25 mi. S.S.E. of Bhopal, Madhya Pradesh. After a 360-mi. northeasterly course it enters the Jumna 500 ft. above sea level 7 mi. E. of Hamirpur, Uttar Pradesh. Nearly one-half its course is run over the Deccan lava plateau of Malwa (*q.v.*) before it breaks into the gneissic upland of Bundelkhand (*q.v.*) through a gap in the sandstone scarp 20 mi. S.W. of Lalitpur. The Betwa's main tributaries, on its right bank, are the Jamni, which flows into it 23 mi. S. of Jhansi, and the Dhasan, which joins it 15 mi. S. of Orai. A 60-ft. weir and a reservoir on the Betwa at Parichha, 17 mi. N.E. of Jhansi, and another weir upstream at Dukwan feed a canal system irrigating more than 200,000 ac.

BETWS-Y-COED, an urban district in the Conway parliamentary division of Caernarvonshire, Wales, at the junction of the counties of Caernarvon and Denbigh. A noted tourist resort, it lies at the head of the Vale of Conway, between its confluence with the valleys of the Llugwy and the Lledr, 24 mi. E.S.E. of Caernarvon and 21 mi. S.E. of Bangor by road. Pop. (1961) 778; Area 7 sq.mi. *Betws,* meaning "beded house," and *y coed,* "(in) the wood," describe the village's situation among the wooded slopes, rivers, and mountains bordering Snowdonia, which attract many climbers, naturalists and anglers. There are numerous trout streams and the Conway abounds in salmon. From David Cox onward artists have added to the reputation of Betws. The seldom used old parish church of St. Michael contains an effigy in armour of Gryffyd ap Dafydd Goch, of the princely house of Llewelyn. West of the village is the winter residence of Rhys Gethin, a 15th-century Welsh knight who campaigned against the English.

The stone Bridge of the Cauldron (Pont-y-Pair), sometimes attributed to Inigo Jones, is separated by rapids and falls from Fir Tree Island. Waterloo bridge, built in 1815 to commemorate the battle, was one of the first iron bridges to be built. To the north of this, past the narrow wooded gorge called Fairy glen, are the Conway and Machno falls. The Swallow falls are 2 mi. W. along the Llugwy. Betws is connected by rail with Chester. Slate, from which the local cottages are tiled, is quarried in the neighbourhood. Most of the male population is employed in forestry.

BEUEL, a town of Germany which after partition of the nation following World War II was in the *Land* (state) of North Rhine-Westphalia, Federal Republic of Germany. It lies on the east bank of the Rhine opposite Bonn and is on the railway from Cologne to Frankfurt. Pop. (1959 est.) 31,447. It was formerly a small town, but has grown rapidly since the construction of the bridge over the Rhine in 1896–98 (destroyed in World War II and replaced in 1949). The church of Schwarz-Rheindorf, originally consecrated in 1151 and restored in 1902–04, is one of the most notable Romanesque buildings in Germany, not only for the peculiarity of its two-storied construction but also for the wealth of its 12th-century mural decoration. The town has textile, chemical, wood and paper industries.

BEUST, FRIEDRICH FERDINAND, Graf von (1809–1886), Saxon and later Austrian statesman and chief author of the Austro-Hungarian compromise of 1867, was born in Dresden on Jan. 13, 1809. Entering the Saxon diplomatic service in 1830, Beust became resident minister in London (1846) and ambassador in Berlin (1848). In 1849 he became the Saxon foreign minister. Having called in Prussian troops to suppress the popular risings of May, he negotiated the alliance of Saxony, Prussia and Hanover (*Dreikönigsbündnis*) later the same month. In 1850, however, he supported Austrian attempts to dissolve the Prussian union. As minister of the interior from 1853 he promoted the rapid economic development of Saxony. In 1863 Beust again supported Austria in its plans for federal constitutional reform and in 1864 he advocated the union of the middle German states.

In the Austro-Prussian War of 1866 Beust allied Saxony with Austria, but after the defeat of Königgrätz (Sadowa) he left the country and, at the invitation of the emperor Francis Joseph, became foreign minister of Austria. In Feb. 1867 Beust succeeded Graf Richard Belcredi as first minister, becoming the imperial chancellor of Austria-Hungary. His aim was the humiliation of Prussia which he hoped would result from the growing tension between Prussia and France.

Between Oct. and Dec. 1867, Beust concluded the compromise between Austria and Hungary, whereby he not only surrendered the Slav populations in Hungary to Magyar rule but also gave the Hungarians a considerable say in Austrian foreign affairs. In the western half of the empire Beust's attempts to establish German ascendancy only embittered the Czechs.

Beust was forced to resign as foreign minister on Oct. 16, 1871. After being Austrian ambassador first in London and then in Paris (1878), he retired in 1882 and died at Schloss Altenberg near Vienna on Oct. 24, 1886. An English edition of his memoirs, *Memoirs of Friedrich Ferdinand Count von Beust,* was published in 1887. In foreign affairs Beust was a statesman of the first rank, but as a foreigner he was ill-equipped to master the racial problems of Austria-Hungary and was hardly aware of the fatal errors of his Slav policy.

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in Jahre 1870 (1927); H. von Srbik, *Deutsche Einheit*, vol. ii–iv (1935–42); L. Eisemann, *Le Compromis Austro-Hongrois de 1867* (1904); E. Grob, *Beusts Kampf gegen Bismarck* (1930). (K. O. V. A.)

BEVAN, ANEURIN (1897–1960), British statesman, the most controversial figure in British politics in the first decade after World War II, is chiefly remembered as the architect of the national health service and for his subsequent leadership of the "Bevanite" group within the Labour party. Born at Tredegar, Monmouthshire, on Nov. 15, 1897, the son of a coal miner, he entered mining himself in 1910 but had to leave the mines after a few years because of eye disease. He became an active trade unionist and, after two years at the Central Labour college and a short apprenticeship in local politics, was elected to the house of commons in 1929 as Labour member for Ebbw Vale. In 1934 he married another Socialist, Jennie Lee, who had also first been elected to parliament in 1929. Initially active in parliament on mining affairs, Bevan's later association with Sir Stafford Cripps's British united front movement led to his expulsion from the Labour party in March 1939. He was readmitted in Dec. 1939 and was an active critic of the government throughout World War II.

As minister of health in C. R. Attlee's postwar Labour governments, Bevan was responsible for housing and for formulating and introducing the national health service. The health service, which brought him into conflict with the medical profession, remained of great personal concern to Bevan even after he had moved to the ministry of labour in Jan. 1951, and the cabinet's agreement to authorize charges for certain of the health service facilities was one of the reasons for his resignation from the government in April that year. For the next few years Bevan was the centre of considerable controversy within the Labour party. He gained great support for his point of view from the constituency parties and involuntarily gave his name to the party's left-wing "Bevanite" group, whose opinions were expressed in the London weekly *Tribune*, of which Bevan himself had been editor from 1940 to 1945. In successive years, 1954 and 1955, he unsuccessfully contested Hugh Gaitskell's election as Labour party treasurer and, after Attlee's resignation in Dec. 1955, he was also defeated by Gaitskell in the election of party leader. Thereafter Bevan accepted official Labour party policy, losing the support of many of his former followers on the party's left wing. He was made Labour spokesman first on colonial affairs and, later, on foreign policy. His speeches became more statesmanlike and he himself mellower. After the general election in 1959, he was elected deputy leader of the party, but soon afterward he became fatally ill. He died at Chesham, Buckinghamshire, on July 6, 1960.

A fighter and a man of political principle and courage, Bevan was a colourful public personality and a scintillating and spontaneous debater. Although he could at times be so rude to his political opponents that he once evoked from Winston Churchill the rebuke that he was a "merchant of discourtesy," he was nevertheless possessed of great personal charm, wit and brilliance. Bevan's autobiography, *In Place of Fear*, was published in 1952.

(E. A. J. D.)

BEVERIDGE, ALBERT JEREMIAH (1862–1927), U.S. senator, orator and scholar, was born in Highland county, O., on Oct. 6, 1862. He graduated from De Pauw university, and in 1887 began the practice of law in Indianapolis. By 1898 he had built a reputation as a lawyer and had attracted attention as an orator in Republican campaigns. He was elected to the U.S. senate in 1899. After a tour of the far east, Beveridge took office and was a stalwart partisan. He toured Russia and Manchuria in 1901 and afterward published a book, *The Russian Advance* (1903). As a senator from 1899 to 1911, Beveridge supported President Theodore Roosevelt in his efforts to regulate trusts. He drafted the federal meat inspection bill and battled for a child labour act. During the Taft administration he joined the insurgents and was keynote speaker at the Progressive party convention (1912). Beveridge was nominated for governor of Indiana but was defeated. He was the Progressive party candidate for senator in 1914, but failed of election and became disillusioned with the collapse of the Progressive party. After visiting the warring countries of Europe in 1914, he published his book *What Is Back of the War* (1915), which was later denounced as pro-German. He opposed U.S. participation in the League of Nations. In 1922 he won the Republican nomination for senator, but again lost. Between campaigns he worked on his biography of John Marshall. When published in four volumes (1916–19) it was widely acclaimed as an outstanding work. He died in Indianapolis, April 27, 1927, while working on a biography of Abraham Lincoln, two volumes of which were published posthumously.

See Claude G. Bowers, *Beveridge and the Progressive Era* (1932).

(H. F. Tr.)

BEVERIDGE, WILLIAM HENRY BEVERIDGE, 1ST BARON, OF TUGGAL (1879–1963), British economist and academic administrator who profoundly influenced British social services through his report on *Social Insurance and Allied Services* (1942), known as the Beveridge report. Beveridge was born at Rangpur, India, on March 5, 1879. After a brilliant career at Oxford, at the age of 24 he was appointed subwarden of Toynbee hall, a London settlement house, where his lifelong interest in the causes and cure of unemployment began. *Unemployment: a Problem of Industry* (1909) revealed the extent to which this was due to the organization of industries. His revised views appeared in the full-scale study, *Full Employment in a Free Society* (1944), strongly influenced by Keynesian economics.

Beveridge was director of labour exchanges (1909–16) and permanent secretary of the ministry of food (1919). In 1919 he became director of the London School of Economics and Political Science and served until 1937 when he was elected master of University college, Oxford. He was prominent in several spheres of public service and served on the Royal Commission on the Coal Industry (1925) and on various committees. Beveridge's crowning achievement came in World War II when, at the invitation of the government, he worked out the blueprints of the new welfare state. Knighted in 1919, he was created a baron in 1946. Beveridge died at Oxford, March 16, 1963.

Beveridge's other works include *Insurance for All* (1924), *British Food Control* (1928), *Planning Under Socialism* (1936), *Pillars of Security* (1943), *The Price of Peace* (1945), *Voluntary Action* (1948), *Power and Influence* (1953), and *A Defence of Free Learning* (1959). (B. Th.)

BEVERLEY, a municipal borough and market town in the East Riding of Yorkshire (of which it is the county town), Eng., lies in the level country east of the Yorkshire wolds, 8 mi. N.N.W. of Hull by road. Pop. (1961) 16,024. Area 3.8 sq.mi. (one-half consisting of common pastures). The town owed its early importance to a religious house founded and dedicated to St. John the Evangelist by John of Beverley (640–721), who became archbishop of York in 705, was canonized in 1037 and who became the patron saint of Beverley. Destroyed by the Danes in 866, the monastery was refounded and rededicated to St. John of Beverley by King Aethelstan as a college of secular canons, with the right of sanctuary for a mile in every direction from the minster, which still contains the fridstool (sanctuary chair). The college was dissolved in 1547. Beverley minster is a building as large as many cathedrals: the west front and slender towers are pure Perpendicular; the nave is Decorated, as is the magnificent Percy tomb; the transepts are Early English.

The first of many charters was granted to the town in 1129, that of incorporation in 1573 and the last by James II. Beverley, a large market centre, was granted three fairs and holds two weekly markets. The cattle market is held in Norwood and the general market in Saturday Market, where there is a fine market cross (1714). Of the five "bars" through which admission was formerly gained to the town only the North Bar (1409) remains, and in North Bar Within is the parish church of St. Mary, a splendid cruciform building chiefly Decorated and Perpendicular. There is a museum, an art gallery and a technical institute; the grammar school was founded in 721. Saint John Fisher (*q.v.*), the martyr, was born at Beverley.

Beverley lies on the main railway line from Hull to York and from 1344 it has been connected by a canal (the Beck) with the river Hull, 1 mi. W., and then with the Humber. Cloth manufacture, Beverley's chief medieval industry, had, by mid-20th century,

been superseded by shipbuilding (especially deep-sea trawlers), tanning, gelatin and the manufacture of railway and automobile accessories.

BEVERLY, a city of Essex county, Mass., U.S., 18 mi. N. of Boston on the Atlantic ocean. Beverly is a small manufacturing and residential city. (For comparative population figures *see* table in MASSACHUSETTS: *Population.*) More than half of Beverly's labour force is engaged in manufacturing. Machinery making is the city's largest industry. Leather industries are also important.

Beverly was settled in 1626, incorporated as a separate township in 1668, and as a city in 1894. Beverly was first occupied by settlers from nearby Salem, and the town rapidly became a fishing centre and later an important colonial port. The first ship to become part of the U.S. navy, the "Hannah," was commissioned there in 1775. After the American Revolution, Beverly gained even greater stature in foreign trade, but this was largely lost during the War of 1812.

Pride's Crossing and Beverly Farms are two well-known residential sections of Beverly, where large estates front upon a coast line of rocky headlands and sandy beaches. (G. K. L.)

BEVERLY HILLS, a residential city of Los Angeles county, Calif., U.S., completely surrounded by the city of Los Angeles (*q.v.*). As a city of homes, it is famous throughout the western portion of the United States. Attractive residences form the chief architecture of the city. Industrial development has been greatly restricted, only light industry being permitted; these consist, primarily, of electronics enterprises. The downtown area contains numerous shops, a large number of which sell luxury clothing.

Beverly Hills developed as an urban community entirely in the 20th century. During Spanish, Mexican and early American times, it was part of a ranch owned by Maria Rita Valdez de Villa. Between 1854 and 1906 the land was used for a variety of agricultural purposes. In 1906 it was acquired by a land and water company for development, and given its present name. At the same time, rigid zoning regulations were established for the development of a residential community.

With only 674 inhabitants, Beverly Hills was incorporated as a city in 1914. The population increased 2500% from 1922 to 1930 with the boom in the motion-picture industry. For comparative population figures *see* table in CALIFORNIA: *Population.* (J. M. Wo.)

BEVERWIJK, an industrial town of North Holland province, Neth., to the north of the North Sea canal, is on the eastern fringe of the coastal sand dunes where they level off to the dead-flat landscape of northern Holland. It is north of IJmuiden and 24 km. (15 mi.) W.N.W. by road of Amsterdam. Pop. (1957 est.) 32,544 mun. In the early 1960s the town was being developed from an agricultural centre into a residential and shopping town for the IJmond furnace and steelworks area. Except for its churches and its town hall, Beverwijk has few buildings of historical interest. The community includes Wijk aan Zee, a growing seaside resort with a fine sandy beach. Manufactures include freight cars, chemicals and lubricating oil. Engineering and iron and steel plants are located there. Vegetables, flowers and strawberries are exported. (P. v. D. E.)

BEVIN, ERNEST (1881–1951), British trade unionist and statesman, who was one of the most prominent leaders of the British Labour movement during the first half of the 20th century and is especially remembered for his tenure of the foreign office from 1945 to 1951, was born at Winsford in Somerset on March 7, 1881. Brought up in poverty and orphaned at the age of 8, he left school when he was 11 and began work on a farm. He moved in 1894 to Bristol, where he eventually found regular employment driving a horse and cart on a mineral-water delivery route.

Like many other trade union leaders, Bevin graduated into the Socialist movement from a Nonconformist upbringing. He formed a carters' branch of the Dockers' union in Bristol in 1910 and by the end of World War I had become the union's assistant general secretary (though the post was not actually created for him until May 1920). He stood, unsuccessfully, as Labour candidate for Bristol Central in the general election of 1918. His reputation as the most forceful and able of the younger trade union leaders was made in 1920 by his presentation of the dockers' case for a guaranteed wage before Lord Shaw's court of inquiry (this won him the title "the dockers' K.C.") and by the part he played in organizing the council of action which threatened widespread strikes if the British government intervened in the war between Poland and the U.S.S.R. In 1921 he persuaded the transport unions to amalgamate, and set up the Transport and General Workers' union, of which he became general secretary and which subsequently grew to be the largest trade union in the world.

As the dockers' leader, Bevin was in the thick of the labour troubles which marked the early 1920s in Great Britain. He became a member of the general council of the Trades Union congress (T.U.C.) in 1925 and was responsible for the improvised organization which carried through the general strike of 1926. When the failure of the strike sapped the militant spirit of the trade unions, Bevin took the lead in persuading the T.U.C. not to fall back on routine wage negotiations but to form and express a trade union policy on the major economic issues facing the country. He played a leading part in the Mond-Turner talks between the two sides of industry (1928–29) and in setting up the economic committee of the T.U.C. general council (1929). In the same spirit, he accepted an invitation to serve on the Macmillan Committee on Finance and Industry (1930) and impressed its members, including John Maynard Keynes, by his grasp of economic and financial problems.

Bevin was critical of the second Labour government's failure to adopt radical measures to deal with the mounting unemployment of the depression years and refused to support James Ramsay MacDonald's "national" government formed in 1931. The uncompromising opposition of the T.U.C. led by Bevin and the general secretary Walter Citrine steadied the badly split Labour party and Bevin agreed, under persuasion from Arthur Henderson, to stand for Gateshead at the election of 1931. His defeat did not weaken his conviction of the need for trade unions to draw closer to the Labour party, and as a member of the National Council of Labour he used all his influence in persuading the Labour party to adopt what he considered a more realistic foreign and defense policy in face of the threat from Hitler and Mussolini.

Bevin's approach to international affairs was highly practical and he played a major role in the International Transport Workers' federation and the International Labour office. Among the groups of workers for the improvement of whose conditions of work he fought a series of unremitting battles were the dockers, road transport workers and the seamen, and with his election as chairman of the T.U.C. general council in 1937 his position as the outstanding trade union leader of his generation was widely recognized.

Bevin had refused any suggestions that he should enter parliament after 1931 and was planning to retire at the age of 60. When Winston Churchill formed his coalition government in May 1940, however, he at once called on Bevin to assume responsibility for the mobilization of the nation's manpower as minister of labour and national service. Bevin was found a seat in the house of commons as member of parliament for Central Wandsworth and was soon invited by Churchill to join the inner war cabinet. No minister played a greater part in organizing the country's resources to win the war. Under Bevin's direction, Great Britain most effectively mobilized men and women for the armed forces and war industry.

When C. R. Attlee formed his Labour government in 1945, Bevin was appointed foreign secretary. Establishing relations of confidence with the United States, he gave a strong lead in building up the framework within which western Europe was enabled to maintain its independence and recover its prosperity. The major stages in this policy were, in 1948, the Brussels treaty, the Berlin airlift, the Organization for European Economic Cooperation and, in 1949, the establishment of the North Atlantic Treaty organization, which Bevin regarded as his greatest triumph. Outside Europe, which was then the main theatre of the cold war, and the Atlantic alliance, Bevin was less successful. His efforts to find a new basis

for Great Britain's relations with the middle east countries broke down in face of the Arab-Israeli conflict and involved Bevin in a bitter dispute with the Zionists. In his last year of office, however, he was able to give expression to his plans to help the underdeveloped countries by setting up the Colombo plan for southeast Asia.

Ill-health forced Bevin's resignation on March 9, 1951. He remained in the cabinet as lord privy seal, but he died in London on April 14, 1951.

Bevin was a man whose massive self-confidence and forceful personality inevitably created strong likes and dislikes. Unembarrassed by his humble origins or his lack of formal education, he was completely himself in any surroundings and rarely failed to impress by his natural intelligence and a power of judgment and foresight which drew on his rich experience of men and affairs. A controversial figure throughout his career, he showed unswerving loyalty to the working class, but won the respect and admiration of his political opponents by his courage and largeness of mind.

See Francis Williams, *Ernest Bevin* (1952); Alan Bullock, *The Life and Times of Ernest Bevin,* vol. i, *Trade Union Leader, 1881–1940* (1960). (A. Bk.)

BEWICK, THOMAS (1753–1828), English engraver, credited with the revival of the art of wood engraving in England, was born at Cherryburn, Northumberland, Aug. 12, 1753. His master (later his partner) was Ralph Beilby, an engraver who did much work for the Newcastle silversmiths. Bewick continued engraving on plate even after he had successfully taken up more rewarding kinds of work, but his most remarkable talents were displayed as a wood engraver, especially in little vignettes of an unaffected rusticity, and in his illustrations of birds and animals. He published several illustrated works of a popular character. His *General History of Quadrupeds* appeared in 1790, and while working on this he engraved the large and celebrated block of "The Chillingham Bull." His most famous publication was *History of British Birds* (vol. I, *Land Birds,* 1797; vol. II, *Water Birds,* 1804); this ran to many editions. The British museum and the Hancock museum, Newcastle upon Tyne, possess many fine water-colour studies for this work. Among his other works are illustrations for Oliver Goldsmith's *The Traveller* and *The Deserted Village,* Thomas Parnell's *The Hermit* and William Somervile's *The Chase.* Bewick died at Gateshead, Durham, Nov. 8, 1828. *See* Woodcut and Wood Engraving.

Bibliography.—Jane Bewick (ed.), *Memoir of Thomas Bewick Written by Himself, 1822–1828* (1862), with introduction by S. Image (1924); D. C. Thomson, *Life and Works of Bewick* (1882) and *Water Colour Drawings of Thomas Bewick* (1930); G. Reynolds, *Thomas Bewick: A Résumé of His Life and Work* (1949); S. Roscoe, *Thomas Bewick* (1953). (R. E. W. J.)

BEXHILL, a seaside town and municipal borough (1902) in the Rye parliamentary division of East Sussex, Eng., 4½ mi. W. of Hastings, on the English channel. Pop. (1961) 28,941. Area 12.5 sq.mi. The residential and resort area dates from the 1880s, but the old village, built around its Norman and Early English parish church of St. Peter founded in the 8th century, lies ½ mi. inland up on the cliff that rises steeply behind it. Though damaged by air raids in World War II, Bexhill flourishes again; by the De la Warr pavilion (1935) is the centre of the town's social life. It has parks and gardens, a bracing climate, and sand is uncovered at low tide along the whole of the 5 mi. of coast line within the borough. There are many boarding schools in the area.

BEXLEY, NICHOLAS VANSITTART, 1st Baron (1766–1851), English politician, was a friend of Henry Addington, Viscount Sidmouth, to whom he owed his political advancement and especially his appointment as chancellor of the exchequer (1812–23). Born in London on April 29, 1766, the fifth son of Henry Vansittart (1732–70), governor of Bengal from 1760 to 1764, he was educated at Christ Church, Oxford, and was called to the bar in 1791. Pamphlets which he wrote between 1793 and 1795 in defense of the government's financial and war policy brought him to the notice of William Pitt, and in 1796 he was provided with a seat in parliament.

At first a follower of Pitt, Vansittart attached himself to Henry Addington in 1801, when he was appointed joint secretary of the treasury, an office which he held until Addington's resignation in May 1804. When, in Jan. 1805, Addington joined Pitt's last ministry, Vansittart was given the Irish secretaryship, but resigned it in September after Lord Sidmouth (as Addington had become) had retired. In the ministry "of all the talents" (Feb. 1806–March 1807) Vansittart was again secretary of the treasury. He was out of office from 1807 to 1812, loyalty to Sidmouth, to whom no offer was made, causing him to reject Spencer Perceval's invitation to take the chancellorship of the exchequer in Oct. 1809. He held that office, however, under Lord Liverpool, from May 1812 to the beginning of 1823.

His abilities, though perhaps more considerable than he has generally been given credit for, hardly rose above mediocrity. After peace returned in 1815, he made himself increasingly unpopular by refusing to cut down expenditure and taxation to a degree which public opinion demanded, but the government survived its defeat on a vital question of finance in 1816—being compelled to abolish the income tax, the sheet anchor of the budget. His own colleagues recognized his financial incapacity but, as the duke of Wellington once remarked, it was much easier to put a man into the cabinet than to turn him out. It is significant that Sidmouth's resignation of the home department (Dec. 1821) was soon followed by Vansittart's departure from the exchequer. He retained his seat in the cabinet, and was given the chancellorship of the duchy of Lancaster and a peerage. He remained in office under George Canning and Lord Goderich (April 1827–Jan. 1828), but Wellington had no use for him and his official career came to an end in 1828. A devout Tory evangelical, he was opposed to Catholic emancipation, and he voted against the Relief bill in 1829. Three years later he was a die-hard opponent of the Reform bill. Bexley died on Feb. 8, 1851.

See Elie Halévy, *History of the English People in the Nineteenth Century,* Eng. trans. by E. I. Watkin, vol. i and ii, 2nd ed. (1949–52). (A. Al.)

BEXLEY, a municipal borough (1937) of Kent, Eng., which under the London Government Act 1963 was amalgamated on April 1, 1965, with Erith, Crayford, and the northern part of Chislehurst and Sidcup to form the new London borough of Bexley (*see* London). Bexley municipal borough is 14 mi. ESE of London Bridge. Pop. (1961) 89,550. Area 7.6 sq.mi. Bexley is a parliamentary constituency. Bixle in the 8th century and Bix in Domesday Book, the town is on the River Cray and on the London-Dover Road (Watling Street). It is a residential area with a few light industries. In the surrounding woods are deneholes—ancient excavations with circular shafts leading to chambers in the shape of a trefoil. St. Mary's parish church dates from the 13th century. The biggest of many open spaces are those of Danson Park (210 ac.) and Hall Place (161.5 ac.), each with a mansion. William Morris (*q.v.*) lived for five years in the Red House which he built at Bexley Heath.

BEY, the modern Turkish spelling of a title found in various forms (*beg, big, biy,* and the feminine *begam*) among Turkish peoples from the earliest times. It was given to rulers of small tribal groups, to members of ruling families and to important officials. Under the Ottoman empire a bey was the ruler of a province, distinguished by his own flag (*sanjak, liwa*), but only in Tunis after 1705 did the title become hereditary. Later the word depreciated into a general title of respect, added after a personal name and equivalent to "esquire" (or "sir" in conversation). Under the Turkish republic, bey, though surviving in polite conversation, was replaced by *bay* before the name (equivalent to "Mr."). (A. D. A.)

BEYERS, CHRISTIAAN FREDERIK (1869–1914), South African general, prominent during the South African War and a leader of the rebellion in 1914, was born in the Cape Colony on Sept. 23, 1869, and educated at Victoria college (later Stellenbosch university). In 1889 he went to the Transvaal, where he qualified and practised as a lawyer. His military ability earned him rapid promotion during the South African War. In Sept. 1900 he was made a general and commanded the Boer forces in the northern Transvaal. After the conclusion of peace (1902) he entered politics and was elected to the head committee of Louis Botha's

Transvaal party, *Het Volk* ("The People"), in May 1904. Beyers subsequently opposed Botha's policy of conciliating the British as being inimical to Afrikaner national interests. After the election under responsible government in 1907, Botha excluded Beyers from his cabinet and had him elected speaker of the legislative assembly. As speaker Beyers, competent and impartial, won the confidence of all, but despite Botha's support in 1910 he failed to become speaker in the first parliament of the Union. Under the defense act of 1912, Beyers became commandant-general of the Union defense force. On the outbreak of war in 1914 he opposed the cabinet's accession to the British request to conquer German South-West Africa. After parliament had endorsed the cabinet's decision, Beyers resigned (Sept. 15, 1914). From this point he drifted reluctantly into armed protest and so became involved in the rebellion. His reputation as a patriot and a religious man brought to his side many Transvaal Boers who believed (erroneously) that Botha and J. C. Smuts had wished to commandeer them to fight in South-West Africa. Following abortive negotiations and some skirmishing, his forces were broken up in the Orange Free State and Beyers himself, in trying to escape across the Vaal river, was drowned on Dec. 8, 1914. (N. G. Ga.)

BEYLE, MARIE HENRI: *see* STENDHAL.

BEZA, THEODORE (THEODORUS BEZA, THÉODORE DE BÈZE) (1519–1605), French Protestant theologian, heir of John Calvin in Geneva, was born June 24, 1519, at Vézelay, Burgundy, the son of a lawyer and bailiff, Pierre de Bèze, and Marie Bourdelot, of noble family. An uncle, Nicholas, counsellor of the Paris *parlement*, placed him under the learned Melchior Wolmar, who had taught Calvin Greek, at Orléans, then at Bourges. The young Beza studied law in Orléans (1535–39) and thereafter began practice in Paris, where, among fashionable friends, he published *Juvenilia*, containing amorous verses later embarrassing to him. After a severe illness he "renewed a vow to serve God openly in his true church," married Claudine Denosse and in 1548 traveled to Geneva to join Calvin. As Greek professor in Lausanne, he aided Calvin's reform and defended him in the case of the burning of Michael Servetus (*q.v.*) in *De Haereticis a civili magistratu puniendis* (1554). In 1559 Beza became rector of the new Geneva academy, a post from which he became after Calvin's death (1564) one of the leading educators, theologians and statesmen of the Reform in Europe.

Like Calvin a devotee of classical studies, but unlike him an Aristotelian in theological method, Beza contributed to the development of Aristotelian structures in the scholastic Reformed theology of the following century. Opposing his former student, Jacobus Arminius, he elaborated supralapsarian predestination; *i.e.*, that God decreed salvation "before" he decreed man's sin. Numerous influential theological and polemical treatises and philological studies came from his pen. His Greek editions and Latin translations of the New Testament were basic to Protestant students for two centuries, and lay behind both the Geneva and the King James bibles. His sermons and commentaries were widely read in his lifetime, and the famous Codex Bezae (D) was presented by him to Cambridge university (*see* BIBLE: *Text of the New Testament*). The writing *De jure magistratum* (1574) defending the right of revolt against tyranny led by inferior magistrates appeared in the wake of the St. Bartholomew's day massacre and became a major political manifesto of Calvinism. Beza died Oct. 13, 1605.

See *Theodori Bezae Opera*, Tome i–iii (1582); P. F. Geisendorf, *Théodore de Bèze* (1949). (E. A. Dy.)

BEZANT (BYZANT), a Byzantine gold coin (known also as a solidus) which had a wide circulation throughout Europe up to about 1250. (*See* MONEY, MEDIEVAL.) Bezants were also issued in Flanders and Spain. Silver bezants, in value from one to two shillings, were in circulation in England in the 13th and 14th centuries. In Wycliffe's translation of the Bible he uses the word for a "talent" (*e.g.*, in Luke xv, 8). In heraldry, bezants are represented by gold circles on the shield, and were introduced by the crusaders. In architecture a bezant is a flat disk used for ornamentation.

BEZBORODKO, ALEKSANDR ANDREEVICH, PRINCE (1747–1799), Russian statesman, foreign minister under the empress Catherine II and grand chancellor of the empire under Paul I, was born at Glukhovo in the Ukraine on March 25 (new style; March 14, old style), 1747, and educated at home and in the clerical academy in Kiev. He accompanied Count P. A. Rumyantsev to the Turkish War in 1768, and was present at the engagements of Larga and Kagul and at the storming of Silistria. Rumyantsev recommended him to Catherine II, and in 1775 she appointed him her secretary of petitions. In 1780 he accompanied her on her journey through Belorussia. On his return from a mission to Copenhagen, he presented to the empress "a memorial on political affairs," which comprised the first plan of a partition of Turkey between Russia and Austria. This document was transmitted almost word for word to Vienna as the Russian proposals. He followed this up with "Epitomized Historical Information Concerning Moldavia." For these two state papers he was rewarded with the posts of "plenipotentiary for all negotiations" in the foreign office and postmaster general. From this time he was inseparably associated with Catherine in all important diplomatic affairs, though officially he was the subordinate of the vice-chancellor, Count A. A. Osterman. He wrote dispatches to the Russian ministers abroad, concluded all treaties and performed all the functions of a secretary of state. He identified himself with Catherine's political ideas, even with that of re-establishing the Byzantine empire under her grandson Constantine. In 1786 he was promoted to the senate and it was through him that the empress communicated her will to it. In 1787 he accompanied Catherine on her triumphal progress through the Ukraine in the capacity of minister of foreign affairs. On his return from concluding the peace of Jassy (Iaşi) (1792) he found his post of secretary of petitions occupied by the empress's last favourite, P. A. Zubov. He complained of this to the empress in a private memorial in 1793. Subsequently Catherine reconciled him with Zubov and he resumed the conduct of foreign affairs. It was he who advised her on the engineering of the second and third partitions of Poland.

On Catherine's death, the emperor Paul entrusted Bezborodko with the examination of her private papers and shortly afterward made him a prince of the Russian empire, with a correspondingly splendid appanage. On Osterman's retirement Bezborodko received the highest dignity in the Russian empire—that of imperial chancellor. He was the only Russian minister who retained Paul's favour to the last. During the last two years of Bezborodko's life the control of Russia's diplomacy was entirely in his hands. His program was peace with all the European powers, revolutionary France included. The emperor's growing aversion to this policy induced the old minister to try to "seek safety in moral and physical repose." Paul refused to accept his resignation. Bezborodko died in St. Petersburg on April 17 (N.S.; April 6, O.S.), 1799.

See N. 1. Grigorovich, *Kantsler Knyaz A. A. Bezborodko v svyazi s sobytiyami ego vremeni* ("The Chancellor Prince A. A. Bezborodko in Connection With the Events of His Time"), 2 vol. (1879–81). (R. N. B.; Lo. L.)

BÉZIERS, a town of southern France, is 76 km. (47 mi.) S.W. of Montpellier and 14½ km. (9 mi.) inland from Valras, the nearest seaside resort, in the *département* of Hérault. Pop. (1954) 58,814. Béziers is the capital of an *arrondissement*, the seat of a subprefect, and has tribunals of first instance. It lies in the great vine-growing district of Languedoc and is one of its chief wine markets. The old, once walled, town occupies a hilly site overlooking the left bank of the Orb river, which is there intersected by the Canal du Midi, or Languedoc canal. Béziers (Besara) was a Roman colony. The early medieval town and cathedral were destroyed with accompanying massacre in 1209 by Simon de Montfort during the crusade against the Albigenses. The walls were rebuilt in 1289, but the town again suffered severely during the wars of the 16th century, and all its fortifications were destroyed in 1632. The Allée Paul Riquet separates the old town (west) from the modern extension. In its centre is a statue of Riquet, builder of the canal (1666–81), who was born in Béziers. At its southern end, before the railway station, is the public garden, the Plateau des Poètes, so called because of its numerous busts of Languedoc poets and writers. The former cathedral church of St. Nazaire, dom-

inating the old town, is a good example of the ecclesiastical fortification common in southern France. The Romanesque church of St. Jacques is also noteworthy, and there are remains of a Roman arena. The main road and railway, as well as the Canal du Midi, cross the Orb at Béziers. Associated with its commercial role in the Languedoc vine-growing country, its industries are alcohol distilling, artificial fertilizers and chemicals for treating the vines.

(Ar. E. S.)

BEZIQUE, a game of cards of French origin. Earlier games incorporating similar principles, such as *mariage* and *brusquembille*, were played in France in the 17th century or before. Bezique suddenly became popular in Paris in 1860 and in London in 1868. A Swedish and German form of bezique, now called pinochle (*q.v.*), became and remained one of the games most widely played in the United States, while several other developments of bezique —rubicon bezique and six-pack or Chinese bezique—grew to equivalent popularity in England and France. The etymology of the term is conjectural but is most often attributed to the Spanish *besico*, "little kiss," a supposed allusion to the "little marriage" of the spade queen and diamond knave.

The Original Game.—Two players use a 64-card pack consisting of two 32-card packs shuffled together, so that there are duplicates of A, 10, K, Q, J, 9, 8, 7, of each suit, the cards ranking downward in that order. Each player receives eight cards, dealt three, two and three at a time. The next card is turned up to determine the trump suit, and the remainder of the pack is placed face down so as partly to cover the trump card, these cards being the stock. The objects of the game are to win tricks containing aces and tens (brisques), which score 10 each; to win the last trick, which scores 10; and to declare certain combinations, as follows:

Royal marriage (K-Q of trumps)	40
Marriage (any other K-Q in the same suit)	20
Bezique (♠Q and ♢J)	40
Double bezique	500
Sequence (A-10-K-Q-J of trumps)	250
Any four aces	100
Any four kings	80
Any four queens	60
Any four knaves	40

Any seven of trumps counts 10 for dealer if turned as trump; and either player holding a seven of trumps may, upon winning a trick, either exchange it for the trump card or merely declare it, and score 10.

The play.—Each trick consists of a card led by one player and a card played by the other. Nondealer leads first. The card led loses to a higher-ranking card of the same suit or to a trump, but wins otherwise. After each trick, each player draws a card from the top of the stock to restore his hand to eight cards, the winner of the trick drawing first. Until the stock is exhausted, it is not necessary to follow suit; thereafter, a player must follow suit to the card led if he can, and must win the trick if he can.

Declaring.—The winner of each trick, before drawing from the stock, may declare and score any of the combinations listed above. Such cards are placed face up on the table in front of the player, but are available for play as though they were still in his hand. The following rules govern declaring:

No card may be counted twice as part of the same declaration (having declared four queens, one must have four different queens to declare the same combination again). A royal marriage may be declared and then the A-J-10 added for a sequence, but a king or queen once used in a sequence may not thereafter be used in a marriage. One bezique may be declared for 40 and another added later for 500, but if both are declared at once they count only 500. Two combinations may be declared in a turn, but no more than one may be scored; for example, with ♠Q already on the table, one may put down four kings, scoring 80 and saying "Twenty to score" (for the ♠K-Q), and the 20 may be scored when next that player wins a trick. There may be no declaring when only two cards remain in the stock, or thereafter.

Scores are usually recorded on special bezique markers, but counters or chips may be used. Declarations are recorded as scored, and brisques are added after play ends. The first player to reach 1,000 points wins the game. Some play that he wins a rubicon (a double game, or the combined points of both players) if his opponent has less than 500.

Rubicon Bezique.—This form of the game had virtually replaced the original game by 1910. Four 32-card packs are used, and each player receives nine cards. No trump is turned; the first marriage declared establishes the trump. If a sequence is declared before a marriage, it establishes the trump. In addition to the declarations listed above, the following are scored:

Back door (sequence, not in trumps)	150
Triple bezique	1,500
Quadruple bezique	4,500

The last trick counts 50 instead of 10. There is no count for the seven of trumps. A player holding carte blanche (no K, Q or J in his original nine cards) scores 50, and continues to do so after each draw until he draws a court card. He must show his hand to score it.

The principal difference between bezique and rubicon bezique is in the scoring of declarations. Cards may be played from a declaration already made and then the declaration restored by adding equivalent cards, whereupon the entire declaration is scored again.

Each deal constitutes a game. The player with the higher score wins the difference in scores plus 500. If the loser has less than 1,000, he is rubiconed and the winner receives the combined scores plus 500, even if the winner's total was also under 1,000. Brisques are not counted unless necessary to prevent a rubicon, but in the event of a rubicon the winner always receives 300 for all the brisques.

Six-pack, or Chinese, Bezique.—This is a development of rubicon bezique and largely supplanted that game in England and France. Six 32-card packs are used, and each player receives 12 cards in the deal. The scoring and play are the same as in rubicon bezique, except as follows:

Four aces of trumps score 1,000; four tens of trumps, 900; four kings of trumps, 800; four queens of trumps, 600; four knaves of trumps, 400. Last trick counts 250. Carte blanche counts 250. Brisques do not count at all, and the tricks are not gathered in.

The high scorer in each deal adds 1,000 for game and wins a rubicon if the loser's score is under 3,000.

In some games, the cards forming bezique depend on what suit is trump: then the ♠Q and ♢J are bezique only when spades are trumps. When diamonds are trumps, bezique is ♢Q and ♠J; hearts, ♡Q and ♣J; clubs, ♣Q and ♡J. The same suit cannot be trump in two successive deals.

Eight-pack Bezique.—This is merely an extension of six-pack bezique, eight 32-card packs being used and each player receiving 15 cards. Quintuple bezique counts 9,000. Five aces of trumps count 2,000; five tens of trumps, 1,800; five kings of trumps, 1,600; five queens of trumps, 1,200; five knaves of trumps, 800. The loser is rubiconed if he fails to reach 5,000.

See Albert H. Morehead *et al., The New Complete Hoyle* (1956).

(A. H. Md.)

BEZRUC, PETR (pseudonym of Vladimir Vasek) (1867–1958), one of the finest and most individual Czech poets, was born at Opava, Silesia, Sept. 15, 1867. After studying in Prague he became a postal official in Moravia, retaining his position until 1927. Thereafter he lived in retirement, shunning honours and publicity. He died at Kostelec, Moravia, Feb. 17, 1958.

Bezruc's reputation rests on the remarkable series of poems written during 1899–1900 and published in the periodical *Cas* between 1899 and 1903. He never matched this intense outburst of inspiration. The subject of almost all these poems is the people of Czech Silesia whom Bezruc saw as a dying race, doomed to denationalization at the hands of German industrialists and Polish priests. From this local theme he created a poetry of national and, indeed, universal validity. In simple, vivid, locally coloured language he portrayed the towns and landscape of Silesia; and the destiny of its people was illuminated in his delineation of a few representative figures who entered into local folklore. The 32

poems of the Silesian issue of *Cas* (1903) had swelled to 88 by the last edition of the collected *Slezske pisne* ("Silesian Songs," 1956). His other poems, though individual in style, are of less lasting significance. (R. Av.)

BEZZENBERGER, ADALBERT (1851–1922), German philologist and archaeologist, was a specialist in the Baltic area. Born in Cassel, Bezzenberger studied at Munich and Göttingen (Ph.D. in 1874). He taught at Göttingen from 1874 to 1880, and later, as professor of Sanskrit and comparative linguistics, at the University of Königsberg. In 1877 he founded the journal *Beiträge zur Kunde der indogermanischen Sprachen*, which in 1907 was fused with the *Zeitschrift für vergleichende Sprachforschung*. He laid the foundations of Baltic philology by re-editing old texts (16th and 17th centuries), in several monographs on Lithuanian, Lettish and Old Prussian, and by numerous articles on Baltic linguistics. His search for the original homeland of the Baltic people led him to archaeological studies, including excavations, in the Baltic area. For 25 years he was the director of the "Prussia" museum in Königsberg and editor of the proceedings of the *Altertumsgesellschaft Prussia*. (Ad. Sn.)

BHADGAON (Bhatgaon or Bhaktapur), a town of Nepal, lies 8 mi. S.E. of the capital city of Katmandu. Pop. (1961) 33,075. It is said to have been founded by Raja Ananda Malla in A.D. 865, and for 200 years prior to the Gurkha conquest (1768) was the most important town in the valley, the territories of Bhadgaon kingdom extending widely outside the valley. After the fall of Katmandu and Patan, Bhadgaon surrendered to Prithvi Narayan without a struggle and so escaped much of the plunder and destruction suffered by the other two towns. The old palace in Durbar square is well preserved and has beautiful carved woodwork and a finely worked gilt gateway, one of the finest pieces of work in Nepal, and perhaps in all Asia. Opposite on a stone pillar is the figure, beautifully worked in copper gilt, of King Bhupatindra Malla who built the palace in about A.D. 1700. There are other temples in this square, and a little to the south is another square in which is the Nyatpola, or five-tiered temple, also built by Bhupatindra Malla. It is raised on a plinth, the steps of which are guarded by a number of mythical figures: the lowest are two fabulous heroes, Jaya Malla and Phatta, said to be stronger than ten men; behind them are two elephants ten times as strong as they; behind these again are two mythical lions or *singhas* ten times as strong again; then come two dragons, and lastly the two goddesses Bhagini and Singhini whose strength is supernatural. On another side of the square is a fine temple to Bhairava, guarded by two copper-gilt *singhas*. About 1 mi. S. of the town, on a wooded ridge, is the temple of Surji Banaik, dedicated to Ganes. On the western outskirts is a large tank, the Sidha Pakhari, built by Raja Partab Malla in 1640–50. (Rt. R. P.)

BHAGALPUR, a city and district in Bihar state, India. Surrounded by groves of trees the city stretches along the high right bank of the Ganges for 7 mi. Pop. (1961) 143,850. There are four colleges, all connected with Bihar university. Tej Narayan Jubilee (T.N.J.) college, established in 1887, has fine buildings. Sabour, 4 mi. E. of Bhagalpur, is the seat of Bihar's premier agricultural college. Bhagalpur is on the Sahebganj loop line of the Eastern railway. The city is noted for coloured and artistic fabrics made by local weavers from tussore (tasar) and *eri* silk, and a government silk institute has been established to foster this industry.

Bhagalpur District is bounded on the north by a line about 10 mi. N. of the Ganges. Area 2,183 sq.mi. Pop. (1961) 1,711,136. The southern third of the district lies in the forested uplands of the Chota Nagpur plateau and the remainder in the alluvial Gangetic plain. The portion of the district lying north of the Ganges is naturally well watered, while that to its south is irrigated by private canals. The principal crops are rice, maize, wheat, barley, gram, oilseeds, lac and silk.

The district is served by the Eastern and Northeastern railways, the two systems being linked across the Ganges by steamer service. Rock sculptures of the 6th or 7th century are found at Patharghatta 8 mi. N. of Colgong. (E. Ah.)

BHAGAVAD GITA, forming part of book vi of the Indian epic the Mahabharata (*q.v.*), is one of the great religious classics of the world. It is to Hindus what the Sermon on the Mount is to Christians. It is in the form of a dialogue between Arjuna, the hero of the epic, and Krishna, his friend and charioteer, who is believed to be an incarnation of God. The dialogue occurs at the most dramatic moment in the epic. In the fratricidal war between the Pandavas and the Kauravas, when their mighty hosts meet on the battlefield of Kurukshetra and the historic battle is about to begin, Arjuna is tempted to desert his post when he sees before him all his kinsmen who would have to be slain before victory could be secured. He consequently proposes to retire from the contest and allow himself to be slain by the enemy. Krishna thereupon reprimands him and points out to him the higher way of dispassionately discharging his duty, with faith in God and irrespective of consequences, and at last persuades him to fight. On the field of battle the discourse must obviously have been a brief one. Vyasa, the traditional author of the Mahabharata, writing probably about the 5th century B.C., expanded it a little, and perhaps some additions were made later. The poem, as it stands now, consists of 700 verses, divided into 18 chapters.

The Gita goes far beyond the ethical question with which it starts. There are, indeed, two broad streams of thought in it: a philosophical stream describing what God is, and a religious stream suggesting what man should do to reach Him. The greatness of the scripture lies in the fact that in its description of both the end and the means it gives a synopsis of the religious thought and experience of India through the ages. Being a predominantly theistic work, it often describes the ultimate reality as a personal god, identified with the avatar Krishna (*q.v.*). But it also quite frequently refers to the supreme as the immanent spirit, as the transcendent absolute and, finally, as the state of one's own awakened soul. Similarly, the means to realization is described in various terms—as the way of works (Karma yoga), as the way of love (Bhakti yoga) and as the way of knowledge (Jnana yoga). These are the three well-known paths of the Hindu religious tradition leading to the mystic union with God. In the Gita they are described as the different aspects of a single way of approach.

The popularity of the Gita is shown by the numberless commentaries, glossaries and expository books written on it in both ancient and modern times. The earliest commentary that has come down to us is that of the great philosopher Shankara (*q.v.*). Other important commentaries of ancient times are those of Ramanuja, Madhva, Nilakanta, Sridhara and Madhusudana, and the most important commentaries of modern times are those of Balgangadhar Tilak, Aurobindo Ghose, Mahatma Gandhi and Sarvepalli Radhakrishnan. The Gita has been translated into many languages. *See* also Hinduism; Sanskrit Literature. (D. S. Sa.)

See Swami Nikhilananda, *The Bhagavad Gita* (1944), and S. Radhakrishnan, *The Bhagavadgita* (1948), both English translations with introductions and notes.

BHAMO, a town and district in Kachin state in the northern part of the Union of Burma. The town was in ancient times the capital of the Shan state of Manmaw. Pop. (1953) 9,817, a large proportion being Chinese and Chinese Shans. About 300 mi. up the Irrawaddy river from Mandalay, and nearly 1,000 mi. by river from the sea, the town is normally the highest point reached by the regular steamer services of the Inland Water Transport board. It is also the nearest point on the river to the Chinese frontier (53 mi.). It stretches for nearly 4 mi. along the Irrawaddy bank in a series of small villages, but the town proper is confined mainly to one high ridge of land running at right angles to the river. Bhamo had long been the terminus of land commerce from China until the building of the Burma road, 1937–39.

Bhamo District lies wholly in the basin of the Irrawaddy. Pop. (1962 est.) 167,063. Area 4,086 sq.mi. On the east of the river is the Shan plateau with its edge running north and south. West of the Irrawaddy there is a series of ranges, enclosing the basins of the Kaukkwe, Mosit, Indaw and other streams down which timber is floated. The hills are inhabited chiefly by Kachins. (L. D. S.)

BHANDARA, a town and district of Maharashtra state, India. The town (pop. [1961] 27,710) is on the Wainganga river 7 mi. from a station on the South Eastern railway and 33 mi. E. of

Nagpur. Cotton cloth and brassware are manufactured there.

BHANDARA DISTRICT with an area of 3,582 sq.mi. and with a population of 1,248,519 (1961) was transferred from Madhya Pradesh to Bombay in 1956 and from Bombay to Maharashtra when the latter state was formed in 1960. It is hilly and well wooded, containing many small lakes and tanks which are used for irrigation. Crops include tobacco, rice, wheat and jowar (millet).

The peoples of Bhandara include the *Ponwans* who are cultivators and Kohlis who are tank constructors and sugar cane growers. There are extensive deposits of high-grade manganese in the northwest of the district producing about 300,000 tons of ore annually; other industries include weaving, which is declining, and cigarette making. The Great Eastern road and the South Eastern railway from Nagpur to Calcutta traverse the district. The chief towns in the interior of the district are Sindia ([1951] 36,686); Pauni, an old walled town and fort (14,389); and Tumsar (18,250).

(M. R. P.)

BHANG, an East Indian name for the hemp plant, *Cannabis sativa*, applied specially to the leaves dried and prepared for use as a narcotic drug. *See* HEMP.

BHARAL (*Pseudois nahura*), the wild blue sheep of Tibet and western China, live in bands of 10 to 50 in mountain meadows above 10,000 feet. The ram is characterized by a black band separating the blue-gray back from the white under parts and by smooth, sigmoid horns sweeping backward in a semicircle.

(H. K. B.)

BHARATA NATYAM, a form of Hindu temple dance indigenous to the Madras region in southeastern India. Its very ancient techniques and terminology were written by the sage Bharata in a work (extant in palm-leaf manuscript) titled the *Natya Shastra*. The probable date of this work is the 6th century, B.C. Bharata Natyam was originally performed exclusively by female temple dancers (devadasis) in temple services, marriages and other religious ceremonies, as well as for the entertainment of the rulers. Not until about 1930 was this art brought to the stage for public performances.

A program of Bharata Natyam usually lasts two hours without interruptions and includes a specific list of procedures, all performed by one dancer who does not leave the stage or change costume. The accompanying orchestra (composed of drums, drone and singer) occupies the back of the stage, led by the guru (teacher) of the dancer.

In pure style, Bharata Natyam is classically clear in technique. The feet beat out complicated counter-rhythms; the lower limbs are bent in a characteristic low squat; arms, neck and shoulders are part of the movement. In the pantomime sections, the hands tell the story through conventional gesture-language, while the face expresses the mood. In the pure dance, the hands are restricted to the 11 pure-dance mudras (hand poses). (R. M. Hs.)

BHARATPUR (BHURTPORE), a city and district of Rajasthan, India. The city is on the Western railway, 34 mi. W. of Agra, Uttar Pradesh, and is surrounded by mud ramparts. Pop. (1951) 37,321. The town is noted for its manufacture of chowries, or fly whisks, with handles of sandalwood, ivory and silver and tails also made of strips of ivory or sandalwood as fine as horsehair. The palace of Suraj Mal, founder of the modern noble house of Bharatpur, is at Dig, 21 mi. N.W. of the city.

BHARATPUR DISTRICT (area 3,127 sq.mi.; pop. [1961] 1,150,849) comprises most of the former princely state of the same name, absorbed into Rajasthan on May 15, 1949, and more than 1,000 sq.mi. of additional territory from neighbouring states. The country is generally level, but detached hills rising to 200 ft. in height occur, especially in the north. These hills contain good building stone and also deposits of iron ore. The Banganga, the only river flowing through the district, enters the Jumna below Agra.

The princely state rose to importance under Suraj Mal, a Jat chieftain who bore a conspicuous part in the destruction of the Delhi empire. Having built the forts of Dig and Kumbher in 1730, he received in 1756 the title of raja, and subsequently joined the Maratha army with 30,000 troops. In 1803 the East India company concluded a treaty, offensive and defensive, with Bharatpur. In 1804, however, the raja assisted the Marathas against the British. Lord Lake captured the fort of Dig and besieged Bharatpur, but was compelled to raise the siege after four attempts at storming. A treaty, concluded on April 17, 1805, guaranteed the raja's territory, but a dispute as to the right of the succession again led to a war in 1825, and Lord Combermere captured Bharatpur on Jan. 18, 1826. The fortifications were dismantled, the hostile chief deported to Benares (Varanasi) and an infant son of the former raja installed under a treaty favourable to the company. In 1853 the state came under British management during a minority and up to India's attainment of independence in 1947 was controlled through the Eastern Rajputana subagency of the Rajputana states agency. (S. M. T. R.)

BHASKARA (BHASKARACARYA, *i.e.*, Bhaskara the learned) (b. 1114) was almost the last great Hindu mathematician until modern times. His versified *Siddhanta-siromani* (1150) consisted of two mathematical and two astronomical parts. The mathematical parts, which are of great originality, were translated with the work of Brahmagupta (*q.v.*) by H. T. Colebrooke (1817), and those on astronomy, which merely restate clearly the older astronomical views, by L. Wilkinson (1861–62). Bhaskara realized the true nature of division by zero; he anticipated modern theory on the convention of signs (minus by minus makes plus, minus by plus makes minus); he represented unknown quantities by letters; he gave general solutions for quadratic equations reduced to a single type (considering positive roots only as genuine); and solved a few cubic and biquadratic equations and some indeterminate equations of the first and second degree. He also computed elaborate tables of sines, studied regular polygons up to 384 sides, giving $\pi = \frac{754}{240}$ (3.141666 . . .), and anticipated Kepler's method for determining the surface and volume of a sphere.

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BHATINDA, a town in the Patiala division of Punjab, India, the headquarters of Bhatinda district, is 173 mi. N.W. of Delhi. Pop. (1951) 34,991. The town has a massive fort, with ramparts 118 ft. high, which was built during the reign of Sher Shah Sur at Delhi (1540–45). It is the seat of Rajindra college, affiliated to Punjab university. Bhatinda is a major junction of the Northern railway (opened in 1897), with main (broad-gauge) lines converging from Delhi, Ferozepur and Patiala, and from Macleodganj over the Pakistan border; and metre-gauge lines from Fazilka, Hissar and Bikaner. The town is chiefly a railway and administrative centre.

BHATINDA DISTRICT is part of the level alluvial plain south of the Sutlej river (*q.v.*). Pop. (1961) 1,056,033, predominantly agricultural. Area 2,253 sq.mi. Rainfall is meagre and unreliable: irrigation is from the Sirhind and Bhakra canals running northeast to southwest across the district. Wheat, gram, cotton, millets and sugar cane are the main crops. Local trade centres include Kotkapura and Faridkot, the seat of another Punjab university college. (O. P. B.)

BHATPARA, a city in Twenty-Four Parganas district, West Bengal, India, lies on the east bank of the Hooghly river, 25 mi. N. of Calcutta. It is in the industrial belt that stretches along the Hooghly and that has a population density of 2,100 per sq.mi. In 1961 its population figure was 147,725 according to the census, and thus it had the fourth largest population in West Bengal, and the largest percentage of industrial workers. Bhatpara and its suburb Jagatdal have one of the five great concentrations of jute mills in the Calcutta area and there are also cotton mills and engineering works. The city was once a famous centre of Sanskrit learning and was notable for its *tols* or free Sanskritic schools.

(D. G. NA.)

BHAVABHUTI, a Brahman of Vidarbha (the part of central India later called Berar), writing in Sanskrit. He passed his literary life chiefly at the court of Yashovarman of Kanauj (about A.D. 700). He was the author of three plays, the first of which, *Mahaviracharita* ("Life of the Great Hero") gives in seven acts the main incidents in the Ramayana, up to the defeat of Ravana and the coronation of Rama. The second, *Malatimadhava*, a do-

mestic drama in ten acts, tells the story of Madhava and Malati, the son and daughter of two ministers of neighbouring kings, who from childhood have been destined for each other, but are for a time threatened with separation by the king's wish to marry Malati to his old and ugly favourite. The play abounds in stirring, though sometimes improbable, incidents. Finally, there is the *Uttara-ramacharita* ("The Later Adventures of Rama"), again in seven acts, which continues the story of Rama from his coronation to the banishment of Sita and their final reunion. This play, though containing far less action than the other two, shows Bhavabhuti at the height of his power in characterization and in presenting suspense and climax, leading many to rate him more highly than Kalidasa (*q.v.*), as a dramatic poet. (J. E. B. G.)

BHAVE, VINOBA (1895–), Indian ascetic and founder of the *Bhoodan Yajna* or land-gift movement, was born on Sept. 11, 1895, at Gagode in Baroda, of a Chitpavan Brahman family. He was educated at the Baroda high school, but abandoned his studies and, in 1916, joined M. K. Gandhi's *ashram* ("community"). He wholeheartedly accepted Gandhi's ideas and devoted himself to a life of austerity, concentrating upon ways of improving Indian village life. At Gandhi's behest he committed civil disobedience and was imprisoned on several occasions. He conceived the idea of the land-gift movement in 1951, while touring villages in Telingana (Andhra Pradesh), where Communist disturbances had been prevalent. A landholder offered him some land in response to his appeal on behalf of a group of landless Harijans (untouchables). After that, he walked from village to village, appealing for gifts of land, to be distributed among those who had little or none. He claimed that this was applying to the land problem Gandhi's doctrine of *ahimsa*, or nonviolence. Land reform would be secured by a change of heart and not enforced by government action. Between 1951 and 1956, 4,000,000 ac. were given. While some critics pointed out that less than 1,000,000 ac. had been distributed, Vinoba saw the need for organization and, in 1954, established a special training camp for *Bhoodan* workers at Kanjirapalli (Kerala state). Against the further objection that the fragmentation of land would obstruct any rationalization of agriculture, Vinoba maintained that he preferred the fragmentation of land to the fragmentation of hearts. Later, however, *gramdan* was encouraged; *i.e.*, the pooling by villagers of all their land, after which the village would be reorganized on co-operative lines. By 1957, more than 2,500 villages had been pooled in this way. Vinoba explained his original project and his philosophy of life in a series of articles later collected together in *Bhoodan Yajna* (1953, reprinted 1957).

See R. P. Masani, *The Five Gifts* (1957). (KE. A. B.)

BHAVNAGAR, a municipal town and seaport in the district of the same name in Gujarat state, India, is situated on the west coast of the Gulf of Cambay. Pop. (1961) 177,488. It has three colleges and a polytechnic institute; the Darbargadh (the old royal palace) and various lakes, parks and temples. It is an important commercial and industrial centre with spinning and weaving mills, steam presses, tile and brick factories, sawmills, ice factories and an iron foundry. It is connected with the main Western railway system and has a good port for small vessels. The town was founded in 1723 by the local ruler Thakur Sahib Bhausinghji.

BHAVNAGAR DISTRICT comprises the former princely state of Bhavnagar whose ruler or thakur was the head of the clan of Gohel Rajputs of Saurashtra who probably settled in the area about 1260 and which was part of the Western India States Agency during the combined Baroda-Western India administration (1944–47) under British paramountcy. Pop. (1961) 1,116,206; area 4,652 sq.mi. After Indian independence in 1947, the state was merged into the new state of Saurashtra, which now forms part of Gujarat state. More than one-half the area consists of regur or black cotton-soil. The chief products are grain, cotton and salt, and manufactures are oil, copper and brass vessels and cloth.

(M. R. P.)

BHIL, the name applied to more than 2,000,000 varied, partly tribal peoples of western India, a name connotative of banditry and rugged independence.

Bhils are distributed widely in upland areas from Ajmer in Rajasthan on the north to Thana district in Maharashtra on the south, and eastward as far as Indore in Madhya Pradesh. Some Bhils may have been pushed southeastward by medieval Rajput conquests: rulers ascending the throne of Udaipur formerly had to be anointed by a Bhil with his own blood.

Nearly all Bhils practise agriculture, a few by the slash-and-burn method, most by the plow even on hilltop millet fields. Highland Bhils generally live in scattered, often-shifted houses of open wattle and thatch. They are self-sufficient in many crafts. Bhils follow Rajasthani kinship usages in Rajasthan, Maharashtrian usages in Maharashtra, etc., but with easier marriage and divorce. Most Bhils worship local deities in varied pantheons only slightly touching the practices of higher Hinduism; a few aristocratic segments such as the Bhilala and some plains groups employ Brahman priests; others are converts to Islam.

Bhils now speak Indo-Aryan dialects akin to Gujarati or to other neighbouring languages. A small non-Indo-Aryan residuum in the Bhil vocabulary is neither Munda nor Dravidian but of unknown affinities. Physical evidence and traditions of intermarriage likewise indicate that the Bhils have received many genetic contributions from the higher Hindu castes, whom many Bhils now resemble more closely than they do any more isolated aboriginal peoples.

Bhil regiments were active and loyal in British service through the latter half of the 19th century.

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BHILSA (ancient, and modern official, VIDISHA), a town and district in Madhya Pradesh, India. The town headquarters of Bhilsa district is on the east bank of the Betwa river (*q.v.*), 33 mi. N.E. of Bhopal. Pop. (1951) 19,184. It is on the Central railway main line from Delhi to Bombay.

Bhilsa was central on the ancient routes between Sovira and Magadha (*q.v.*) and between the Andhra capital Paithan and Sravasti (*see* GONDA). This is reflected in the many Hindu, Buddhist and Jain monuments within 12 mi. radius, including about 60 ruined stupas or Buddhist relic-domes. Bhilsa is identified as Vidisha, seat of the Sunga prince Agnimitra (2nd century B.C.) and the eastern capital of Malwa (*q.v.*). Jain scriptures call it Bhadalpur, birthplace of Sitalnath, the Jains' 10th *tirthankara* or patriarch. Outside the archaeological museum in Bhilsa camp stand a colossal stone figure of Kubera, king of the yakshas (a class of Indian deities), and a yakshi statue, both found in the river bed.

Four miles northwest of Bhilsa is Besnagar (Vesnagar), birthplace of Devi, consort of the emperor Asoka (*q.v.*). There stands the monolithic Kham-baba or Heliodorus column (late 2nd–early 1st century B.C.). It was erected in honour of Vasudeva (Vishnu) by Heliodorus, envoy of the Indo-Greek king Antialkidas of Taxila. Two miles further northwest are the nine rock-cut Vaishnavite and Jain sanctuaries of Udayagiri (late 4th century A.D.).

BHILSA DISTRICT is drained by the Betwa and its tributaries. The eastern part is traversed from south to north by a branch of the Vindhya range, from which good building sandstone is quarried. The remainder has rich black soils; wheat and tobacco are cultivated. Pop. (1961) 490,200; area 2,839 sq.mi. (D. G. NA.)

BHILWARA, a town and district formerly in the state, and now in the division of Udaipur, Rajasthan, India. The town lies about 80 mi. N.E. of Udaipur city, on the Western railway. It is the headquarters of the district. The population in 1901 was 10,346 and by 1951 it had risen to 29,668. Bhilwara is noted for the excellence and durability of its tinned utensils, which are largely exported, and for cotton ginning and pressing. There was formerly a mint producing coins called Bhilari.

BHILWARA DISTRICT, had a population of 865,835 in 1961, an increase of 513,789 from 1901. The greater part of the district is covered with rocky outcrops, and parts of it are hilly and forested, the plains being mostly barren with sparse bush and thorn scrub.

The main marketable products are fuel and charcoal. The nearest markets for the products of the forest areas are Beawar and Ajmer. (S. M. T. R.)

BHIMA, in the epic Hindu mythology, one of the Pandava princes in the Mahabharata, distinguished by his size, strength and voracity.

BHIND, a town and district in Madhya Pradesh, India. The town, the headquarters of the district, lies 48 mi. N.E. of Gwalior. Pop. (1961) 28,193. It is on the road from Gwalior northeastward to Etawah in Uttar Pradesh, and at the terminus of a metre-gauge branch from Gwalior on the Central railway's Delhi-Bombay main line. Locally known as Bhind Bhadwara, it was the chief seat of the Bhadwara branch of the Chauhan Rajput clan until it fell in the 18th century to Sindhia of Gwalior.

The town has an old fort and a lake, Gauri Tal, on which stands the Vyankateshwar temple. There are a few cotton presses and ginning factories.

Bhind District is in the Jumna-Chambal badlands and its fertile land is scoured by many ravines, 30–40 ft. deep, and large-scale gully erosion. Pop. (1961) 641,226; area 1,723 sq.mi. The Chambal forms the district's northern border before joining the Jumna; another Jumna tributary, the Sindh, crosses the east of the district. Main crops are wheat, cotton and millets. (S. M. A.)

BHIR (Bir), a town and district in Maharashtra state, India. The town, headquarters of the district, is 67 mi. S.S.E. of Aurangabad. Pop. (1951) 25,636. It is connected with other parts of the state by road, but there is no rail connection. It is noted for leatherwork, especially the type of Indian water bottle known as a chagul. Before the Muslim invasion of the Deccan, Bhir was a possession of the Chalukyas (*see* Chalukya) and, in the 13th century, of another Hindu dynasty—the Yadavas of Deogiri (now Daulatabad). It was taken by Mohammed ibn Tughlak, sultan of Delhi, in 1327 during his efforts to reassert authority in the Deccan. The subsequent history of the town is part of that of the Deccan under the Muslim regimes of the Bahmani kings, the sultans of Ahmednagar (*q.v.*), the Moguls and the nizams of Hyderabad (*q.v.*).

Bhir District lies between the Godavari river (*q.v.*) and its tributary the Manjra to the south. Pop. (1961) 1,001,105; area 4,261 sq.mi. Its climate is in general temperate with an annual average rainfall of 30 in. The main agricultural products are cotton, linseed, jowar and bajra millets, wheat and pulses. The district was transferred to Bombay state on the dissolution of Hyderabad in 1956 and was included in Maharashtra state on its foundation in 1960. (S. Ah.)

BHOPAL, capital city of Madhya Pradesh, India, is in the district of Sehore (*q.v.*), 183 mi. N.W. of Nagpur (Maharashtra). Pop. (1961) 225,460. It is the seat of a postgraduate teachers' college attached to the University of Sagar and a government degree college and a medical school of Agra university. The city, lying 3,000 ft. above sea level, enjoys a temperate climate with an average annual rainfall of 40 in. Bhopal is served only by a secondary road network but is on the main Delhi-Bombay line of the Central railway. Another line runs westward via Sehore and Ujjain to Nagda on the Western railway's Agra-Bombay route. There is an airport west of the city, but no regular service. The main industry is the manufacture of transformers, switchgear, traction motors and other heavy electrical equipment. The factory, established in 1960, has a large training school for apprentice engineers, and also in the city is a division of the National Power Research institute.

Bhopal State, of which the city was the capital, was the second largest Muslim principality of the British-Indian empire. It was founded in 1723 by Dost Mohammed Khan, an Afghan adventurer. In 1778, when Warren Hastings dispatched Gen. Thomas Goddard's column on its spectacular march across India against the Marathas, Bhopal was the only central Indian power to show itself friendly. When another British expedition arrived under Gen. Sir Barry Close in 1809 the nawab of Bhopal petitioned earnestly but in vain for British protection. In 1817, however, at the outbreak of the Pindari War, a subsidiary treaty was concluded between the then nawab and the British. From 1844 to 1926 the state had female rulers, three of whom, Sultan Jahan and her predecessors, Nawab Sikander and Shah Jahan, were considered enlightened and benevolent.

Bhopal was controlled under British paramountcy through the Central India agency and a local subsidiary administration, the Bhopal agency, which also conducted imperial relations with a number of adjacent petty states and hereditary estates. When India became independent, Bhopal remained a separate province of the new dominion, to which it formally acceded in 1949. But in 1952 the central government removed the last vestiges of the nawab's absolute rule and installed a chief commissioner to govern the state with the assistance of a ministry and elected legislature. In 1956 when, under the States Reorganization Commission act, all the Hindi-speaking areas south of the Vindhyas were united in the enlarged Madhya Pradesh, Bhopal was absorbed into it. At the same time Marathi-speaking Nagpur was transferred to Bombay state (now Maharashtra) and Bhopal city replaced it as capital of Madhya Pradesh. (S. Gl.)

BHUBANESWAR (Bhuvaneswar), the capital of Orissa state, eastern India, is in the district of Puri (*q.v.*), 18 mi. S. of the former capital, Cuttack. Pop. (1961) 40,000. It is on the Southeastern railway main line and has an airport served by flights between Calcutta (409 km. [254 mi.] N.E.) and Madras.

Bhubaneswar has two parts: the old city of temples, and, to the north, a planned township built after the state capital was transferred there from Cuttack in 1958. In the latter are the Rajbhavan (residence of the state governor), secretariat, legislative assembly, Orissa state museum and the buildings of Utkal university (founded in Cuttack in 1943) and of the Rural university with their affiliated colleges. At the city centre is the Gandhi Memorial park. In the 1960s a zoological and botanical garden was established.

Bhubaneswar's history can be traced back to the 3rd century B.C. in archaeological remains nearby. These include rocks inscribed with edicts of Asoka (*q.v.*) on Dhauli hill, 5 mi. S., which refer to his viceregal town of Tosali. Known elsewhere as Ekamrakanan the place later became known as Bhubaneswar after Tribhuvaneswar Siva, its presiding deity. From the 7th to the 16th century A.D., under the Soma and Ganga dynasties, many temples were built, of which about 30 survive intact. There may be seen the whole development of Orissan temple architecture, from the small Parasurameswara shrine (*c.* A.D. 750) to the splendid temples of Lingaraja (*c.* A.D. 1000) and Raja Rani (*c.* A.D. 1000) with their soaring towers, rich exterior sculpture and complex of assembly and ritual halls. At Udayagiri hill (6 mi. N.W.) is a group of caves about 2,000 years old. Excavations at Sisupalgarh, 1 mi. E., revealed Kalinganagar, the capital of Kharavela (1st century B.C.).

See P. Brown, *Indian Architecture* (*Buddhist and Hindu Periods*), pp. 118–124 (1942). (Ma. M.; N. K. S.)

BHUTAN (Druk-yul), a semi-independent state, lies in the eastern Himalayas between Tibet and India and is a country of great scenic beauty. It is bounded on the west by Sikkim. Rugged mountains and dense forests prevent easy access from the outside world. Even the best road into the country through the Chumbi valley and the Natu La (pass) in Tibet requires several days of difficult travel. The government enforced this isolation as a means of preserving peace, but at the price of maintaining a premedieval existence of the people. By the middle of the 20th century most Bhutanese (*Drukpa* or Thunder people) had never seen a wheel. Then, under pressure of neighbouring countries with strategic interests in Bhutan, a very slow change began and the lack of outside contacts became a hindrance to modernization. The land attracted international attention when part of it was included within China's boundaries on maps printed by the Chinese Communist government in 1958 (see *History*, below).

Physical Geography.—The country is about 200 mi. long and up to 90 mi. wide, yet it reaches from 24,000-ft. peaks in the north to the low hills and the pass through the Sinchula mountains at Buxa Duar on India's borders. The most northerly tract, running from east to west and about 20 mi. wide, is wild and snowy, offering little but grasslands for herds of yaks. The next tract, about 40 mi. wide and between 3,500 and 10,000 ft. high, is covered with coniferous and some other trees and contains in its western half most of the population. The most southerly tract, about 30 mi. wide, is the lowest, hottest and most humid. It is covered with

dense, semitropical vegetation with an abundance of big game.

The country is cut up by mountain ranges, running from north to south, of such character that people usually can exist only in the river valleys separating the ranges. The main ranges, from east to west, are the Masongchung-dong, between the rivers Amo Chu and Wang Chu; the Dokyong La between the Wang Chu and Ma Chu; the Black Mountain range, between the Ma Chu and Manas, and finally the Tawang range. In those valleys which are flat, low and temperate enough, such as Paro, Ha and Punakha, the Bhutanese grow rice, corn (maize), barley, wheat, buckwheat and some other cereals, fruits and vegetables, for their own support and some export to Tibet. All kinds of climate can be found and the estimated rainfall varies up to 300 in. annually in the tropical region to 40–60 in. in the more temperate zones.

THE TIMES, LONDON

TAK TSANG ("TIGER'S LAIR") MONASTERY, 2,000 FT. ABOVE PARO VALLEY, BHUTAN

The People.—The total area of Bhutan is 19,305 sq.mi. with a population (1958 est.) of 650,000. The people live in villages, though there are some towns of a few thousand inhabitants, such as Punakha, the winter capital; Tashi Chho and Paro, the summer capitals; Tongsa; and Ha. In effect, the capital is where the maharaja resides and this is presumed to be Thimbu most of the time. About 65% of the people are Bhutias, of Tibetan stock, speaking a basically Tibetan language. They are predominantly Lamaist Buddhists, recognizing the dalai lama as their spiritual leader and supporting a large number of lamas spread across the country in numerous monasteries. In outlook and character these people are Mongolian and oriented more to Tibet than India. They live mostly west of the Black Mountain range. The sparse population east of that range came presumably from the hills to the northeast of Assam. About 20% to 30% of the population are Nepalese, concentrated in the foothills west of the Amo Chu. They are in many ways discriminated against for fear that eventually they might outnumber the Bhutias.

Agriculture is the main occupation of the people, though they are skilled also in handicrafts, mainly wood carving, metalwork and weaving. About 10 to 15 prominent families each own between 100 and 150 ac. of land. Average holdings are 5 to 10 ac. and a 1960 law aims at maximum holdings of 30 ac.

History.—Bhutan's early history is unknown. It is clear, though, that Bhutan has existed as a political entity for many centuries. Early sagas report constant warring among Bhutan's neighbours and the Bhutanese themselves for control of the country. It is fairly certain that by the 9th century A.D. the Tibetans had driven out the Indians and settled in the country. In 1720 a Chinese imperial army invaded Tibet and established suzerainty there and also over Bhutan. Control over the country changed several times thereafter and its exact territorial extent was not clear. When the British established dominion over Bengal in 1765, Bhutan included parts of Darjeeling and the duar ("door" or pass) of Jalpaiguri. In 1772 the Bhutanese invaded Cooch-Behar and carried off the raja as a prisoner. Warren Hastings, governor of Bengal, responded to an appeal for help and invaded Bhutan. The regent of Tibet, the tashi lama, claiming Bhutan as a dependency, intervened and a peace treaty was signed on April 25, 1774. In that year George Bogle and in 1783 Samuel Turner, British emissaries on their way to Tibet, passed through Bhutan to settle frontier issues and promote trade. They failed. Friction in the border region increased when the British occupied Assam in 1826. To put an end to it, the British, in 1841, took over the duars in the Darrang district of Assam and promised payment of a subsidy of Rs. 1,000 to Bhutan as long as peace prevailed. It did not do so for long. In 1863 Sir Ashley Eden went to Bhutan to demand reparations for border raids but instead was forced to sign a treaty, which the British denounced as soon as Sir Ashley escaped from Bhutan. They sent an ultimatum to Bhutan and followed it up with an invasion of the country in 1865. The Bhutanese, finally defeated, signed the treaty of Sinchula on Nov. 11. Bhutan agreed to free all British prisoners; to cede the Athara Duars in the foothills as well as the Assam, Bengal, and Eastern Duars; and to accept British mediation in disputes between Bhutan and the chiefs of Cooch-Behar and Sikkim. In return, Great Britain promised to pay Bhutan an annual subsidy of Rs. 25,000, increasing gradually to Rs. 50,000, as long as the treaty would be kept. All this fighting and the treaty negotiations proceeded with disregard of the Chinese or Tibetan governments, thereby weakening their claim to suzerainty. The definitive end of that suzerainty came in 1910 when, over Chinese protests, the Bhutanese government agreed in a treaty to be guided by Great Britain in external affairs in return for an annual subsidy of Rs. 100,000 (increased to Rs. 200,000 in 1942) and the British promise of noninterference in Bhutan's internal affairs. This treaty reflected both British security interests and the friendly relations between the two countries. Bhutan became gradually oriented politically toward India, although much of its trade continued with Tibet.

Upon India's independence, a Bhutanese delegation appeared in New Delhi in 1946 to clarify the country's new position. After much discussion, on Aug. 8, 1949, a treaty was signed continuing the British system, but increasing the subsidy to Rs. 500,000 and transferring 32 sq.mi. of land, known as the Dewangiri, in Assam, to Bhutan. As a result, India handles Bhutan's foreign relations, with the exception that Bhutan has an agent in Lhasa, Tibet. This arrangement was of little relevance while both countries agreed that Bhutan should continue its isolation from the world. The situation changed when the Chinese Communist government took over Tibet in 1950 and deployed troops along the Himalayan borders. Contacts between Indian and Bhutanese officials increased. Since 1958 Chinese Communist maps showed considerable areas of Bhutan as within China. Chinese pressure for direct relations between China and Bhutan began. India urged Bhutan to take measures for its own security and in 1959 promised to come to its aid in case of aggression. To avoid use of the path through Tibet, the two countries began to build roads for direct communication, the first road runs between Phunchholing, on the Indian frontier, and Paro.

Government.—The government of Bhutan has always been autocratic, with no law codes, courts or any of the features of modern public administration. Between the middle of the 17th and the early 20th centuries, the government was divided between a spiritual ruler, the Dharma raja, an incarnation of the Buddha who was usually discovered among the children of the ruling families, and the Deb raja, the temporal ruler, formally elected, but in fact nominated by the *penlop* ("governor") of either the Tongsa or the Paro district (west and east Bhutan), the most powerful among the *penlops*. In 1907, after the Dharma raja had died and the Deb raja withdrawn into a life of contemplation, the then strongest *penlop*, Sir Ugyen Wangchuk of Tongsa, was "elected" by a council of lamas, abbots, councilors and laymen as hereditary maharaja, while the lamas continued to have strong spiritual influence.

The maharaja rules with the assistance of a prime minister, a council of ministers and a national assembly in which each of the ten administrative districts is represented. Every district has a *penlop* or a *dzongpon*, resembling a feudal lord and residing in a fort (*dzong, jong*), the centre of public life, around which the villages are clustered. His functions consist mainly in collecting taxes and maintaining order. He is assisted by a small staff in the *dzong* and a hierarchy of officials, among whom the richest landholders usually can be found. Also at his disposal are the local troops, poorly trained and equipped, but adequate to control the peaceful population.

This medieval system of government underwent a very slow, steady change with the influx of new ideas from neighbouring countries after World War II and especially after the arrival of the Chinese Communists on Bhutan's borders.

The assembly's participation in legislation increased. The government began to plan for the construction of roads, the creation of schools, the building of hospitals and dispensaries, the exploitation of natural resources, the training of a professional army and the centralization of the national administration. The Indian government offered financial and technical aid, but taxes had to be raised nevertheless to realize these measures. Dissatisfaction was spreading among the population, but could not be expressed because the maharaja did not tolerate opposition. Thereupon, the national congress, a party created by the long-dissatisfied Nepalese in Bhutan with headquarters in Siliguri (India) near the Bhutanese border, made itself the spokesman also of these dissatisfied elements and added to its program of abolishing discrimination against the Nepalese, the liberalization of the "autocratic and arbitrary rule" of the maharaja and a demand for the establishment of popular government in Bhutan, but the government made few concessions to these demands.

The government of India is represented by its political officer residing in Gangtok, Sikkim.

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BIALIK, HAYYIM NAHMAN (1873–1934), the leading Hebrew poet of modern times, was born in Rady, Volhynia (Ukraine), Jan. 9, 1873. His father died when he was five or six and he was brought up by his grandfather. He suffered under rigorous traditional education and soon left the famous Talmudic academy in Volozhin (now Belorussia), where he wrote his first poem *El ha-Tzippor* ("To the Bird"). Bialik, who, like his fellow writers, wished to transform Jewish national cultural and social life, turned his back on the existence prevailing among eastern European Jewry and in 1891 went to Odessa, then the centre of Jewish modernism. He failed to make a living there and left to work and write in various out-of-the-way places, establishing himself as a "national" poet and leader of Hebrew culture before returning to Odessa (1900). In 1921 he left Soviet Russia for Germany, where Jewish writers had established a short-lived Hebrew centre, then settled in Palestine (1924) and visited the U.S. (1926). In Palestine he devoted himself to scientific matters and public affairs, producing few poems, the most important of which was *Yatmut* ("Orphanhood"), a long poem about his childhood, written shortly before his death. He died in Vienna, July 4, 1934.

Bialik is the classic poet of modern Hebrew. His poetry deals largely with his childhood sufferings and his inner struggle with tradition, most movingly in the long poem *Ha-Matmid* ("The Talmud Student"); his poems in reaction to the Kishinev pogrom (1903), Zionist poetry and poems in the folk-song manner are important. He also wrote in Yiddish, translated some European classics and S. A. Anski's Yiddish play *Der Dybbuk* into Hebrew and wrote stories and essays.

An indefatigable editor and literary organizer, Bialik was active in the ingathering (*Kinnus*) and the presentation to the modern Jew of early and medieval Hebrew literature, assisted by his lifelong associate J. H. Rawnitzki, with whom he founded the publishing firm Devir and edited the *Sefer ha-Aggadah* (1908–10), the most popular collection of midrashic legends. He also edited the poems of Solomon ibn Gabirol (*q.v.*) and began a popular modern commentary on the Mishnah. Bialik's influence upon the formation of Hebrew culture in what is now Israel can hardly be overestimated. His long participation in the Language council's work affected the development of the Hebrew language.

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Translations: L. V. Snowman, *Poems From the Hebrew* (1924); M. Samuel, *Selected Poems* (1926); I. Efros, *Complete Poetic Works, I* (1948); I. M. Lask, *Aftergrowth and Other Stories* (1944); for bibliography *see* J. Kabakoff, "Bialik's Works in English Translation," *Jewish Book Annual*, vol. xvii, pp. 73–81 (1959–60). There are German translations of his poems, by E. Muller, 2nd ed. (1921); and some Russian, by V. Jabotinsky (1926).

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BIALYSTOK, a town and *wojewodztwo* (province) in northeastern Poland. The town, capital of the *wojewodztwo*, lies in the Podlasie lowlands on the Warsaw-Leningrad railway line. Pop. (1960) 120,800. When the Germans occupied the town during World War II they massacred about 50% of the population, including all the Jews in the ghetto. Bialystok was known as a village in the 14th century. Town rights were granted it in 1749 as a result of representations made to Klemens Branicki, its owner. From 1795 to 1807 Bialystok belonged to Prussia, but was transferred to Russian rule by the treaty of Tilsit (*q.v.*). It returned to Poland in 1919. In 1939 it was incorporated in the U.S.S.R., occupied by Germany in 1941 and returned to Poland in 1945.

The development of Bialystok has been closely associated with the foundation in 1824 of the textile industry, mainly woolen goods, which increased rapidly in the town and neighbourhood to supply the demand of the Russian market. The Germans destroyed 76% of the industry between 1941–45, but it was rebuilt and extended after the war. The main emphasis was placed on the linen industry, based on the use of local resources. The timber industry was also represented. Two colleges were opened in Bialystok after 1945: the Academy of Medicine and the Higher Evening Technical college.

BIALYSTOK WOJEWODZTWO borders to the north and east on the U.S.S.R. Pop. (1960) 1,089,700. Area 23,148 sq.km. (8,937 sq.mi.). The province contains 12 *powiaty* (districts) of which three (Elk, Goldap and Olecko) were incorporated in Poland after World War II. Most of the region consists of lowlands drained by the Narew, Biebrza and Bug rivers which flow through wide, marshy plains. There are about 500 lakes in the northern, wooded sector, with its varied moraine landscapes. The *wojewodztwo* has mainly poor, sandy soils; the chief industry is agriculture, which produces rye, oats, potatoes and flax. Approximately 45.4% of the area is used as arable land, 21.6% as meadows and pastures and the remainder is forested. The forests, mostly coniferous, include that of Bialowieza (Puszcza Bialowieska) 1,250 sq.km. (483 sq.mi.) in area, the largest wooded region in the central European plain, which provides raw material for the large timber works at Hajnowka. Since 1945, 580 sq.km. (224 sq.mi.) of the forest have belonged to Poland, the remainder to the U.S.S.R. In 1921, 4,716 ha. (18 sq.mi.) of the forest were made into the Bialowieza National park. It contains bison, elk and beaver.

Economically the *wojewodztwo* is one of the most underdeveloped regions in Poland, and is sparsely populated (47 inhabitants per sq.km.). Only 28% of the population is employed in industry (mainly textile and timber) which is concentrated in a few urban centres. The chief towns (pop. 1960) are Bialystok 120,800, Elk 22,000, Lomza 20,000, Suwalki 20,000, Augustow (pop. 1958 est.) 13,300. The *wojewodztwo* is crossed by the railway line from Warsaw to Leningrad. (K. M. WI.)

BIANCHINI, FRANCESCO (1662–1729), Italian astronomer and antiquarian associated with calendar reform, was born of a noble family at Verona on Dec. 13, 1662. After studying at

Padua he proceeded to Rome in 1684, was for a time librarian to Cardinal Ottoboni (later Pope Alexander VIII) and established an observatory at Albano. He was subsequently appointed secretary of a committee on calendar reform by Clement XI and in 1703 he published *De kalendario et cyclo Caesaris*. Among his other published works were *Hesperi et Phosphori nova phaenomena* (1729) in which he gave a 24½-day rotation period for Venus; *Astronomicae et geographicae observationes selectae* (1737); and *Opuscula varia* (1754). He also published some papers, including one on G. D. Cassini's method of parallaxes. He died in Rome on March 2, 1729. (Cn. A. R.)

BIARRITZ, the world-famous seaside resort, is in the *département* of Basses-Pyrénées, southwest France, with the Landes to the north and the Pyrénées to the south, on the Bay of Biscay about 8 km. (5 mi.) W.S.W. of Bayonne. Pop. (1954) 21,542 (quadrupled at the height of the season). The town is modern with a large number of hotels and has beaches, casinos and a rich sea museum. The varied scenery both on the coast and inland and the all year mild climate attract a great number of tourists. A promenade runs from the sandy Grand Plage, facing northwest, to the Côte des Basques. It passes south of the triple Promontoire de l'Atalaye whose small peninsulas are surrounded by rocky islets, some of them united by jetties which enclose the Port des Pêcheurs. The folklore and traditions of the Basque inhabitants of the district are picturesque. Biarritz has two stations on the main line from Paris and Bordeaux to Hendaye and Spain, and a branch line from the Biarritz-Négresse station also serves the centre of the town. From the airport of Biarritz-Parme (2 km. [1 mi.] S.E.) there are services to London, Dublin, Gibraltar, Tangier, Casablanca, Paris, Lourdes and Nice. During the battles around Bayonne on Dec. 10–13, 1813, Biarritz was the scene of fighting, but it remained a fishing village until Napoleon III and the empress Eugénie went to stay there 40 years later and made it a fashionable resort. During World War II it was occupied by the Germans from June 1940 to Aug. 1944. (G. Co.)

BIAS (6th century B.C.), one of the Seven Wise Men of ancient Greece, was a citizen of Priene in Ionia. He was prominent in the political affairs of his city in the difficult period ensuing from the overthrow of Lydia by the Persians and is reported to have advised the Greeks of Ionia to emigrate *en masse* to Sardinia (Herodotus, i, 170). A few aphorisms traditionally attributed to Bias propound a common-sense ethic. For the aphorisms *see* F. W. A. Mullach (ed.), *Fragmenta philosophorum graecorum,* i (1860); or H. Diels and W. Kranz, *Fragmente der Vorsokratiker,* ii, 7th ed. (1954).

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BIBAUD, MICHEL (1782–1857), the author of French Canada's first volume of poetry and the first substantial history of Canada, was born on Jan. 19, 1782, at Côte des Neiges, near Montreal, of a poor family. Belatedly educated at the Collège Saint-Raphaël and Collège de Montréal, he lived modestly as a teacher, journalist, translator and civil servant. Devoting himself to the development of French-Canadian intellectual life, he began by founding a newspaper (*L'Aurore,* 1817), publishing arithmetic textbooks and composing the satiric and didactic verse of his *Epitres, satires, chansons, epigrommes et autres pièces de vers* (1830). He then launched a series of short-lived literary and scientific magazines (1825–43), for which he wrote most of the articles. These included chapters of his *Histoire du Canada,* vol. i, on the French regime (1837); vol. ii, on the English regime to 1830 (1844); vol. iii, on the controversial period 1830–37 appeared posthumously (1878). Ponderous and unimaginative, Bibaud's history was not well received by his contemporaries because of its pro-English and bureaucratic sympathies. Disillusioned, he published nothing more but carried on research until a paralytic stroke caused his death in Montreal on Aug. 3, 1857.

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BIBER, HEINRICH (Ignaz Franz) von (1644–1704), Bohemian composer, the first notable central European violinist composer, was born at Wartenberg, Bohemia, Aug. 12, 1644. He spent most of his life at the court of the archbishop of Salzburg, rising from a humble position to that of high steward and musical director (from 1676). He traveled widely as a virtuoso. He died at Salzburg, May 3, 1704.

Biber composed mainly for his own instrument. His sonatas for violin and clavier, and his solo sonatas with *continuo,* are of well-defined form and some technical difficulty, showing development of the resources of the violin, especially use of the *scordatura* (abnormal tuning to produce special effects). His most famous works are the five sonatas on the 15 mysteries in the life of Mary. He also composed a few stage works of which only the librettos, and the score of *Chi la dura la vince* (1687), have survived. (C. P. Co.)

BIBIENA (Bibbiena), **GALLI DA,** a family of Italian artists of the 17th and 18th centuries, who took their name from the birthplace of their progenitor, Giovanni Maria Galli (1625–65), born at Bibbiena near Florence. He studied painting under Francesco Albani and first laid the foundations of an artistry which was carried on by his descendants, who devoted themselves to scenic work for the theatre.

Employing freely the highly ornate style of the Italian late baroque architecture and sculpture, the various members of the family produced a series of designs which are amazing for their splendour and spacious proportions achieved by intricate perspective. From about 1690 to 1787 eight Bibienas enchanted most of the courts of Europe with dazzling settings for operas, funerals and weddings. The Habsburgs were their most lavish patrons.

Ferdinando Galli Bibiena (1657–1743), born at Bologna, was the son of Giovanni Maria. He studied painting under Carlo Cignani and architecture under Giulio Troili, called Paradosso. On Cignani's recommendation he entered the service of the duke of Parma. His chief work at this period was the villa and garden of Colorno, but he soon established a reputation for scenic designs and worked for the theatre. In 1708 he was called to Barcelona to arrange the decorations in connection with the wedding festivities of the future emperor, Charles VI; when this prince ascended the imperial throne, Ferdinando went to Vienna and was there employed on designs of scenery and decorations for festivities at the court and at the opera. On his return to Bologna in 1717 he was elected a member of the Academia Clementina. In 1731 he built the royal theatre of Mantua, burned in 1781. He produced several books: *L'Architettura civile* (1711), reissued under various titles, and *Varie opere di prospettiva* (1703–08).

Francesco Galli Bibiena (1659–1739), born at Bologna, was the second son of Giovanni Maria. He studied under Lorenzo Pasinelli and Cignani, worked at Piacenza, Parma and Rome and then became ducal architect at Mantua. After a stay in Genoa and Naples he was called to Vienna, where he built a large theatre. He was architect of the great theatre at Nancy; of the Teatro Filarmonico at Verona, which Milizia calls the finest theatre in Italy; and of the Teatro Alibert in Rome. In 1726 he returned to Bologna and directed the Academia Clementina.

Alessandro Galli Bibiena (1687–1769), eldest son of Ferdinando, was born at Parma. In 1719 he became architect and painter at the court of the elector of the Palatinate. Among his works were the right wing of the *Schloss* and the opera house (both burned 1795) and the Jesuit church at Mannheim.

Giuseppe Galli Bibiena (1696–1757), second son of Ferdinando, was the most distinguished artist of the family. He was born at Parma on Jan. 5, 1696. As a youth he accompanied his father to Barcelona and afterward to Vienna. Staying on, when his father left, he there became the chief organizer of splendid court festivities and functions. He designed catafalques for the funerals of more than 30 nobles and sovereigns, and scenery for plays and dances. In 1722 he worked in Munich and in 1723 in Prague. In 1742 he designed the decorations for the Vienna opera; in 1747 he was employed at the opera in Dresden; in 1748 he designed the interior of the theatre at Bayreuth and in 1750

renovated the Dresden opera, burned 1849. He died in Berlin in 1757. He published his stage sets in three series of engravings: *Alcina* (1716); *Costanza e Fortezza* (1723); *Architetture e prospettive* (1740–44).

ANTONIO GALLI BIBIENA (1700–1774), third son of Ferdinando, was the architect of the Academia Virgiliana at Mantua and of the Teatro Communale at Bologna. He was also employed at the court of Vienna.

CARLO GALLI BIBIENA (1728–1787), son of Giuseppe, was born in Vienna. This last of the theatrical Bibienas traveled farther than any. He worked in Germany, France and the Netherlands (1746–60); London (1763); Naples (1772), where he published five opera sets; Stockholm (1774); St. Petersburg until 1778; and died in Florence.

As the Bibienas' works in theatrical scenery were not executed in durable material, and as their decorations for court functions were necessarily of a temporary character, little has survived, and their richness and splendour only can be judged from drawings, which have been preserved in great numbers and are found chiefly at Vienna, Munich and Dresden.

See Corrado Ricci, *I Bibiena* (1915); A. Hyatt Mayor, *The Bibiena Family* (1945). (I. A. R.; A. H. MR.)

BIBLE, the sacred writings of Judaism and Christianity and probably the most influential collection of books in human history. Whatever one may think of the Bible's contents, its role in the development of western culture and in the evolution of many eastern cultures makes at least some acquaintance with its literature and history an indispensable mark of the educated man in the English-speaking world.

For the adherents of Christianity and Judaism, of course, the primary function of the Bible is religious. The Bible is the deposit of divine revelation. It tells the story of those events to which the Jewish and Christian communities look as the source of their existence, and it contains the prescriptions and prohibitions by which pious believers seek to regulate their lives. Becoming acquainted with the biblical narrative of these events is thus part of the process by which children or converts acquire a sense of participation in the community. From the Bible are derived the themes and symbols that dominate the formal and personal worship of both Judaism and Christianity—their hymns, their prayers and their liturgies. When Jews and Christians need to find the resources of their faith for a personal crisis, they often turn to the Bible. Its teachings as well as its terminology have tended to dominate the many controversies that have broken out among theologians and religionists throughout Jewish and Christian history. Even the way religious controversialists cite it is a measure of the importance of the Bible in the internal life of both Judaism and Christianity.

Still it would be a mistake to assume that only the formal adherents of Judaism and Christianity are interested in the Bible, or that only religious people read it. Many Jews, long after they may have severed their connection with the religious community, go on reading the Scriptures. The study of the Bible as literature is part of the curriculum in many colleges and universities. Phrases and sentences have passed from it into the common speech of many countries, although their origin often is forgotten in the process; thus the saying that "a house divided against itself must fall" is attributed as often to Abraham Lincoln as to the Gospels. Knowledge of biblical language and history is useful for an understanding of most major works of literature in most western countries. For the understanding of some major works, such as Dante's *Divine Comedy* or Goethe's *Faust* or Milton's *Paradise Lost*, such knowledge is indispensable, as is evident from the writings of critics who have lacked it. Countless individuals and entire nations have learned to read through the Bible, and the translation of the Bible has been the occasion for the creation of many scripts for languages that previously had been only oral. To be sure, many parts of the Bible do not rank very highly as literature; their style is ordinary and their language repetitive. But the literary power of some sections marks them as classics. To many readers who are without biblical faith, the beauty and power of the Bible still make it a source of inspiration and insight.

Such an article as this cannot hope to treat the history and influence of the Bible exhaustively. For in a sense the entire history of Judaism, of Christianity and of western civilization since the 4th century is a series of footnotes upon the Bible. Nor is this article intended to be a catalogue of all the many theories about the Bible that have come both from simple believers and from scholars. Literary study of the biblical books is a necessary element in their interpretation, but it is not the only element. The pertinent literary information about the several books will be found in the articles dealing with them individually, and relatively little of it will be repeated here. On the other hand, this article does not pretend to be either an exposition of the doctrinal themes in biblical religion (or religions) or an analysis of how to interpret the Bible. These expositions and analyses appear in such articles as CHRISTIANITY; JUDAISM; EXEGESIS AND HERMENEUTICS, BIBLICAL; and in the articles dealing with the various Christian denominations, churches and theologians.

What this article does seek to do is to acquaint the reader with the three major divisions in the study of the Bible and in this way to introduce him to the Bible itself. The following are the major divisions of this article:

I. Outline of the Books of the Bible
  A. Old Testament
    1. Pentateuch
    2. Prophets
    3. Hagiographa
    4. Apocrypha
  B. New Testament
    1. Gospels
    2. Acts
    3. Epistles
    4. Revelation
II. Canon and Text
  A. Canon of the Old Testament
    1. Jewish Canon
    2. Christian Canon
  B. Text of the Old Testament
  C. Canon of the New Testament
    1. Canon and Tradition
    2. Acknowledged Books
    3. Disputed Books
    4. Rejected Books
    5. Formation of the Canon
  D. Text of the New Testament
    1. Evidence
    2. Method
III. Translations
  A. Greek and Latin
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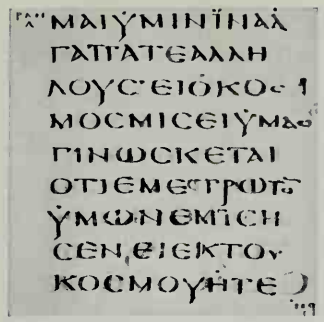
The reader should consult also the individual articles on the books of the Bible and that on INSPIRATION.

I. OUTLINE OF THE BOOKS OF THE BIBLE

The Bible is not a single book but a collection of books (*biblia*, "books"). These books were composed over a period of many centuries (how many is a matter of debate) in three languages—Hebrew, Aramaic and Greek. Their authors include the shepherd and the king, men of considerable learning and men of very little. The Book of Psalms contains some of the most sublime lyric poetry in literature, the Books of Kings some of the most prosaic prose. The Gospel of Mark is matter-of-fact in its accounts; the Epistles to the Colossians and to the Hebrews are almost breathtaking in their speculations. Initially, therefore, the most impressive single feature about the Bible is the great variety of the literature contained between its covers. Beneath this variety there is an underlying unity. But the unity is one of theme and direction, while the variety is one of form and purpose. For that reason an outline of the biblical books probably should be content to summarize them one at a time, leaving the problems of biblical chronology and the harmonization of the various accounts to the special studies of these topics. Such an outline divides itself naturally into the Old and the New Testament.

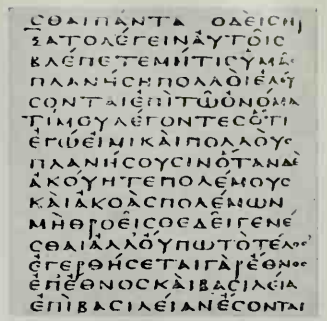
A. OLD TESTAMENT

At least three-fourths of the Christian Bible is made up of the

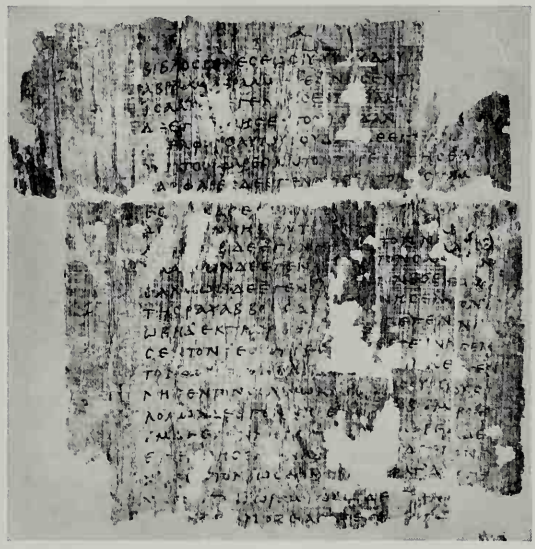


Codex Purpureus Petropolitanus, Greek, 6th century; portion of John xv. British museum

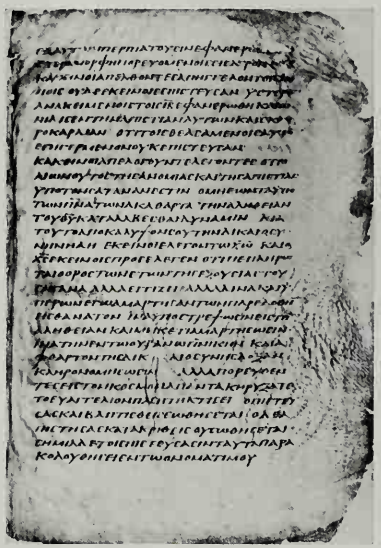
Codex Sinaiticus, Greek, 4th century; portion of Matt. xv. British museum



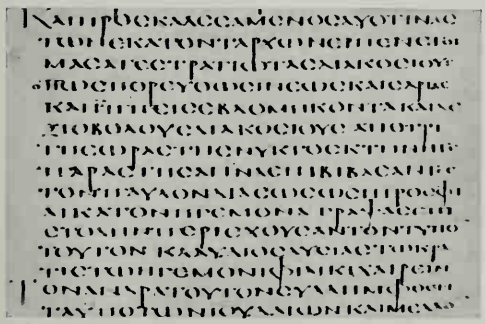
Codex Vaticanus, Greek, 4th century; portion of Mark xiii. Vatican library



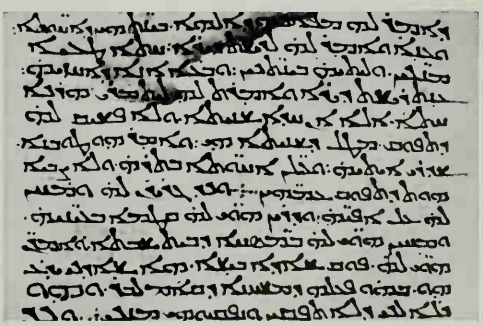
Oxyrhynchus Papyrus, Greek, 3rd century; portion of Matt. i. University museum, Philadelphia



Codex Washingtonianus, Greek, 5th century; interpolation after Mark xvi. Freer Gallery of Art, Washington, D.C.



Codex Alexandrinus, Greek, 5th century; portion of Acts xxiii. British museum



Codex Palimpsestus Sinaiticus, Old Syriac, 4th century; portion of Luke xix. Library of Congress

PORTIONS OF GREEK AND SYRIAC NEW TESTAMENT MANUSCRIPTS

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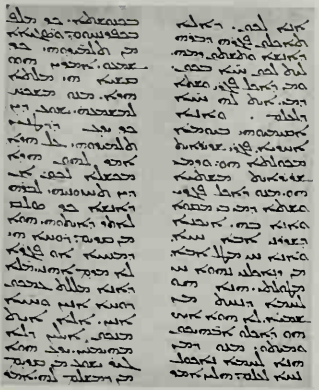
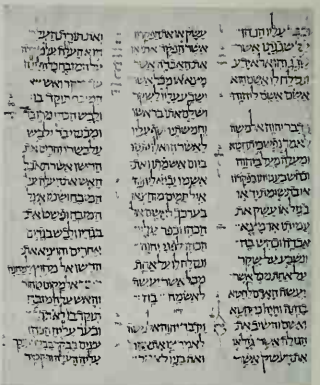
BIBLE

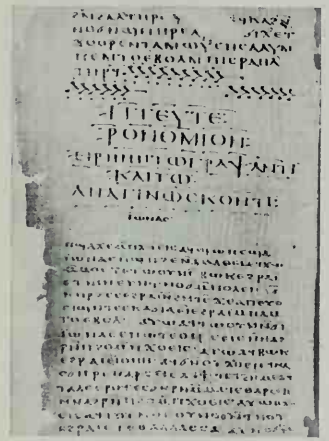


Codex Nitriensis Curetonianus, Old Syriac, 5th century; portion of John vi. British museum

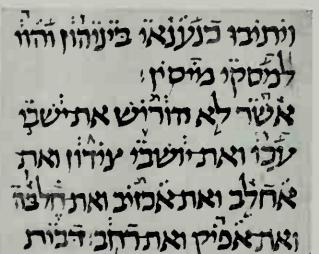
Armenian version, 13th century; portion of Matt. vi. University library, Cambridge



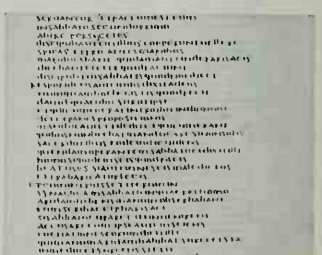
Hebrew, 10th century; page showing part of Lev. v. British museum



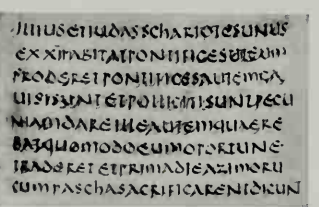
Coptic version, 4th century; portions of Deuteronomy and Jonah. British museum



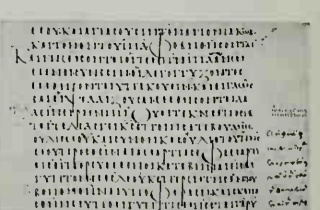
Hebrew, 9th century; portion of Judg. i. University library, Cambridge



Codex Bezae, Latin page, probably 5th century; portion of Luke vi. University library, Cambridge

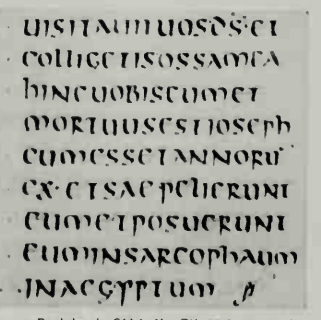


Codex Bobiensis, Old Latin, 4th–5th century; portion of Mark xiv. Biblioteca Nazionale, Turin

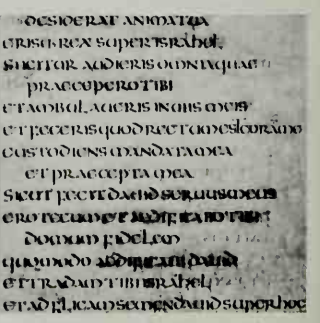


Codex Marchalianus, Greek, 6th century; portion of Isa. xxix. Vatican library

BIBLICAL MANUSCRIPTS OF THE 4TH TO THE 13TH CENTURIES



Lyons Pentateuch, Old Latin, 7th century; portion of Gen. i. Bibliothèque Municipale, Lyons



Latin, fragment of early 8th-century Vulgate manuscript; portion of III (I) Kings xi. British museum

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Hebrew Scriptures, known since early Christian days as the Old Testament. Its exact scope and content have been the subject of controversy (see *Canon and Text*, below). In its general framework the Old Testament is the account of God's dealings with Israel as his chosen people. (However, since the "choseness" of Israel is conceived by reference to the ultimate redemption of all mankind, the Hebrew Bible begins with the story of creation, and in the vision of the prophets it projects the prospect of universal reconciliation with God and deliverance from evil.) Although it begins with the story of the creation, the Old Testament is not an attempt at a history of the world, much less of the universe. Whatever references it contains to the created universe and to the world of nations outside Israel is part of its general purpose—to describe the ways of God in his relations with Israel. That purpose dominates the Old Testament.

Traditionally the Jews have divided the Scriptures into three parts: the Pentateuch, the Prophets and the Hagiographa. The Pentateuch, together with the Book of Joshua (hence the name Hexateuch [*q.v.*]) can be seen as the account of how Israel became a nation and of how it possessed the Promised Land. The division usually designated "the Prophets" continues the story of Israel in the Promised Land, describing the establishment and development of the monarchy and presenting the messages of the prophets to the people. The Hagiographa or "Writings" include speculation on the place of evil and death in the scheme of things (Job and Ecclesiastes), the poetical works of the Old Testament and some additional historical books. In the Apocrypha of the Old Testament various types of literature are represented; the purpose of the Apocrypha seems to be to fill in some of the gaps left by the indisputably canonical books and to carry the history of Israel to the 2nd century B.C.

A detailed chronology of Old Testament history appears in the article JEWS and need not be repeated here. The time span covered by the main body of the Old Testament is approximately 1,000 years. According to most archaeologists and historians the Exodus (*q.v.*) took place some time after 1300 B.C. and the return of Ezra shortly before 400 B.C. For the accounts preceding the Exodus very few chronological data are available, and those exceedingly difficult to synchronize with other information from ancient history. At the other end of the story the Books of the Maccabees provide some additional dates for the period between Ezra and the New Testament. But Old Testament history deals largely with the nine or ten centuries beginning at the Exodus. Some individual events and persons in that history can be synchronized with what is known of ancient history outside the Old Testament; others can be dated with the help of modern archaeological discoveries. Even with all this, however, most assignments of occurrences in the Old Testament to corresponding dates in the Egyptian, Persian, Syrian and Greek calendars are arbitrary and hypothetical. A chronology of the Old Testament, like a historically satisfying biography of Jesus, is impossible on the basis of the materials in the Bible. As in the case of the life of Jesus, this impossibility leads to a fundamental conclusion about these materials: they are intended not primarily as a chronicle but as a testimony of faith. This intention dominates both the form and the content of the Old Testament and is built into the structure of its several parts.

1. Pentateuch.—In the Pentateuch or Torah ("Law") the Bible presents the record of the divine action and legislation underlying its entire subsequent account. With the completion of the events related in the Pentateuch, Israel had finished its captivity in Egypt and its wanderings and was ready to enter the Promised Land. Thus the Pentateuch in a very real sense is the book of Israel's beginnings. For an analysis of the complex literary problems raised by the present form of the books in the Pentateuch, the reader is referred to the article PENTATEUCH and to the articles on its individual books. Genesis is a book about beginnings. It deals first with the beginnings of the universe and of the human race, sketched in the dramatic form of divine commands and actions. There follows the story of man's fall into sin, which is followed in turn by a sequence of events leading up to the deluge. After the deluge comes the second set of beginnings, and it is with these that Genesis is principally concerned. The call of Abraham inaugurates the special covenant of God with him and his descendants, and the remainder of the book is devoted to the history of this covenant as it passes from Abraham to Isaac to Jacob and thus to the tribes of Israel. In the narrative about each of the patriarchs the events of his career are intertwined with reflections that anticipate the later experiences of Israel. A noteworthy feature of these narratives is their continuing emphasis upon the human frailties of the patriarchs, frailties that also anticipate the history of Israel. Running throughout the book is the theme of God's promises to Abraham and, through him, to the covenant people. These promises, in turn, form the ground for the commandments and the warnings of later books. In more than a simple chronological way, therefore, Genesis is the beginning of the Bible. The outline of the Bible and of its message begins with Genesis; without it the remainder of the biblical narrative, Old or New Testament, would not make sense.

Nevertheless, the real beginning and foundation of the Old Testament is contained not in Genesis but in Exodus, which recounts the deliverance from Egypt upon which the covenant relationship between God and Israel is based. The drama of the deliverance opens with an account (or accounts) of the call of Moses to lead Israel out of Egyptian bondage. It continues with the miracles by which God makes known his power and his desire to liberate the people. With the institution of the Passover and the death of the first-born in Egypt the Exodus is inaugurated, and the crossing of the Red sea accomplishes it. Now the Book of Exodus makes the transition from the story of the Exodus proper to the story of Sinai, which is the second and larger part of the book. The giving of the Law at Sinai is an occasion for the reminder that God has brought Israel up out of Egypt and is now affirming his covenant with the people. Corresponding to the human frailties of the patriarchs is the idolatry of the people in the worship of the golden calf. But God pays heed to the intercession of Moses and renews the covenant they have disrupted. The closing chapters of Exodus describe the enactment of the prescriptions for worship given at Sinai, the establishment of the priesthood and the presentation of the tabernacle. Further prescriptions for worship make up the bulk of the Book of Leviticus. These deal with the various types of sacrifice and the appropriate acts accompanying them, with the ceremonial and moral equipment of the Levitical priesthood, with the meaning of ceremonial purity and with the main outlines of Israel's sacred calendar. Leviticus is thus an extension of the narrative in Exodus; and some sections of it, notably the "laws of holiness," represent an amplification of the legislation in Exodus as well. When taken together, Exodus and Leviticus summarize the establishment of Israel as God's covenant people and the enactment of the cultic and other laws that were to mark its life as a covenant people.

Numbers and Deuteronomy likewise belong together, despite the differences between their literary histories. Numbers picks up the narrative at Sinai, adding the account of the census and some additional legislation. From Sinai it carries Israel through the 40 years of wandering in the wilderness and describes certain events during those years. Finally it brings the tribes to the plains of Moab and prepares the way for the account of the conquest of Canaan, which is told in the Book of Joshua. Like Exodus, Numbers repeatedly describes the ingratitude and disobedience of the people, the wrath of God and his forgiveness. The setting of its concluding chapters on the plains of Moab is also the scene of the discourses of Moses in Deuteronomy. This last book of the Pentateuch is a rehearsal of the events that have brought Israel within sight of the Promised Land. It reminds the people of the prerogative given them by God through the particular covenant he has made with them. On the basis of this covenant Moses is represented as repeating and interpreting the moral, ceremonial and civil laws summarized in the earlier books of the Pentateuch, with the rewards and punishments attached to them. Deuteronomy closes with Moses' farewell to the people, his final charge to them in two long poems and his death. Most scholars, though agreed that Deuteronomy was composed rather late in Israel's history, have come to lay increasing stress upon it as a summation of the Pentateuch and therefore a link between the

Pentateuch and other sections of the Old Testament. Taken together, the books of the Pentateuch set up the plot for the remainder of the Old Testament. Among the Jews, therefore, the Law has held a unique place within biblical literature, a place that was not changed with the adoption of other sacred books.

2. Prophets.—Under this title the Jewish Scriptures include a collection of eight books according to the Jewish reckoning; these are listed separately in Christian Bibles and total 21. The collection contains the books ascribed to the prophets, plus several historical books that provide their background and setting.

Historical Books.—The historical books, called the "former prophets," are Joshua (Josue), Judges, I and II Samuel and I and II Kings (Roman Catholic versions of the Old Testament follow the Septuagint in numbering the books of Samuel and of Kings as I–IV Kings). Joshua recounts the narrative of how Israel entered, conquered and divided the Promised Land under Joshua's leadership; it is closely related to the Pentateuch as the fulfillment of its promises and the completion of its story. The Book of Judges (*q.v.*) forms a transition from the account in Joshua, describing the situation of Israel after it had taken over Palestine but before it had stabilized its political and religious life. That stabilization came through the establishment of the Jewish monarchy, whose development is portrayed in the books of Samuel and Kings. I Samuel begins with the career of Samuel as a prelude to the history of the monarchy. Samuel anoints Saul as the first king of Israel, and the rest of the book is a chronicle of his reign, his successes and his ultimate downfall. It is especially concerned with the struggle between Saul and the young David, who had been selected as his successor. In II Samuel are found the biography and character portrait of David (supplemented and revised in I Chronicles). The book seems to be an official version of his life but by no means an idealized one. I and II Kings trace the decline of the monarchy after David. The glory of Solomon's reign is followed by his partial apostasy, and after his death the nation is split into the two kingdoms of Judah and Israel. The books conclude with the history of Elijah and Elisha, whose prophetic work is apparently one of the grounds for classifying these books with the Prophets; actually, the term may perhaps be best reserved for the "major" and the "minor" prophets.

Major Prophets.—The major prophets are Isaiah (Isaias), Jeremiah (Jeremias) and Ezekiel (Ezechiel). Isaiah is probably the most important among them and one of the most influential books in the entire Bible. Literary study of the book has led most scholars to the conclusion that in its present form Isaiah represents the work of at least two prophets (*see* ISAIAH, BOOK OF). Ch. i–xxxix are a commentary upon the relation between Judah and other nations, notably Assyria. The prophet interprets the invasion of Palestine by the Assyrian armies as a sign of divine judgment, but he also promises that eventually God will bring salvation to his people and through them to all mankind. In ch. xl–lxvi Jerusalem has been sacked, and the people have been dispersed in Babylon. These chapters elaborate upon the promises of the earlier section, representing the salvation as coming through the faithfulness of God's suffering servant rather than through the military or political might of the nation.

Similar themes appear in the prophecies of Jeremiah, but the political distress of Judah dominates them even more completely than it does Isaiah's. Jeremiah is the voice of doom for the kingdom of Judah. He sees the coming of the Babylonians as an indication that God wanted to wipe Judah off the map as he had Israel. But Jeremiah also foresees the coming of a new covenant, written into the hearts of men and thus indestructible. Therefore he summons the people to repent, to acknowledge that their defeat forms part of God's merciful purpose.

Ezekiel, too, interprets Israel's foreign relations in the light of the purposes of God, using visions rather than prophetic discourses as the vehicle for his interpretation. In the first half of the book the prophet warns his nation of their impending doom and calls upon them to acknowledge their sin; in the second half he comforts the people in their affliction and promises the new city and new land that God would create for them. (*See* EZEKIEL, BOOK OF.)

For all three of the major prophets, therefore, the purpose of God in permitting the dispersion and captivity of his people is a major theme and a basic problem.

Minor Prophets.—The 12 "minor" prophets are thus designated not because they are less important but because their books are so much smaller; in the Jewish Scriptures they form one book. Hosea (Osee) is a vivid denunciation of Israel's apostasy as adultery, illustrated by the infidelity of the prophet's wife (*see* HOSEA, BOOK OF). Joel uses a plague of locusts and a drought as the basis of his prophecy that God will punish his people but eventually deliver them. Amos directs his prophecy against social and economic injustice, coupled as it was with a smug trust in the correctness of Israel's worship as a guarantee of its future (*see* AMOS, BOOK OF). Obadiah (Abdias) is a vindication of the cause of Israel against the Edomites, who had helped to destroy the kingdom of Judah. Jonah (Jonas) contains more narrative than prophecy and is intended to show that the mercy of God extends not only to the covenant people but to all nations, even to Nineveh. Micah (Micheas) echoes the prophecies of Amos against the notion that worship without social justice would secure the favour of God. Nahum, like Jonah, deals with the city of Nineveh, but with its ruin rather than with its repentance; he interprets its fall as God's punishment for its past sins. Habakkuk (Habacuc) uses the intrusion of marauding bands of Babylonians not to denounce the sins of the people but to consider the providence of God in relation to evil in human history. Zephaniah (Sophonias) views the collapse of Assyria as a sign that the terrible day of divine judgment is imminent. Haggai (Aggeus) is a call for the reconstruction of the Temple in Jerusalem after the Babylonian captivity. Zechariah (Zacharias) is likewise an appeal for the Temple, but it is cast in the form of eight visions of the future. Malachi (Malachias) denounces both the priests and the people for their disobedience to God and for their betrayal of the covenant between God and the nation.

Thus the books of the prophets, both major and minor, form a commentary upon the history of Judah and of Israel. They interpret this history as a sign of God's judgment and of God's mercy, and they call the nation back to repentance and faithfulness. Their role in the total corpus of Old Testament literature is therefore very important (*see* also PROPHET).

3. Hagiographa.—This division comprises a miscellaneous collection of sacred writings that cannot be classified in either the Pentateuch or the Prophets.

Psalms, Proverbs, Job.—These three books constitute the principal poetic literature of the Old Testament, although there are poetic sections in other books as well. In many respects they represent the high point of the Old Testament as literature.

In the Psalms are found poems and hymns that date from various periods in the history of Israel, assembled for use at public worship in the Temple of Jerusalem. Tradition maintains that it was David who originally gathered them together into a psalter, and that after David additional psalms were included. The Psalms express the devotion of the individual and of the nation in reflection upon the deeds of God.

A different kind of reflection lies behind the Book of Proverbs. Like the Psalms, it has a composite origin in the wise sayings of many wise men in Israel and even in the proverbial wisdom of other peoples. The Book of Proverbs differs from most of the Old Testament in many ways, but the most significant difference is the absence of any reference to the events of Israel's history during or since the covenant of the Exodus, as well as of any allusions to the hope of Israel for the future. Instead, most of the book is concerned with general maxims about life that would seem to apply even apart from the history and the hope of Israel.

The Book of Job, one of the most difficult and most profound pieces of literature in the entire Bible, describes the plight of a good man who has become the victim of a series of disasters. Through the device of conversations between Job and other people the writer lists most of the explanations that men put forward for such a plight, and in each case the conversation shows that the explanation is wrong or at least oversimplified. Eventually God himself intervenes, not to provide an oversimplified solution of his own but to declare that the ways of God are essentially

mysterious and that the only solution is to trust in his hidden purposes. (*See* JOB, BOOK OF.)

Megilloth.—A second group in the Hagiographa are the Megilloth or rolls, consisting of the Song of Solomon (Canticle of Canticles), Ruth, Lamentations, Ecclesiastes and Esther. The Song of Solomon, in the opinion of many scholars, is a poem in praise of human love; but by the time it was put into the canon of the Old Testament it was probably being interpreted as an allegory about the love between God and Israel. The Book of Ruth tells the story of a Moabite woman who married an Israelite and became an ancestress of David. Lamentations is a series of acrostics describing the capture of Jerusalem and mourning its fate; it closes with a petition for divine mercy. The Book of Ecclesiastes, like the Book of Job, may well be intended to refute the suggestion that some were drawing from the Proverbs, namely, that the person who obeys the maxims of common-sense morality will prosper on earth. The Book of Esther describes the history of King Ahasuerus and Queen Esther as an explanation for the rise of the Jewish festival of Purim. From the Jewish classification of these five books together and from the contents of the books it is evident that the rather "secular" tone of several of them has made their status as Scripture somewhat problematical. (*See* ECCLESIASTES.)

Daniel, Ezra, Nehemiah, Chronicles.—Also included among the Hagiographa are Daniel, Ezra (I Esdras), Nehemiah (II Esdras) and I and II Chronicles (I and II Paralipomenon). The Book of Daniel describes the career of Daniel and God's interventions on his behalf, and its second half is a highly symbolic interpretation of world history under the direction of divine providence. The other books belong together as apparently the work of one man, usually called the "chronicler." (*See* DANIEL, BOOK OF.) In I and II Chronicles he repeats much of the material from earlier historical books, concentrating upon the history of the kingdom of Judah. I Chronicles is basically a biography of David, which adds further facts to the story as given in Samuel. II Chronicles begins with Solomon and goes through the division of the kingdom to the reign of Zedekiah; here, too, the chronicler had access to materials that supplemented the account in I and II Kings. In the Book of Ezra he describes the return of the Jews from the Babylonian captivity and the reconstruction of the Temple. He includes lists of the families who returned and the texts of the decrees under which they returned. In the Book of Nehemiah, closely related to Ezra, the reconstruction of the city walls of Jerusalem becomes the basis for a meditation upon the relation between God and his people. This book too contains lists of those who participated in the reconstruction, but much of it concentrates upon the description of Nehemiah and his persistence in performing this assignment. *See* also articles on other books of the Old Testament.

4. Apocrypha.—Protestants apply this term to those "deuterocanonical" books that appear in the Septuagint translation of the Old Testament into Greek, but not in the Hebrew text, in Roman Catholic but not in Protestant versions of the Scriptures. They include additions to Esther, Jeremiah and Daniel, but they are made up chiefly of seven books: Tobit (Tobias), Judith, the Wisdom of Solomon, Ecclesiasticus, Baruch and I and II Maccabees (I and II Machabees).

The Book of Tobit tells the separate stories of Tobit and of Sarah, each of whom turned to God in prayer after enduring great anguish. With the help of the angel Raphael, Tobit's son Tobias and Sarah are brought together and are married; the book closes with a description of their blessed estate before God. The Book of Judith is a story of how the beautiful Jewish widow Judith tricked the Assyrian general Holofernes and enabled Israel to resist and defeat its enemy. The Book of Wisdom, like the Book of Proverbs, contains advice for both rulers and subjects; and like Proverbs, it also establishes the origins of wisdom in God. Ecclesiasticus, too, belongs to the wisdom literature and is sometimes called "the Wisdom of Jesus the Son of Sirach." Baruch is apparently a blending of several elements: confessions of sins, a praise of divine wisdom and a series of poems. The Books of the Maccabees are probably the most important in this entire group, supplying much of the narrative between the Old and the New Testament. Both of them relate the struggles of the Jews, under the leadership of the Maccabees, to defend the worship of Israel against the encroachments of pagans like Antiochus Epiphanes. I Maccabees frames its narrative more in historical, II Maccabees more in theological language. Taken together, they are a major source of information about the history of the Jews until a century or so before the time of Jesus. *See* also APOCRYPHA, OLD TESTAMENT; ECCLESIASTICUS; JUDITH, BOOK OF; MACCABEES, BOOKS OF.

B. New Testament

The New Testament is by far the shorter portion of the Christian Bible, occupying less space than the Psalms plus the major prophets. Through its associations with the spread of Christianity, however, the New Testament has wielded an influence far out of proportion to its modest size. Christians are usually more familiar with the content of the New Testament than they are with that of the Old; and probably more has been written about it, despite its size, than about the Old Testament.

Like the Old Testament, the New Testament is a collection of books, including a variety of early Christian literature. The four Gospels deal with the life, the person and the teachings of Jesus, as he was remembered by the Christian community. The Book of Acts carries the story of Christianity from the resurrection of Jesus to the end of the career of Paul. The Epistles are letters by various leaders of the early church, chief among them the apostle Paul, applying the message of the church to the sundry needs and problems of early Christian congregations. The Book of Revelation (the Apocalypse) is the only canonical representative of a large genre of apocalyptic literature that appeared in the Christian movement (*see* APOCALYPTIC LITERATURE). Common to all these types of Christian literature is their setting within the communal life of early Christianity. That communal life is presupposed throughout, even in those New Testament passages that do not seem to reflect it. Its worship, its teaching, its use of the Old Testament and its hope for the future are reflected in the language and content of the books in the New Testament, despite the diversity among them.

The setting of the New Testament within the Christian community is one factor that makes a biography of Jesus or a history of the 1st-century church difficult or impossible. (The problems of such biography and history are discussed in the article JESUS CHRIST.) The books of the New Testament were composed not in order to satisfy historical curiosity about the events they recount but to bear witness to a faith in the action of God through those events. A history of the New Testament is made difficult also by the relatively short time span covered by its books when compared with the millennium and more of history described by the Old Testament. There is less historical information in the New Testament than in the Old, and many historical facts about the church in the 1st century therefore must be arrived at by inference from a statement in one of the Gospels or Epistles. For a detailed analysis of the literary problems in the study and interpretation of the books of the New Testament the reader is referred to the individual articles dealing with them, and for the historical and biographical issues they raise he is referred to the article on CHRISTIANITY as well as to the biographical articles on JESUS CHRIST; PAUL, SAINT; PETER, SAINT; etc.

1. Gospels.—What the Pentateuch is to the Old Testament, the Gospels are to the New Testament: the testimony of faith to the basic events by which the believing community has been constituted. For the Pentateuch, these are the events surrounding the Exodus; for the Gospels, they are the events surrounding Jesus Christ. The Gospels also share with the Pentateuch the distinction of being the portion of the Scriptures to which literary critics have devoted the most detailed attention, as the article GOSPEL makes clear. Though they seem to be dependent upon one another for much of their material, the first three Gospels are distinct books, each with its own purpose and structure; and the Fourth Gospel, whatever its origin, is more individual than any of the others. Seen as a composite, these four portraits form

the basis for the rest of the New Testament. Other parts are earlier, some may be theologically more profound. But the Gospels occupy a special place in the outline of the Bible as the presupposition for all subsequent history and instruction.

The Gospel of Matthew begins with the genealogy of Jesus, followed by an account of his birth and infancy. Its narrative of Jesus' public career opens with the story of his baptism and of his temptation in the wilderness. The next major section of the Gospel presents the collection of sayings known as the Sermon on the Mount in the most complete version extant. It is followed by a series of miracles and by the sending of the Twelve. The clash between Jesus and his adversaries, a series of parables and the story of his repudiation at Nazareth prepare the way for the second half of the Gospel. In this Jesus is represented as going up to Jerusalem with his disciples and preparing them for the events of his suffering by warnings and examples. His controversies with his opponents become more intense, and thus the Gospel sets the stage for the account of his suffering and death. This account now follows, containing some details not reported in the other Gospels. The Gospel of St. Matthew concludes with a brief account of some of Jesus' appearances after the resurrection and with his "great commission" to extend the ranks of disciples to all nations. Throughout the Gospel there are many references to the Old Testament, leading many scholars to the conclusion that it was intended for Jews who had become Christian.

The Gospel of Mark is the shortest and (in the opinion of most scholars) the earliest of the four Gospels. It has no data about Jesus' beginnings at all, but plunges *in medias res* with his ministry of miracles and teaching, inaugurated by his baptism at the hands of John the Baptist. The early chapters of St. Mark contain miracles of feeding, healing and power over natural forces, as well as a number of parables. Like Matthew, Mark devotes its middle chapters to preparation for the story of the crucifixion. Jesus is seen as warning his disciples of the impending events, as entering Jerusalem and cleansing its Temple and as predicting the end of the city and of the world. The last chapters of the Gospel contain a narrative of the last days of Jesus, of his capture and execution and of his appearances after the resurrection. In the middle of telling about this last, the text of the Gospel breaks off; at least two attempts were made in the early church to fill out the story. If the emphasis of St. Matthew is upon Jesus as the fulfillment of Old Testament prophecy, the emphasis of St. Mark is less upon this fulfillment than upon Jesus as the worker of mighty deeds.

The Gospel of Luke contains much material that is in neither Matthew nor Mark. It opens with stories about the birth and the early life of Jesus that are unique to it, and to these it adds its own genealogy. The baptism and temptation of Jesus form the prelude to his ministry. This ministry is described first in its Galilean phase, which includes many miracles of healing as well as some instruction, part of which is Luke's shorter version of the Sermon on the Mount. There follows the largest single section of the Gospel, recounting the travels of Jesus through Samaria, Judaea and Peraea. Some of the material in this section appears elsewhere, but much of it is peculiar to Luke, as for example the parable about the prodigal son and that about the Pharisee and the publican. Like Matthew and Mark, Luke prefaces his version of the passion story with an account of Jesus' activities in Jerusalem in the last days. His account of the passion contains some facts that are absent from the other Gospels, and his reports of the appearances of Jesus after the resurrection are particularly detailed. St. Luke seems to have been written for Christians of non-Jewish origin, of whom the unknown Theophilus mentioned in the first chapter was a representative.

The Gospel of John has very little in common with any of the other Gospels. After its famous prologue, dealing with the incarnation of the Word of God, the Gospel narrates the adult life of Jesus around the framework of several Jewish festivals. Thus it is from this Gospel that the supposition of three years, more or less, as the duration of Jesus' ministry is derived. Into the first year St. John seems to put the early miracles of Jesus, the cleansing of the Temple (assigned to the last days of Jesus by the other Gospels) and activity in both Judaea and Galilee. As this Gospel seems to reckon the chronology, the second year contains much of the Galilean ministry recounted by the other Gospels. Most of St. John is concerned with the third year, into which it seems to put the majority of its discourses. In addition to details of the passion that appear elsewhere, the Fourth Gospel presents the closing words of Jesus to his disciples in the upper room, including his last prayer to the Father before his suffering. Most of the material in the resurrection accounts of John is also unique to this Gospel. Interpreters are not in agreement about whether the Gospel intends its framework to be chronological or symbolic, but they are agreed in assigning it a distinctive place among the four portraits of Jesus.

2. Acts.—Written as a continuation of the Gospel of Luke, the Acts of the Apostles is also a link between the Gospels and the Epistles. The ascension of Christ and the coming of the Holy Spirit introduce the story of the growth of Christianity. In the early chapters of the book, the dominant figure is Peter, who is the spokesman for the church and the leader of the Twelve. The preaching and the martyrdom of Stephen close this description of the congregation at Jerusalem and provide a transition to the main section of the Acts, the ministry of Paul to the gentiles. A heavenly vision is instrumental in converting Paul, and another convinces Peter that the Gospel is for gentiles as well as Jews. Most of the remaining chapters describe the missionary journeys of Paul and his associates, covering Asia Minor and parts of Europe. The missionary practice on those journeys raises once more the question of applying the Levitical regulations to gentile converts, and a council at Jerusalem has to settle the question. On a subsequent visit to Jerusalem Paul is involved in a riot and appeals to his Roman citizenship. As a result he appears before various Roman officials; and after delays, including a shipwreck, he lands in Rome. Here the book leaves him, and the denouement of the story must be supplied from the Pauline Epistles and from tradition. Neglected though it has sometimes been by students of the Scriptures, the Book of Acts performs for the New Testament the same function that is performed for the Old Testament by its historical books. Without it the reader of the Epistles frequently loses his orientation.

3. Epistles.—By far the largest number of writings in the New Testament are the Epistles, 21 in all. Most of them were composed in response to a specific need in one of the 1st-century Christian congregations, but some of them seem to have been circular letters intended for several congregations. More than half of them are ascribed to Paul, although critics have questioned this ascription in some cases. The state of research on such problems as authorship and date is discussed in the separate articles on each of the Epistles and need not be repeated here.

The Epistle to the Romans has the most complete statement of Paul's teaching contained in any one letter. From the demonstration of the universality of human guilt it moves to the doctrine of justification, exhibited in the faith of Abraham. Next the apostle discusses the new life that comes in justification and his own struggles of faith. Consideration of this leads him to ponder the mystery of Israel and of divine election. The second part of the epistle lists some of the concrete personal and social situations in which the new life is to find expression. I Corinthians describes some of the problems that were afflicting early Christian communities: schism, an overemphasis upon the eloquence of certain preachers, sexual immorality, eating meat offered to idols, discrimination and other disorders at the Lord's Supper, confusion because of the gift of tongues, and denial of the resurrection. II Corinthians, too, considers the problems of the congregation, but not in such detail. It consists largely of a vindication of Paul's apostolic ministry against his detractors and a commendation of the generosity of the Corinthian congregation. Vindication of Paul's apostolic ministry is likewise a major theme of the Epistle to the Galatians, which distinguishes even more sharply than does Romans between the Gospel and the Jewish Law. It is thus a defense of Christian liberty. The Epistle to the Ephesians also seems to have been occasioned by the problem of Jewish-Christian

relations, but here the theme is the unity of Jew and gentile in the one church of which Christ is the head. The Epistle then applies that unity to the ethical life of Christians, especially to marriage and the family. The Epistle to the Colossians has much in common with Ephesians, and the literary relationship between them has been a puzzle to New Testament scholars. Like Ephesians, Colossians concentrates its attention upon the church; but it seems to have been evoked by a denial of the church's view of Christ, and therefore the close connection of Christ and the church receives a new emphasis. (*See* COLOSSIANS, EPISTLE TO THE.) The Epistle to the Philippians is one of the more personal of Paul's letters. After describing his personal feelings for the church at Philippi, he holds up the humility of Christ as an exemplar for its members and goes on to recount his own faith and experience. On the basis of this he urges them to fulfill their Christian vocation.

The First Epistle to the Thessalonians, like Philippians, has a strongly personal tone. It describes the history of Paul's relationship with the congregation at Thessalonica and then goes on to present the second coming of Christ as a comfort to those who were mourning the death of their fellow-Christians. II Thessalonians seems to have been intended chiefly as a corrective for the impression created by I Thessalonians. Expectation of the second coming had unsettled the congregation, and therefore the writer describes some of the events that had to precede the advent of Christ, especially the rise of the Antichrist; he concludes with an admonition to steadiness and industry.

The Pastoral Epistles (*q.v.*) are written in the form of advice from the apostle to two young associates, Timothy and Titus. Their authorship by Paul is widely questioned by biblical scholars. The First Epistle to Timothy urges Timothy to defend the apostolic faith against false teachers and to conduct his ministry according to the instruction and the example of Paul. II Timothy also counsels him to be steadfast in the conflict with false teachers, and it adds some personal notes about Paul as he faces the prospect of martyrdom. In the Epistle to Philemon Paul pleads the cause of a runaway slave, Onesimus, and asks that he be treated kindly by his master.

The Epistle to the Hebrews is still attributed to Paul by some students of the Bible, but the vast majority of scholars would not maintain that Paul wrote it himself. It is an elaborate argument for Christianity as the successor of Judaism. To support this argument it describes the superiority of Christ to the angelic and human mediators of the old covenant. It is especially concerned to show that he is superior to the priests of the Old Testament, and that his sacrifice is permanent while theirs was temporary. The Epistle concludes with an exhortation to follow the example of the heroes of faith, past and present.

The seven remaining letters in the New Testament often are grouped as the "Catholic Epistles." The Epistle of James (*q.v.*) seeks to combat the notion that the free grace of God makes good works unnecessary, and it contrasts a false religion of outward Christian profession with the true religion of Christian service. The First Epistle of Peter encourages Christians in the midst of suffering by describing their prerogatives as recipients of God's inheritance, and it urges them to live so blamelessly that, if they do suffer, it will be for their loyalty to Christ and not for any failure in morals. II Peter is much different in character and purpose. It warns its readers against false teachers who have come into the church, describing both their heresies and the horrible fate that awaits them. The Epistle of Jude contains the same warning and probably was used by the author of II Peter. I John also directs itself against the false teachers, but it places this warning in a discussion about love. Reflection of God's love in human life and a proper confession of Jesus as the Christ are the marks of the true Christian. II John is another admonition to beware of false teachers and to practise Christian charity. III John is a brief letter of recommendation for one Demetrius, addressed to one Gaius. (*See* JUDE, EPISTLE OF SAINT.)

4. Revelation.—The last book of the Bible, the Revelation to John, or Apocalypse, consists of a series of visions granted to the writer and now communicated by him to several Christian congregations in Asia Minor. In these visions, whose details always have caused consternation to students of the Bible, the seer glimpses the eventual victory of the church over its enemies through the power of Christ, the Lamb of God, but only after a bitter conflict. The victory is to lead to a new heaven and a new earth and to the destruction of the enemies of the church. Written to churches that faced the twin perils of persecution and indifference, these visions were intended to strengthen their hope and their resolution.

II. CANON AND TEXT

From the outline given above it is evident that the Bible is a series of pictures, some of them simple portraits, others more subtle sketches, still others highly abstract symbols. For that reason the determination of what does or does not belong in the Bible is not an easy task, as this section of the article will show. The translation of this variety of language and literature into a new language likewise creates difficulties, some of which will be discussed below, under *Translations*.

When a Protestant examines a Roman Catholic version of the Bible, he notices the presence of certain books that do not appear in his own Bible. Why should this be so, he may ask, and how did those books get into the Bible? To answer this question is the purpose of studies in the history of the biblical canon. In addition, when almost any reader examines a new translation of the Bible, he discovers that some well-known passages are missing from it. Why should this be so, and on what basis have these passages been excluded? To answer this second question is the purpose of studies in the biblical text. These two questions should be answered together, because they both deal with the problem: What belongs in the Bible and what does not? But since the methods used to answer them are quite different, each question needs to be handled individually. As regards both text and canon, moreover, the study of the Old Testament creates special difficulties, different from those encountered in the study of the New Testament. This discussion will take up these four topics in succession.

A. CANON OF THE OLD TESTAMENT

The question as to which books belong in the Old Testament is complicated by the history of the Old Testament in both Judaism and Christianity. Not only is the use of the word "canon" as a designation for an authoritative list of sacred books a rather late phenomenon, even the idea of a fixed and final list came about only after a long evolution.

1. Jewish Canon.—It is not known when and how the earliest collection of sacred writings in Hebrew arose. The incident reported in II Kings xxii clearly presupposes the existence of some such collection; but both the incident and the collection are impossible to date, and some critics believe that the whole story is actually intended to explain the composition of portions of the Pentateuch, including most or all of the Book of Deuteronomy. Evidently, however, the Pentateuch (or at least its first four books) was in process of assembly in Jerusalem before that time.

Division of the Old Testament into the Law, the Prophets and the Hagiographa may reflect stages in the history of the canonization of the Old Testament. Thus the Law (with or without Deuteronomy) may have been the first to be canonized, then the written form of the message of the prophets, then some other writings whose status and scope meanwhile had remained in doubt. On the other hand, some historians of the Old Testament canon are inclined to question this interpretation. It would be possible to speak with greater authority if the content of the books referred to in the stories of Ezra vii and Nehemiah viii–x as "the Law" were known. A late Jewish tradition maintains that a "Great Synagogue" at the time of Ezra and Nehemiah met to establish the canon of the Bible. Although this tradition has enjoyed wide circulation and credence among both Jews and Christians, most historians tend to doubt its reliability; for it is obvious from other and more reliable sources that the extent of the Old Testament continued to be a problem for Jews and Christians long after Ezra and Nehemiah.

The safest generalization permitted is this: various collections of sacred writings were put together quite early in the history of

Israel, but they did not become a "canon" until much later. How much later, depends upon the interpretation put upon the list of books assembled in the Greek translation of the Old Testament, the Septuagint (see *Translations,* below). By the time it was completed, this translation included the Law, the Prophets, the Hagiographa and the Old Testament Apocrypha; but it did not list them in that order. The inclusion of the Apocrypha in the Septuagint has caused some scholars to conclude that there were two Jewish canons, a narrower one current in Palestine and a broader one current in the Greek-speaking world. Most scholars, however, have drawn the inference that the Jewish collection of sacred books was still in a fluid state in the 2nd century B.C., that the status of the Apocrypha, as well as that of some books in the Hagiographa, was unclear. This circumstance permitted these books to be included in the Septuagint. But it seems to be an anachronism to speak of any collection in this period as a canon, Palestinian or Alexandrian. For the subsequent history of the Old Testament canon, however, the list of books assembled in the Septuagint was to be of vital importance.

The name canon may properly be applied to the books that seem to have been adopted by the assembly of rabbis at Jamnia about A.D. 90 or 100 under the leadership of Rabbi Akiba. Until then, apparently, the status of the Song of Solomon and of Ecclesiastes remained doubtful, but at Jamnia they were definitely included in the canon. That canon did not include the additions to Esther, Jeremiah and Daniel that are found in the Septuagint; nor did it include Tobit, Judith, Wisdom, Ecclesiasticus, Baruch and the Books of the Maccabees. Formally, then, the Jewish canon of the Scriptures came to include the Pentateuch, the Prophets and the Hagiographa, as it has ever since. In this canon, however, the Pentateuch has held a special place as a "canon within the canon"; the usage in the New Testament suggests that it had some such status by early Christian times and probably much earlier.

Additional light on the process by which the Jewish canon of the Old Testament was formed has come from the discovery of the Dead sea scrolls. The books of the Old Testament included in them suggest that the Pentateuch and the Prophets had been standardized by about the 4th century B.C., together with most of the Hagiographa; but some of the Hagiographa (including apparently Daniel) were still in dispute until the assembly at Jamnia. After the fall of Jerusalem in A.D. 70 and the rise of the Christian movement, the Jewish community felt obliged to fix the limits of its Bible more precisely. So it was that certain books occasionally included were excluded (the Apocrypha) and that others previously challenged were included (some of the Hagiographa).

2. Christian Canon.—The Bible of Jesus and of the early Christians was the Old Testament, but no list of the books it might have included exists. To ascertain its scope it is necessary therefore to scrutinize the Old Testament quotations and references that appear in the New Testament. Such scrutiny has occupied generations of biblical scholars, who have identified references and allusions to most of the books of the Old Testament, though not to all of them. Among the books to which the New Testament refers are several of the deuterocanonical books of the Old Testament, as well as some books, such as Enoch, that do not belong to any canon. Some scholars even have attempted to identify two canons of the Old Testament lying behind the New; they contend that the Old Testament used by the Epistle to the Hebrews was the Septuagint canon, while that used by other portions of the New Testament was the narrower Palestinian canon. These attempts, however, have not proved convincing to the majority of biblical historians. Thus it seems that the study of the Old Testament quotations in the New Testament has led to an ambiguous conclusion regarding the state of the Old Testament "canon" in the 1st century A.D.

That ambiguity makes it understandable that the early Fathers of the Christian Church were unclear about the canon of the Old Testament. Melito of Sardis, who lived during the 2nd century, is said by Eusebius to have inquired among eastern rabbis about the scope of their canon. The catalogue they gave him, as reproduced by Eusebius, corresponds neither to the Hebrew nor to the Greek list of books: it contains the Wisdom of Solomon but it does not contain the Book of Esther. A list given by Origen during the 3rd century includes Esther but puts it at the very end; the catalogue of Athanasius (4th century) omits Esther altogether. For most of the early Christian Fathers the Old Testament meant the Septuagint, since few of them other than Origen knew Hebrew. Although they were aware of the divergence between the canon as accepted by the Jews and the list of books contained in the Septuagint, the examples of Melito, Origen and Athanasius suggest that the status of the disputed books remained in doubt during the first four centuries of the Christian era.

Jerome (*c.* 347–*c.* 420) was one of the few Christians in those centuries to learn Hebrew. What he learned from Jewish rabbis caused him to distinguish sharply between the canon as approved by the Jews and the catalogue represented in the Septuagint. As he came to prefer the Hebrew text to the Septuagint, so he also assigned primary authority to the Jewish canon and put the deuterocanonical books or Apocrypha into, at best, a secondary position. Jerome's contemporary, Augustine, on the other hand, provides a catalogue of Old Testament writings that includes these books. Throughout the middle ages the status of the deuterocanonical books remained doubtful. Some theologians followed Jerome and excluded them altogether from the Bible in the strict sense; others followed Augustine and accepted them with very little hesitation; still others had reservations about them but used them as Holy Scripture. Contact between Jewish and Christian scholars, which was commoner during the middle ages than is often supposed, served to point out to many Christian theologians the discrepancies between their Old Testament and the Bible of the Jews. But it was not until the period of the Reformation that the issue once more became a matter of concern and of controversy to Christian thinkers.

As part of their insistence that the church return to the Bible, the Protestant Reformers called for the elimination of the deuterocanonical books from the Scriptures. Luther's translation of the Bible included them but put them into a separate section as

Canon of the Old Testament

Judaism*	Roman Catholicism and Eastern Orthodoxy	Protestantism
(1) Bereshith	Genesis	Genesis
(2) Shemoth	Exodus	Exodus
(3) Wayiqra	Leviticus	Leviticus
(4) Bemidbar	Numbers	Numbers
(5) Devarim	Deuteronomy	Deuteronomy
(6) Yehoshua	Josue	Joshua
(7) Shofetim	Judges	Judges
(17) Ruth	Ruth	Ruth
(8) Shemuel	I Kings	I Samuel
	II Kings	II Samuel
(9) Melakhim	III Kings	I Kings
	IV Kings	II Kings
(24) Divre Hayomim	I Paralipomenon	I Chronicles
	II Paralipomenon	II Chronicles
(23) Ezra-Nehemyah	I Esdras	Ezra
	II Esdras	Nehemiah
(Noncanonical)	Tobias	(Apocrypha)
(Noncanonical)	Judith	(Apocrypha)
(21) Ester	Esther	Esther
(15) Iyob	Job	Job
(14) Tehillim	Psalms	Psalms
(16) Mishle	Proverbs	Proverbs
(19) Qoheleth	Ecclesiastes	Ecclesiastes
(18) Shir Hashirim	Canticle of Canticles	Song of Solomoo
(Noncanonical)	Wisdom	(Apocrypha)
(Noncanonical)	Ecclesiasticus	(Apocrypha)
(10) Yeshaya	Isaias	Isaiah
(11) Yirmeya	Jeremias	Jeremiah
(20) Ekha	Lamentatioos	Lamentations
(Noncanonical)	Baruch†	(Apocrypha)
(12) Yehezqel	Ezechiel	Ezekiel
(22) Daniel	Daniel	Daniel
	Osee	Hosea
	Joel	Joel
	Amos	Amos
	Abdias	Obadiah
	Jonas	Jonah
(13) Tere Asar	Micheas	Micah
	Nahum	Nahum
	Habacuc	Habakkuk
	Sophonias	Zephaniah
	Aggeus	Haggai
	Zacharias	Zechariah
	Malachias	Malachi
(Noncanonical)	I Machabees†	(Apocrypha)
(Noncanonical)	II Machabees†	(Apocrypha)

*Numbers indicate order in Hebrew Bibles.
†Part of the Roman Catholic but not of the Eastern Orthodox canon.

"Apocrypha," which deserved to be read but not to be put on the same level as canonical Scripture. The other Reformers were even more vigorous in their opposition. Believing that the Old Testament canon in use among the Jews of their time was also the Bible of Jesus and of the early Christians, they refused to accept quotations from the Apocrypha as support for Christian teaching. The use of certain passages in the Apocrypha to support prayers for the dead and other Roman Catholic practices and doctrines only strengthened them in this refusal. During the 19th century Protestants in England went so far as to prohibit the printing of Bibles that included the Apocrypha, even with an explanatory note like the one in Luther's translation. Not until the 20th century did it become possible once more to issue the Apocrypha within the covers of Protestant Bibles, and that only in some few editions.

In antithesis to the position of the Reformers, the Roman Catholic Council of Trent (1545–63) made the larger canon, including the deuterocanonical books, the official list of books for the church. A century later, in 1672, the Synod of Jerusalem established the Old Testament canon for the Eastern Orthodox churches, accepting four of the books in the Septuagint (Tobit, Judith, Wisdom and Ecclesiasticus) but rejecting Baruch and the Books of the Maccabees.

Ever since the 16th and 17th centuries, therefore, the churches of Christendom have had a clearly defined canon of the Old Testament—or, rather, three canons, one each for Roman Catholicism, Protestantism and Eastern Orthodoxy. The canon of Protestantism and that of Judaism are identical, but the order of books is different. The differences among the several canons can best be illustrated by means of a table, in which are given also the names of the Biblical books as they are used in Judaism, Roman Catholicism and Protestantism.

B. Text of the Old Testament

The form in which the Hebrew text of the Old Testament is presented in most manuscripts and printed editions is that of the Masoretic text, the date of which is usually placed somewhere between the 6th and 8th centuries A.D. (*See* Masoretes.) It is probable that the present text became fixed as early as the 2nd century A.D., but even this earlier date leaves a long interval between the original autographs of the Old Testament writers and the present text. Since the fixing of the Masoretic text the task of preserving and transmitting the sacred books has been carried on with the greatest care and fidelity, with the result that the text has undergone practically no change of any real importance; but before that date, owing to various causes, a larger number of corruptions indisputably were introduced into the Hebrew text.

Originally the text consisted only of consonants, since the Hebrew language had an alphabet without vowels. It is also likely that in the earliest texts the words and sentences were not divided. The evolution of the Masoretic text was an attempt to make up for both these deficiencies. It supplied vowels by adding marks to the consonantal text, and it divided the words and sentences. For many centuries it was believed that these vowel points formed part of the original text; some theologians argued that the points were inspired by the Holy Spirit. But subsequent research has proved beyond doubt that they are younger by almost 1,000 years than the text itself.

On the basis of a variety of evidence it is possible to show that the Masoretic text is not a completely reliable index to the readings of the autographs of the Old Testament. Even a superficial comparison between its readings and the Septuagint translation discloses many passages in which the translators of the Old Testament into Greek ascribed different vowels to the consonantal text or divided the words differently from the way they are now divided in the Hebrew text. In other passages they simply had another text before them. Considering that the Septuagint translation antedates the Masoretes by so long a span, we are forced to admit that the Hebrew text underlying it sometimes comes closer to the original reading of a particular passage than does the Masoretic. Other evidence, too, renders an uncritical acceptance of Masoretic readings impossible; it is obvious that the text has been tampered with in some places. In determining the text of the Old Testament, the scholar is not faced by the multitude of manuscripts and variants that provide the materials for New Testament textual criticism (*see* below); but for that very reason the task of arriving at a reliable text is even more complicated.

What complicates the task is, among other things, the sorry state of the Septuagint text itself. Parts of it are very well attested and may form the basis for judgments about the Hebrew, but other parts are so confused textually that in some instances scholars are inclined to posit two or more translations. After all, without a reliable text of the translation, the translation cannot very well be used to emend the text of the original. What is more, a study of the Septuagint also reveals many passages in which the translators purposely paraphrased the text or changed its meaning when the original was either embarrassing to them or unclear; for example, certain concrete terms in Hebrew are translated into abstract terms in Greek to avoid the charge of anthropomorphism.

Such considerations prompt the textual critics of the Old Testament to be cautious in emending the Masoretic text where it is at variance with the Septuagint, but the critics are by no means agreed about how much weight they should assign to the Masoretic readings and how much to the Septuagint in the various parts of the Old Testament. Even so renowned a student of the Old Testament text as Paul Kahle was unable to secure universal acceptance of his textual theories. The Dead sea scrolls have reinforced the reliability of the Masoretic readings in some passages of the Old Testament, while in others they have shown a marked similarity to the Hebrew text on which the Septuagint seems to have been based. They make clear the existence of several textual traditions even in Hebrew; they have therefore made important contributions to the textual criticism of the Old Testament, but they have not solved its fundamental problem. Barring a major discovery of manuscript materials, this problem is probably insoluble, and the best that can be achieved is an approximation of the text of the Old Testament.

C. Canon of the New Testament

Christians usually have to think twice to realize that there was once a time when the Christian Bible did not contain both the Old and the New Testament. New Testament statements such as II Tim. iii, 16, "All scripture is inspired by God," are predicated of what came later to be called the Old Testament; so are many of the references to "Scripture" in the early Fathers. Only gradually did Christians find it necessary to add a second collection of sacred books as the "New" Testament alongside the Old. In tracing the history of that collection and of its adoption as the canon of the New Testament, we are supplied with a much more detailed set of source materials than we are when we attempt to sketch the evolution of the Old Testament canon. Unfortunately, this does not necessarily mean that the history of the New Testament canon is always clearer than the history of the Old Testament canon, only that it is more amply documented.

1. Canon and Tradition.—Before any books were included in the canon of the New Testament, or even composed, the Christian Church used the Old Testament as its Bible; but it possessed also its tradition of memory about Jesus Christ. This tradition lies behind and is presupposed throughout the New Testament. To it St. Paul could refer in discussing the Eucharist or the resurrection. His Epistles say as little as they do about the life and teachings of Jesus at least partly because the church was already rehearsing these in the forms of its tradition. Its teaching, preaching and worship all reflected this tradition. Its very interpretation of the Old Testament appears to have been part of the tradition, as the use of certain Old Testament passages in the New Testament and in early fathers suggests. Awareness of this tradition is necessary for understanding of the processes by which the canon of the New Testament was evolved, for it helps to explain why certain books were selected as canonical and at least some of the criteria by which the selection was made.

Several factors seem to have been responsible for the rise of the New Testament canon, but church historians vary in the amount

of weight they assign to each. One factor certainly was the sheer passage of time, as the church needed to discover whatever resources it could to bind it to its past and to guarantee its continuance in the tradition of the faith; the "memoirs of the apostles" were one such resource. Also responsible for the establishment of the canon was the circulation of writings that bore the names of apostles but did not contain apostolic teaching (as that apostolic teaching was being interpreted by the church). The only way to eliminate these forgeries was to define the limits of the apostolic writings. Such a definition became a crucial necessity when the heretic Marcion (*q.v.*) compiled a canon of the New Testament containing his edition of the Epistles of Paul and of the Gospel of Luke, which he regarded as the only genuine Gospel. Although it now appears that Marcion did not cause the church to establish its canon, he did accelerate the process. Another heretical movement that helped to accelerate it was Montanism (*q.v.*), whose claim of speaking in the name of the Spirit could be countered only by reference to the authentic speaking of the Spirit in the apostolic witness of the New Testament writings. The task of sifting through the writings of the early church and of identifying this apostolic witness occupied Christians well into the 4th century. Eusebius (*q.v.*) suggested the following division of these writings: (1) some were acknowledged almost universally as part of the New Testament; (2) others were disputed but finally accepted; (3) still others were considered more or less seriously but eventually rejected.

2. Acknowledged Books.—The earliest pieces of Christian literature to be collected seem to have been the letters of Paul, but it could appear that initially at least they did not qualify as "Scripture." From the liturgical usage of the church at Rome it would appear that the Gospels were the first Christian books to be added to the Old Testament as supplementary Scripture, and that this had happened by the middle of the 2nd century. Also from Rome, and also apparently from the 2nd century, comes the oldest extant list of New Testament writings, the so-called Muratorian fragment, so named because it was published by Ludovico Muratori. It was written in Latin and contains the names of the books being read in the church at Rome about A.D. 200. By about that time, as the writings of Irenaeus and Tertullian suggest, both Lyons and Carthage were using the Gospels, the Epistles of Paul and some other Epistles as Scripture. A few years later the works of Origen in Alexandria make it clear that he also was working with a similar though not an identical collection.

From these four places—Rome, Lyons, Carthage and Alexandria—may be compiled a list of books on which they all seem to have been agreed. That list would include the following, given in the order now employed in the New Testament: Matthew, Mark, Luke, John, Acts, Romans, I Corinthians, II Corinthians, Galatians, Ephesians, Philippians, Colossians, I Thessalonians, II Thessalonians, I Timothy, II Timothy, Titus, Philemon and I John.

3. Disputed Books.—From these same sources and from several church fathers quoted by Eusebius may be assembled also a list of the books that were disputed on one or another ground, but that eventually were included in the canon of the New Testament. The Epistle to the Hebrews belongs to this category. It seems to have been accepted in the eastern section of the church but disputed in the west, for it does not appear in the Muratorian canon and is also questioned by other writers. The Epistle of James was in doubt among even more writers. Although I Peter is almost universally acknowledged, it is not listed in that category because of its absence from the Muratorian catalogue. II Peter, on the other hand, was questioned by many fathers who accepted I Peter. The Epistle of Jude appears in the Muratorian canon but was rejected elsewhere. II John and III John sometimes were included with I John as one book, but they did not receive the universal support that it did. The Book of Revelation probably was the object of more antagonism than any other of the books eventually canonized. The Montanist movement made apocalyptic literature suspect in the orthodox church, and some writers did not believe that the same man had written the Gospel of John and Revelation.

4. Rejected Books.—An exhaustive list of these appears in the article Apocrypha, New Testament.

5. Formation of the Canon.—The writings of Eusebius and of his great contemporary Athanasius make it evident that agreement on the disputed books was approaching by the middle of the 4th century, and that the canon of the New Testament that now appears in our Bibles was gaining general, if not quite universal, acceptance. That canon appears for the first time in the 39th Festal Letter of Athanasius, A.D. 367.

After the Festal Letter other traditions held their own for a time. Thus the school of Antioch in general accepted only three Catholic Epistles—James, I Peter, I John—while one of its most illustrious representatives, Theodore of Mopsuestia, rejected the whole of this section of the canon. The west followed the lead of Athanasius. In 382 a synod was held at Rome under Pope Damasus at which the influence of Jerome secured the adoption of a list of books answering to that of Athanasius. This was ratified by Pope Gelasius at the end of the 5th century. The same list was confirmed independently for the province of Africa in a series of synods at Hippo Regius in 393 and at Carthage in 397 and 419 under the leadership of Augustine. The second canon of the second Trullan council of 692, the Quinisextum, may be taken to have formally closed the process of the formation of the canon for east and west. Yet Eusebius' distinction between acknowledged books (homologoumena) and disputed books (antilegomena) did not disappear completely from the church. It was revived by Luther in his objections to the Epistle of James, and it formed part of the basis for the modern reconsideration of the canon.

D. Text of the New Testament

The text of the New Testament probably has received more attention and careful study than any other document in history, ancient or modern. In fact, many of the techniques of textual criticism now applied to literary sources of all kinds were developed originally for the establishment of the text of the New Testament. Textual criticism is important as part of the process by which the church and scholarship seek to determine what belongs in the Bible and what does not. Canonical questions and textual questions are technically distinct, but they often intersect. Thus the question of the "long ending" of Mark's Gospel involves both textual and canonical judgments. Did the last chapter of St. Mark originally end with verse 8, as it now does in the best manuscripts, or with one of the endings attached to it in other manuscripts and in several translations or with a conclusion now lost? On the other hand, when the Gospel became part of the canon, was the "long ending" (verses 9–20) already a part of the accepted text? Usually, however, canonical study determines which books belong in the Bible, while textual study determines which text of each of those books comes closest to being the right one.

1. Evidence.—Textual criticism of the New Testament becomes necessary because of the thousands of variations in the existing manuscripts and versions. Some of these variations, to be sure, are inconsequential, involving three different forms of the name "Jerusalem" or three different renderings of the name "Gerasenes" in Mark v, 1. Other variations, however, affect the meaning of an entire passage or verse. If Roman v, 1 reads "*We have* peace with God," it means one thing; but if it reads "*Let us have* peace with God," it would seem to mean another thing. When scholars set about to decide which of these two readings should be adopted, they must consult the available textual evidence.

The main source of the evidence and of the variations are the manuscripts of the New Testament, dating from the 2nd to the 10th century or even later. In the process of copying, these manuscripts underwent the revisions that necessitate textual criticism. Some of these revisions were unintentional, as the scribe skipped a word or a line or as he mistook one character for another. Other revisions came from the desire of the scribe to harmonize the text of one Gospel with another or of one Testament with the other, or from his pious wish to "correct" or clarify the text at another point. But now that variations in the text exist, collation of the manuscripts is a difficult task. The books listed in the bibliography to this article provide a detailed description of the chief codices of the New Testament, together with plates illustrating the text.

Here are listed only a few of the most important ones, together with their usual symbols.

Codex Sinaiticus (ℵ).—This manuscript (now in the British museum), containing the Greek Bible (Old Testament incomplete) plus the Epistle of Barnabas and part of the *Shepherd of Hermas,* was discovered in 1844 in the monastery of St. Catherine on Mt. Sinai by L. F. K. von Tischendorf (*q.v.*). It was written probably in Egypt, probably during the latter part of the 4th century.

Codex Alexandrinus (A).—Presented by Cyril Lucaris to James I of England, this early 5th-century manuscript contains the Greek Bible (not quite complete) together with some other material including I and II Clement (both incomplete). Its history before the 17th century is obscure, but it may have come from Mt. Athos and perhaps was written in Egypt. It is now in the British museum.

Codex Vaticanus (B).—Also from the 4th century and probably from Alexandria, this codex contains the entire Greek Bible (not complete). It is housed in the Vatican library, where it has been at least since 1481; its early history is unknown.

Codex Ephraemi Syri Rescriptus (C).—Although this palimpsest manuscript of the Greek Bible is very incomplete, its 5th-century origin and the evidence it supplies make it important for the text of certain portions of the New Testament, every book of which except II Thessalonians and II John is represented in it to some extent. It is preserved in the Bibliothèque Nationale, Paris.

Codex Bezae (D).—For the text of the Gospels and the Acts, this manuscript (probably 5th century) in both Greek and Latin is of fundamental significance. It was presented to Cambridge university, where it is still housed, by Theodore Beza in 1581. Its history before the 16th century is unknown.

Other Evidence.—In addition to these codices of the New Testament, there are other manuscripts, the oldest written on papyrus and dating from the 2nd and 3rd centuries. Other less ancient manuscripts have affected certain readings; for the establishment of the text is not simply a matter of giving credence to the oldest available manuscript but a much more complex process.

Nor are the manuscripts of the Greek New Testament, whatever their age, the only source of textual evidence. Versions in other languages sometimes reflect variants in the original text that correct the readings of the Greek manuscripts. Although these versions do not figure so prominently in the study of the text of the New Testament as the Septuagint does in Old Testament study, they must not be ignored in any attempt to establish the text. Especially important textually are the Latin and Syriac versions.

When the textual scholar has examined the manuscripts and the versions, he still has not exhausted the evidence for the New Testament text. The writings of the early Christian fathers often reflect a form of text differing from that in one or another manuscript. In some cases these writings represent the only access to textual traditions that have long since disappeared; and therefore their witness to the text, especially as it corroborates the readings that come from other sources, belongs to the testimony that textual critics must consult before forming their conclusions.

Compilation of Evidence.—Assembling and collating the evidence from all these sources is a task that generations of scholars have been performing, and the task is not finished yet. Erasmus may be regarded as the father of textual criticism, but it was with the work of Johann Albrecht Bengel that the science moved into its modern phase. Three modern editions of the Greek New Testament are of major importance for their collection of the textual evidence described above: (1) that of Tischendorf (8th ed., Leipzig, vol. i, 1869; vol. ii, 1872; vol. iii [Prolegomena by C. R. Gregory], 1894); (2) that of B. F. Westcott and F. J. A. Hort (London, 1881–82); and (3) that of H. von Soden (Berlin, 1902–13). Perhaps the most convenient compilations of the evidence are the many editions of the Greek New Testament by Eberhard and Erwin Nestle (Stuttgart, 1898 ff.).

2. Method.—From all the evidence collected in these critical editions, how does a scholar settle upon one reading in preference to all the others? Merely counting the manuscripts pro and con will not decide the question; for they are not all of equal value, and the same manuscript is not of uniform value for various books of the New Testament. The date of a manuscript does not necessarily indicate its relative worth, for a later manuscript may reflect a more trustworthy text. Even grouping the manuscripts by families or by the "quality" of their text is not a satisfactory method, for this "quality" is not constant throughout a manuscript or a group of manuscripts. Selection of the reading that conforms to custom or to some regional tradition is no solution. Each of these methods has some contribution to make, but the only defensible procedure would have to include all of them—and other considerations besides.

The method that most textual critics follow begins with the accumulation and evaluation of the external evidence listed above. This evidence must be assigned relative weight according to the usefulness of a particular manuscript or version or church father for the passage being studied. Once this has been done—and the opinions as to the relative usefulness of these witnesses vary widely—the textual critic also must consider internal evidence. He must examine the context of the passage, the style of the writer, the structure of the sentence and paragraph; these may provide a clue to the proper reading. As he considers the witness of the manuscripts, versions and fathers, he must ask himself which of the variants would most satisfactorily explain the rise of the other variants; the variant that does this deserves consideration as the possible source of the entire textual tradition. When he has exhausted the possibilities supplied by both the external and the internal evidence, the critic must still consider the possibility that no existing text supplies the original reading and that this reading must be arrived at by conjecture. Such conjecture is as hazardous as it is necessary. Some conjectures have been dramatically substantiated by later discoveries; others have received no support.

A good illustration of the problem and of the method is the familiar *Gloria in excelsis* from the Christmas story in Luke ii, 14. Centuries of exposure to the Authorized version have established the text in the minds of many people as: "Glory to God in the highest, and on earth peace, good will to men." That reading has the support of some manuscripts (those usually assigned to Caesarea and to Antioch) of the Syriac text and of some church fathers. Modern editors, however, almost unanimously present the reading that underlies the Revised Standard version: "Glory to God in the highest, and on earth peace among men with whom he is pleased!" This reading is supported by the great codices listed above, as well as by the Latin versions. From this external evidence and from the internal evidence most textual scholars conclude that the reading "men of [God's] good will" is more reliable than the reading "good will to men." But there are still some critics who would prefer the nominative to the genitive. Even from this one instance it is clear how complex the task of the textual critic is and how vital it is to the determination of what the New Testament actually says.

III. TRANSLATIONS

The Bible in whole or in part has been translated into more than 1,000 languages, and into most of these during the 19th and 20th centuries. The mission and expansion of Christianity has brought the Scriptures to new peoples, and in many cases the translation of the Bible provided the occasion for reducing a spoken language to written form. Certain translations, however, have influenced their own cultures and the general course of cultural and religious history so profoundly that they deserve special mention.

A. Greek and Latin

1. Septuagint.—The first translation of the Bible—in fact, one of the first translations of any book to be written down—was the Greek version of the Old Testament from the 3rd and 2nd centuries B.C. Because of the legend that it was composed by 70 or 72 scribes under divine inspiration, the version acquired the name Septuagint (often abbreviated as LXX). Actually, it seems to have been the product of more than a century of work by many hands. First the Pentateuch, then the Prophets, then the Hagiographa (including the Apocrypha) were translated. A translation

of the Old Testament into Greek had become necessary because the large Jewish colony in Alexandria was becoming estranged from the Hebrew and thus from the Jewish faith. To some extent the translators also may have intended the translation as a means of commending Judaism to the Greek-speaking public, but their chief concern appears to have been for the survival of their own religious community.

Careful study of the Septuagint by modern scholars has made it clear that the translation reflects the ambivalence of that community in relation to its gentile environment. Some sections of the Septuagint are so literal in their rendition of the original that any non-Jew would have difficulty understanding them, while others adapt the language and even the thought to the tastes of Greek readers. As was pointed out above, the Septuagint plays a significant role in the textual criticism of the Old Testament, based as it is upon a Hebrew text older than most of those at hand today. The state of its own text, however, is confused and in some sections chaotic. This confusion and the obvious misreading of the Hebrew that is evident in some passages complicate the problem of using the Septuagint as a guide to the Hebrew text, and many scholars have serious reservations about its reliability.

Nevertheless, the influence of the Septuagint upon Jewish and especially upon Christian history has been very extensive. The growing conservatism of Jewish religious leaders after the destruction of Jerusalem in A.D. 70 made the Septuagint unacceptable, especially because it differed in both canon and text from the Hebrew version then being adopted. Among Greek-speaking Jews the Septuagint was partially replaced by the extremely literal translation of Aquila (about A.D. 140). In spite of this Jewish attitude, or perhaps because of it, the Septuagint was the Old Testament for most early Christians. Its collection of books became the Old Testament canon of a large part of Christendom, and upon its text were based many of the most important liturgical and theological discussions of the first Christian centuries. The New Testament itself manifests the influence of the Septuagint, though not uniformly throughout; thus the Epistle to the Hebrews depends upon it far more than does the Gospel of Mark. Most of the church fathers could not read Hebrew, and the Septuagint gave them their sole access to the Hebrew Scriptures.

2. Vulgate.—From the writings of Tertullian and Cyprian it is evident that during the 2nd and 3rd centuries there arose Latin translations of the Bible, one in north African usage and another in Italian usage. Confusion between these two versions and the existence of yet other Latin translations caused Pope Damasus I to commission Jerome as editor of a new and standardized text of the Latin Scriptures. The outcome of this commissioning was the Vulgate, which was the Bible of the Western Church for more than a millennium.

Jerome laboured at this project for more than 20 years, revising and reworking different sections of the Bible. It was completed in about 404. Some parts of his translation differ radically from earlier versions, while others follow the Old Latin text more closely. Three separate and distinct renditions of the Psalms appeared under Jerome's name, the first two based upon the Septuagint and the third translated from the Hebrew. Jerome's Bible did not win immediate support, despite the endorsement of Augustine and other leading churchmen. Once it was adopted, it fell victim to the same difficulties of transmission that have afflicted the Greek text. Indeed, the wide circulation of the older Latin versions made the transmission of the Vulgate even more complex, for snatches of these versions were introduced into Vulgate manuscripts as they were being copied. Throughout the middle ages scholars attempted to purify the text; but when the advent of printing made a standard text necessary, there was none. The Council of Trent adopted the Vulgate as the standard Latin version to be used in the church, and at the same time it ordered the preparation of a new edition. One such, prepared in 1590 and revised in 1592, was called the Clementine Vulgate after Pope Clement VIII. In 1907 Pope Pius X appointed an international commission to work on a new edition of the Vulgate, the first volume of which appeared in 1926.

As the official version of the Bible in the Western Church for so many centuries, the Vulgate has helped to mold the development of many national cultures. Phrases such as *Agnus Dei* or *Gloria in excelsis* have passed from it into the liturgy and thus into the language of the western peoples. It shaped the hymnody of Christendom, and its rhythms became the basis for the Gregorian chant. Even the language of the Protestant Reformers is incomprehensible without a knowledge of the Vulgate. Roman Catholic translations of the Bible into modern languages continue to be based upon it. It is probably accurate to say that no other version of the Bible has exerted so broad an influence upon western religion and culture as has the Vulgate.

B. English

Despite the many English translations of the Bible in whole or in part undertaken during the middle ages, it is not until the 16th century that the history of the English Bible as we know it actually begins. The New Testament of William Tyndale, published in 1525–26, was a translation directly from the Greek original rather than from the Vulgate, as its predecessors had been. Tyndale followed this with translations from the Hebrew Old Testament, but he did not finish the entire Bible. The translation of Miles Coverdale, published in 1535, although it included the entire Bible, was based upon other translations rather than upon the Greek and Hebrew texts. Circulation of these and other translations of the Scriptures during the 16th century caused a demand for a version of the Bible that would have the sanction of ecclesiastical authorities behind it. In response to this demand an official commission prepared the so-called Great Bible of 1539, which the leaders of church and state sought to enforce as the only permissible version of the Scriptures. Yet the continuing popularity of other versions made some revisions of the Great Bible seem desirable; these were incorporated into the Bishops' Bible, published in 1568. Even these revisions did not go far enough, and the Bishops' Bible did not succeed in establishing itself among the people or even in the churches. England needed a new translation that would incorporate the best features of earlier versions but recast them.

Such a new translation was provided by the Authorized or King James version of 1611. While the Authorized version has never lacked critics, it has so embedded itself in the religious and literary history of the English-speaking peoples that its secure place has been challenged only by revisions of it, not by replacements for it. Such revisions came in the (British) Revised version of 1881–85, followed by the American Standard version of 1901. This latter was more drastically revised in the Revised Standard version (New Testament 1946, Old Testament 1952, Apocrypha 1957), which was accorded more general acceptance among U.S. Protestants than the American Standard had received. In addition to these official revisions of the Authorized version, private translations of the Bible have continued to appear in English. The 20th century was especially rich in these, many of them attempting to introduce more colloquial forms of expression in place of the formal and sometimes stilted language of the Authorized version. Of these private translations those of R. F. Weymouth, James Moffatt and J. M. Powis Smith-E. J. Goodspeed were perhaps the most noteworthy. In 1947 a commission of scholars from Great Britain began working on a completely new translation; their translation of the New Testament appeared in 1961.

Of the Roman Catholic translations of the Bible into English the most influential was the Reims-Douai Bible of 1582–1610, more commonly known as the Douai version. In accordance with the decree of the Council of Trent it was based upon the Vulgate. Modern studies have demonstrated many instances of its influence on the Authorized version. The Douai version, too, has required revision from time to time. Roman Catholic scholars in the English-speaking world also have issued modern translations of the Bible, particularly of the New Testament. One prepared by the Confraternity of Christian Doctrine and one produced by Ronald Knox aroused more than ordinary interest.

Translation of the Bible is fraught with special problems, in addition to those present in the translation of any literary classic.

It requires the knowledge of not one but two major languages, Hebrew and Greek, and an awareness of the distinctiveness of Aramaic alongside Hebrew. To render biblical terms appositely into another language, the translator ought to be able to presuppose the presence in that language of the technical terms for the myriad theological, liturgical and mystical concepts throughout the Old and the New Testament. On the other hand, such technical terms cannot appear in a language until it possesses and absorbs a translation of the Scriptures. There is therefore a continuous reciprocity between the history of biblical translation and the history of language. In addition, few books contain the variety of literary forms present within the Bible. If the translator ignores the unique patterns of Hebrew poetry or of Hebrew historiography or prophetic denunciation, he will falsify the meaning of the text. Each portion of the Bible contains special pitfalls for the translator, and the history of biblical translation is filled with the sometimes comic pictures of scholars falling into these pitfalls.

Speaking both for themselves and for all translators of the Bible into all languages, the editors of the *Revised Standard Version of the Holy Bible* (copyrighted by the Division of Christian Education of the National Council of Churches [1946, 1952]) expressed the religious significance of the Bible for all ages of Jewish and Christian believers:

> The Bible is more than a historical document to be preserved. And it is more than a classic of English literature to be cherished and admired. It is a record of God's dealing with men, of God's revelation of Himself and His will. It records the life and work of Him in whom the Word of God became flesh and dwelt among men. The Bible carries its full message, not to those who regard it simply as a heritage of the past or praise its literary style, but to those who read it that they may discern and understand God's Word to men. That Word must not be disguised in phrases that are no longer clear, or hidden under words that have changed or lost their meaning. It must stand forth in language that is direct and plain and meaningful to people today. It is our hope and our earnest prayer that this Revised Standard Version of the Bible may be used by God to speak to men in these momentous times, and to help them to understand and believe and obey His Word.

See further BIBLE, TRANSLATIONS OF; *see* also Index references under "Bible" in the Index volume.

BIBLIOGRAPHY.—Most of the books listed below are intended more for the general reader than for the specialist in biblical literature, history and religion. They contain bibliographies of more specialized works on individual problems of biblical study. Thus the reader of this article can move next to some of the titles listed below, and then, if he wishes, to titles listed in them.

General: André Robert, *Guide to the Bible,* 2 vol. (1951–55), is a leading Roman Catholic introduction; others are John E. Steinmueller, *A Companion to Scripture Studies* (1941); John Joseph Laux, *Introduction to the Bible* (1932); Henry Daniel-Rops, *What Is the Bible?* (1958). Books by Protestant scholars include: E. C. Colwell, *The Study of the Bible* (1937); G. Ernest Wright and Reginald H. Fuller, *The Book of the Acts of God* (1957); *The Interpreter's Bible,* ed. by Nolan B. Harmon, 12 vol. (1952 ff.), contains not only introductions to individual books and commentaries upon them but materials on questions of history, canon and text, with bibliographies.

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BIBLE, TRANSLATIONS OF. By 1960 parts of the Bible had been translated into 1,151 languages, including the entire Bible in 219 languages. As the earliest versions can be dated back to the 3rd century B.C., the tradition of biblical translation is more than 2,000 years old. About A.D. 1450, the time of the invention of printing, the number of translations was 33; by about 1800 the number had risen to 71. These numbers, however, are of no great significance, for in the middle ages, when illiteracy was widespread, the religious communities could learn the sacred story from sermons and recitations of paraphrases in prose and rhyme, or from frescoes, carvings and paintings in churches and from the *Biblia pauperum* (these last, common in the middle ages, were picture books demonstrating the fulfillment of the Old Testament in the New).

In this article only actual translations of the Bible will be discussed; paraphrases or poetry about biblical subjects are omitted. A short outline of the principles underlying biblical translations from Jerome to Erasmus is followed by a history of English translations and a brief account of translations into other European and into non-European languages.

PRINCIPLES OF BIBLICAL TRANSLATION

It would be possible to discuss all the questions concerning biblical translation from the religious point of view, asking if a rendering of God's Word is possible without detracting from its religious significance. The desirability of making Holy Scripture accessible to the ignorant layman, who might try to interpret the most difficult passages without knowing of the restraint imposed upon the pious by tradition, could be questioned. It might be argued that even the most faithful rendering could create diversities of exegesis that might lead to diversity of religious views and destroy the unity of the religious community. Such questions have played their part in the history of biblical translation, and the conviction that certain versions of the Bible contradicted tradition and were therefore heretical led of necessity to the prohibition of some and the authorization of other translations.

In addition to religious questions, there are questions of a literary character. How should the Bible be translated? Is there a difference between the rendering of a profane work of literature and that of God's Word? St. Jerome, following earlier traditions, asserted that every translation should be according to sense but that the Bible should be rendered word for word to preserve the unfathomable profundity of the sacred text. Augustine maintained that the translator who is not inspired should be "in servitude to the words." This demand for word-for-word rendering contributed to the establishment of the literal translation of the Bible in the middle ages. In modern times this view has frequently been challenged. Ronald Knox, for example, applied to the translation of the Bible Hilaire Belloc's advice: "Transmute boldly: render the sense by the corresponding sense without troubling over the verbal difficulties in your way" (*On Translation,* Clarendon Press, 1931). On this view the translator should change the style of the original into the corresponding mode of expression in his own language, and no difference is made between translating the Bible and rendering a profane book.

Finally it is important to consider the influence of biblical translation on the European languages. The Bible has a distinctive terminology that influenced the vocabularies of all those nations that were converted to Christianity. Moreover, literal renderings transformed the style of the vernacular languages, whose own linguistic structures were consolidated or even created by the syntax of the Greek or Hebrew original.

The early versions of the Bible are discussed in the main article BIBLE. In this article their significance for the method of translation will be traced.

In the so-called letter of Aristeas (*c.* 100 B.C.) it is asserted that the translation into Greek of the Hebrew text of the Old Testament was made by 72 learned Jews of Palestine, that the agreement of those translators warrants the accuracy of the rendering, and that their version (called the Septuagint), being final, cannot be improved. The view that Holy Scripture should be rendered by a group and not by one person has gained adherents in the last centuries; indeed, many official versions of the Bible have been made by committees specially appointed for this purpose.

Another account of the Septuagint was given by Philo of Alexandria (1st century A.D.), who believed that the 72 translators worked separately, and yet every one of them wrote the same, word for word, as all the others. The translators thus were inspired, a new revelation of God's Word had made a new rendering into another language possible, and the Septuagint therefore replaced the original Hebrew text.

Accepting this view, St. Augustine argued that St. Jerome should make the Septuagint the basis of his new translation of the Bible. But Jerome, who had been requested by Pope Damasus I in 382 to revise the Old Latin version (*Vetus Latina*), was convinced of the superiority of the Hebrew text of the Old Testament. As a philologist he could not accept the view that a translation could replace the original. He therefore made from the Hebrew Old Testament and from the Greek New Testament a new Latin version of Holy Scripture, known as the Vulgate (completed *c.* 404), which soon began to be used for church services and which was the only Bible known in the west during the middle ages. Medieval exegesis and medieval translation derived from this text, which, authorized by the Council of Trent in 1546, remains the official Bible of the Roman Catholic Church.

The new learning in the 15th and 16th centuries revived the study of Greek. About 1449 Lorenzo Valla, comparing Greek manuscripts of the Bible with the Vulgate, found that there were differences between the Latin translation and the Greek original and that the Greek wording was generally preferable. His *adnotationes* on the subject were published in 1505 by Erasmus, who independently had come to similar conclusions. The first edition of Erasmus' New Testament, containing the Greek text, his own translation into Latin and his commentary, was published in 1516. Further editions followed quickly. (*See* ERASMUS, DESIDERIUS: *The New Testament.*) J. Reuchlin had already published a Hebrew-Latin dictionary (1506) and a new Latin translation of the penitential psalms (1512), asserting that the Hebrew text was preferable to the Vulgate. Both Erasmus and Reuchlin objected to a translation or an exegesis not derived from the original Hebrew or Greek. Clearly the humanists, especially Erasmus, seriously undermined the authority of the Vulgate, with the view that, since every language possessed a character of its own, the translator should render sense for sense and not word for word. This view inaugurated a new era in biblical translation.

Two other 16th-century translations may be mentioned since they had a certain influence on the English Bible. In 1528 S. Pagninus, a Dominican, published a Latin word-for-word translation of the whole Bible from the original Hebrew and Greek. His knowledge of Greek was limited but his version of the Old Testament forms part of the important edition of the Bible by Robert Estienne (Stephanus) of 1557. In 1534–35 S. Münster edited the Hebrew text of the Old Testament with commentaries and a Latin literal translation. In spite of the inelegant and crude Latin style it was reprinted several times. (WE. S.)

ENGLISH

The mystery of meaning that attaches to any translation is infinitely heightened when the words are those of Holy Scripture. Every translation is an act of creation; a translation therefore may be an act of impiety if it implies modifying the creative impulse of God himself. These primary sanctions have operated strongly in the history of English translations of the Bible, and to them have been added other powerful considerations, theological, liturgical and social.

Against the powerful conservative forces forbidding translations two contrary impulses have led to the constant renewing of the Scriptures in the vernacular. The first acknowledges the primacy of the Bible as the source of doctrine and hence the necessity of shaping the nuances of translation in accord with the subtleties of theological speculation. Successive Reformation versions throughout western Europe influenced the course of controversy on the doctrine of the Trinity, of the church and sacraments, of the status of holy orders. The second impulse acknowledges the centrality of the Bible in Christian worship: in the epistle and gospel of the Eucharist, in the lections of the divine office, in every variant of private meditation. Here originates a paradox: with the development of vernacular liturgies in the period of the Reformation (and the renewed impetus of the "liturgical movement" throughout the Christian world in the 20th century) a new conservative force was unwittingly established. A liturgy quickly assumes its own life and integrity, establishing a formal context, highly charged both intellectually and emotionally, for the reading of biblical passages and for the biblical texts quoted in sermons. All this argues for the strongly established status of an "authorized version" and an equally strong reluctance to modify the words that have acquired such potent associations.

The conditions establishing and limiting the English translations then are complex but clear. Major changes in semantic associations in the languages and development in theological speculation both demand revision of the Bible; yet even where linguistic or historical scholarship demonstrates that the Greek or Hebrew originals or the intellectual milieu of the original authors required a sense different from that implied by the current translation, long association is strong against change in an "authorized version."

One further issue adds depth and significance to the problem in the English-speaking world. Many fragments of biblical translation are embedded in English works of a high order of creative imagination: in works of "vision" and "dream" in Old and Middle English, in "poetry of meditation" from the 15th to the 17th century and in allegory throughout English literature. These exert a strong if indefinable influence on subsequent translations. Even in cases in which the literary values are questionable, as in some of the numerous metrical versions of the Psalms, a powerful conservative tradition is being cumulatively established.

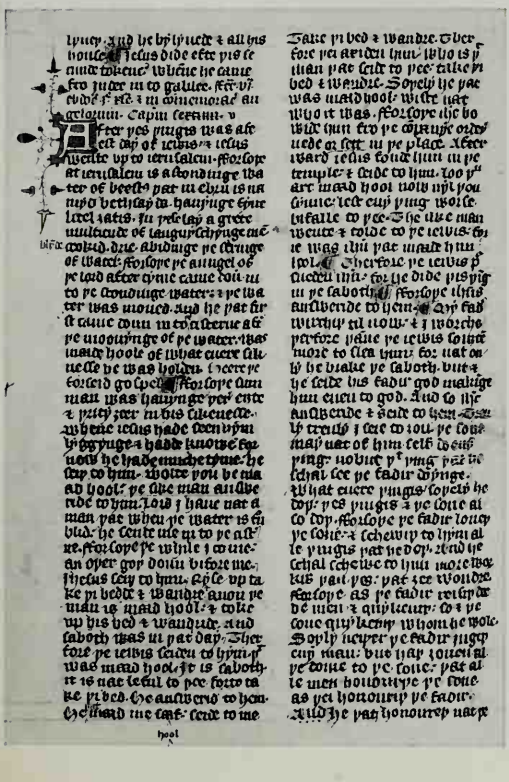
Old English.—The spare but moving story of biblical translation in the Old English period is an epitome of many of the factors that influenced later translators. It turns upon three figures: the illiterate poet Caedmon of the 7th century, the learned Bede (d. 735) and the great preacher Abbot Aelfric (10th century). Caedmon may stand for all those whom the words of the Bible inspired to creative work of their own. He did not of course actually translate, but after hearing the Scriptures expounded by the scholarly monks of Whitby he composed alliterative poems based on their words. It is uncertain how much is genuine of the paraphrases from the Pentateuch and Daniel extant under his name. In the first half of the 8th century the Venerable Bede undertook translations and glosses (based on the Vulgate), of which unfortunately nothing survives, as part of his far-reaching iife of scholarship. Meanwhile partial translations, especially of the psalter, were in progress.

Finally, Aelfric provided extensive versions of passages from the Old and New Testaments in his homilies (*c.* 990–996), and translated the whole of the Hexateuch from the Vulgate. His ambivalent attitude to translating the Scriptures is characteristic of much later orthodox thought. He wished to expound the faith to his people, and for this exposition the Scriptures in the vernacular tongue were essential; at the same time he was inhibited from a full translation of the Bible, "lest peradventure the pearls of Christ be had in disrespect."

Aelfric's Easter day homily was published in 1567, and in 1571 John Foxe edited an 11th-century translation of the four Gospels from the Vulgate into West Saxon. The object of this publication, made under the patronage of Archbishop Matthew Parker and dedicated to Elizabeth I, was to demonstrate that "the religion presently taught and professed in the church at thys present, is no new reformation of thinges lately begonne . . . but rather a reduction of the Church to the Pristine state of olde conformitie." The links across the centuries are as much linguistic as theological; for as the 16th-century translators struggled to render the flexible Greek into suitable native English forms so this Anglo-Saxon version translated the Latin by the Old English compound, sometimes with lively effect; *e.g.*, "learning cnicht" for *discipulus*, "aerist" for *resurrectio*, "gesamnung" (gathering together) for *synagoga*.

Middle English.—Two new conditions affected scriptural versions in the later middle ages: the impetus toward private judgment based on study of the Bible, fostered by growing criticism

Woodcuts showing the creation, from Miles Coverdale's Bible, 1535. British museum



Jacob's Ladder, woodcut illustrating Gen. xxviii, 10–15, in the Bishops' Bible, 1568. British museum

EARLY ENGLISH BIBLES

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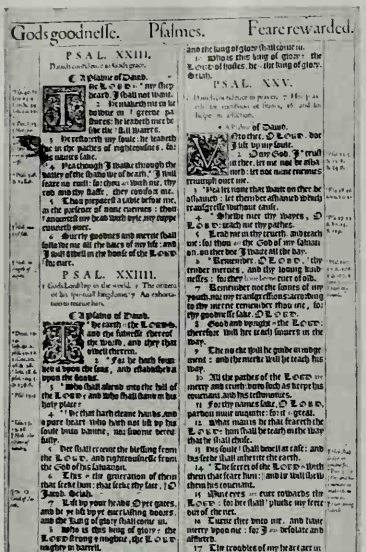
A page from the Wycliffe Bible, late 14th century; portion of John iv–v. British museum

BIBLE, TRANSLATIONS OF

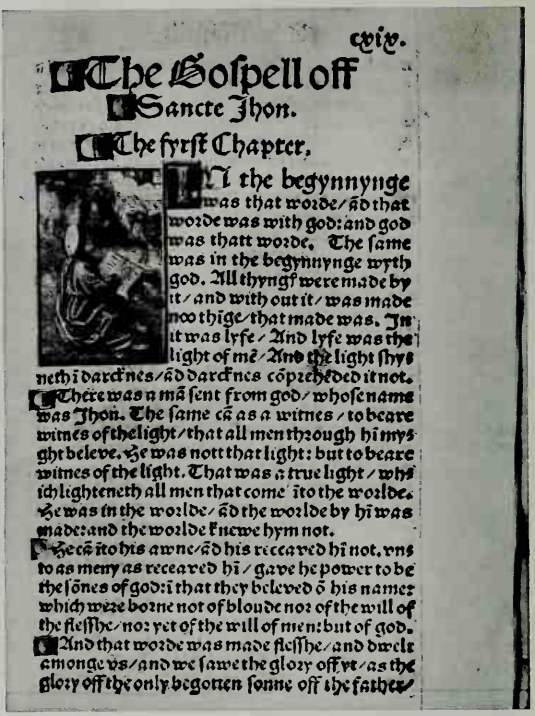


Gods goodnesse. Psalmes. Feare rewarded.

PSAL. XXIII.

PSAL. XXIIII.

A page of Psalms, beginning with the 23rd, Authorized or King James version, 1611. British museum



cxiv.

The Gospell off Sancte Jhon.

The fyrst Chapter,

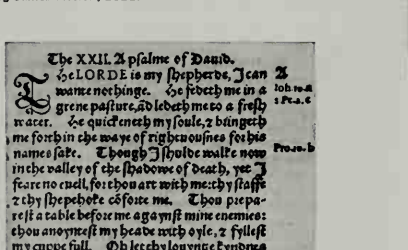
In the begynnynge was that worde/ and that worde was with god: and god was thatt worde. The same was in the begynnynge wyth god. All thyngs were made by it/ and with out it/ was made noo thige that made was. In it was lyfe/ And lyfe was the light of me/ And the light shyneth in darckenes/ and darckenes cõprehended it not.

There was a mã sent from god/ whose name was Jhon. The same cã as a witnes/ to beare witnes of the light/ that all men thzough hi myght beleve. He was not that light: but to beare witnes of the light. That was a true light/ whi ch lighteneth all men that come into the worlde. He was in the worlde/ and the worlde by hi was made: and the worlde knewe hym not.

He cã to his awne/ and his receaved hi not. vnto as many as receaved hi/ gave he power to be the sõnes of god: i that they believed õ his name: which were borne not of blonde nor of the will of the flesshe/ nor: yet of the will of men: but of god.

And that worde was made flesshe/ and dwelt emonge vs/ and we sawe the glory off yt/ as the glory off the only begotten sonne off the father/

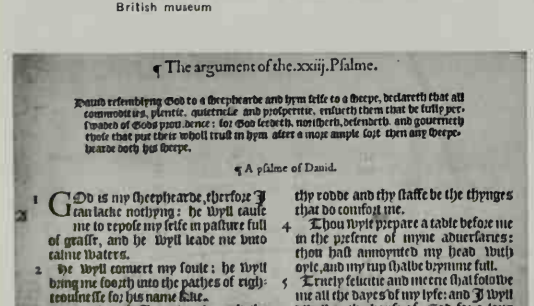
The opening of St. John's Gospel. Above, Tyndale's Bible, 1525–26; Baptist college, Bristol. Below, the Geneva Bible, 1560; British museum



The XXII. A psalme of Dauid.

The LORDE is my shepherde, Jcan wante nethinge.

The 23rd Psalm (numbered 22, following the Vulgate enumeration) in Coverdale's Bible, 1535. British museum



¶ The argument of the.xxiij. Psalme.

Dauid remembrynge God to a sheephearde and hym selfe to a sheepe, declareth that all commoditees, plentie, quietnesse and prosperitie, ensueth them that be fully persuaded of Gods prouidence: for God feedeth, nourisheth, defendeth, and gouerneth thole that put their whole trust in hym after a more ample sort then any sheepheearde doth his sheepe.

¶ A psalme of Dauid.

1 GOd is my sheepheearde, therfore I can lacke nothyng: he wyll cause me to repose my selfe in pasture full of grasse, and he wyll leade me vnto calme waters.

2 He wyll conuert my soule: he wyll bring me foorth into the pathes of righteousnesse for his name sake.

3 Yea though I walke through the valley of the shadowe of death, I wyl feare no euyll: for thou art with me, thy rodde and thy staffe be the thynges that do comfort me.

4 Thou wylt prepare a table before me in the presence of myne aduersaries: thou hast annoynted my head with oyle, and my cup shalbe brymme full.

5 Truely felicitie and mercie shal followe me all the dayes of my lyfe: and I wyll dwell in the house of God for a long tyme.

The 23rd Psalm in the Bishops' Bible, 1568. British museum

COMPARISONS OF ENGLISH BIBLES

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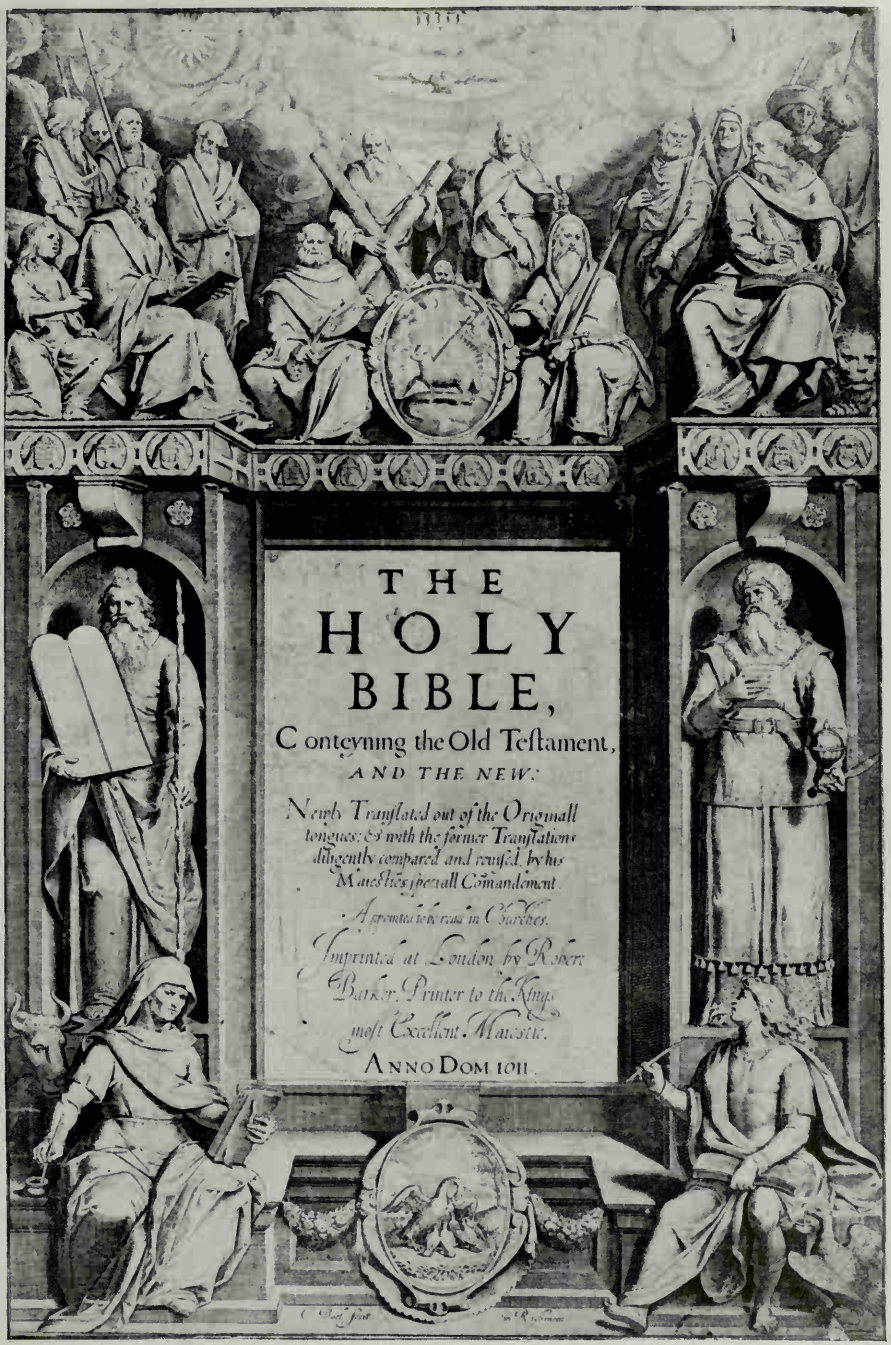

Title page of the Authorized or King James version of the Bible, printed at London in 1611

KING JAMES VERSION OF THE BIBLE

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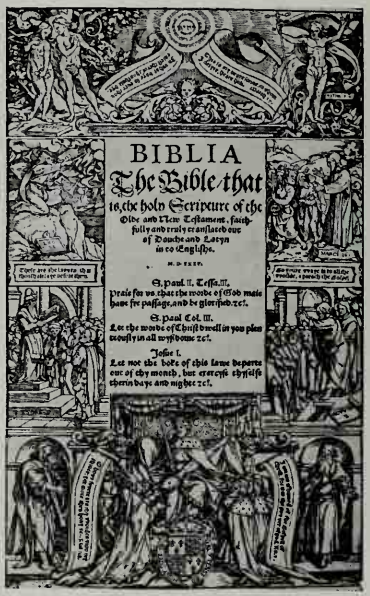
BIBLE, TRANSLATIONS OF

Dutch, *Statenbijbel*, 1637. The Netherlands Bible society



English, Coverdale's Bible, 1535. British museum

TITLE PAGES OF 16TH- AND 17TH-CENTURY BIBLES

English, Matthew's Bible, 1537. British museum

English, Geneva Bible, 1560. British museum

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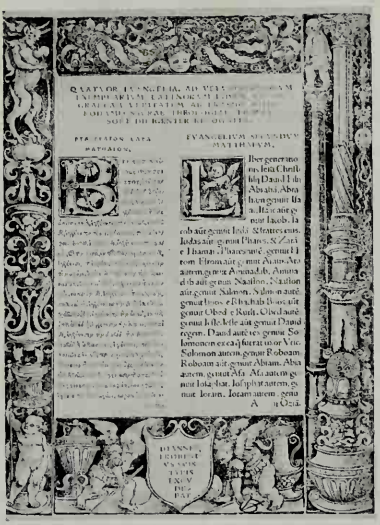

Erasmus' New Testament, Greek text and his own Latin translation in parallel columns; 1516. British museum

OPENING OF ST. MATTHEW'S GOSPEL, THREE 16TH-CENTURY BIBLES

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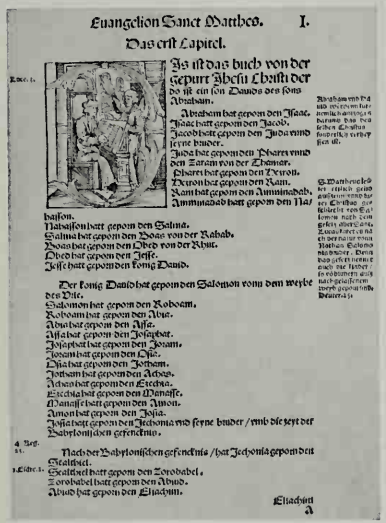
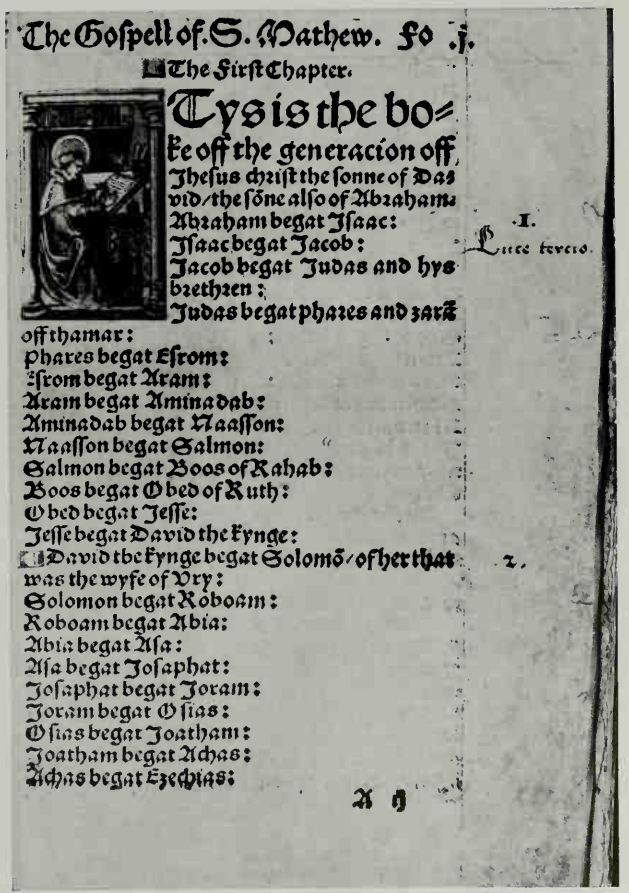


Luther's New Testament, the *September Bibel*, German; 1522. British museum



Tyndale's Bible, English; 1525–26. Baptist college, Bristol

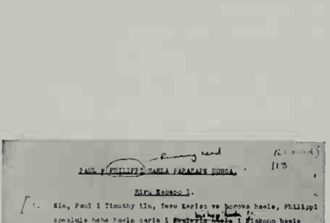
BIBLE, TRANSLATIONS OF

NON-EUROPEAN VERSIONS OF THE BIBLE

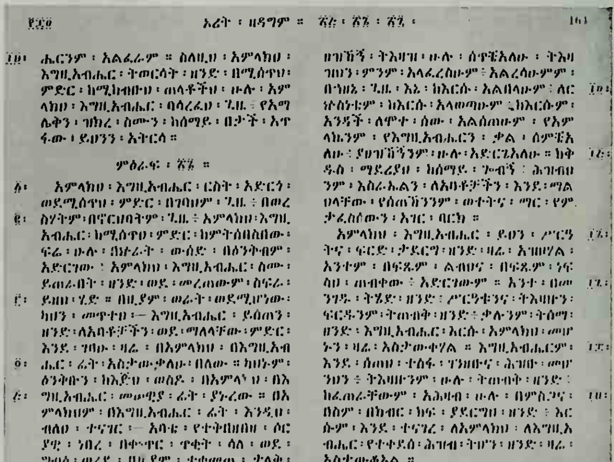
BY COURTESY OF (ALL) THE BRITISH & FOREIGN BIBLE SOCIETY

8 Itsene umwu tsilutile tsoni itsywu tutsovile tsywu itsywu twita: ywu ali unteketsi umbaha uvi tuli nave, atamile kukivoko ikyandyo kukiñalwangula kya vutwa kya mwenevudwadwa uvuvaha kukyaña. 2 Ipelile ukuva mbombi va kuvomba nambuvalatse namuhema ja jilweli ijyu imike unkuludeva ijyu navimiki avanu. 3 Maña voni avateketsi avavaha vavikilwe pambombo tsa kugega isya kulaha ninekelo itsihinzilwe. Pwu namwene upita ave nasyu isya kugega. 4 Maña angave avetsaga nkilunga umwu nalino pwu ndili nuvuteketsi nali nteketsi umwene, ulwakuva pwuvali avateketsi avigega isya kulaha, avikonga umwu tsilagye isimilitso. 5 Avene vivomba itsa kukivombela ki kihwaoi vuvule, gwu mwitsitsi gwa sya kukyaña, nduvwu UMose apulikage kwa Nguluve vwu ita imikage ihema. Nditsova ilikata: Lola vwu iva umwene, syoni uvombe sive ndaka vutolela ukwu ndikuvonyage pakidugala. 6 Lino pwu umwene ipelile mbombeli va pambombo induti uvunonu, ulwakuva ipelile ukuva ndamuli va lwidiñano ululuti uvunonu. 7 Maña lungave ulwidiñano ululongotsi lulya ulwu vidiñine, lungave lwavetsaga luvalatse itsa kulutsova, pwu ndili navalondili pavwidiñanilo ulwidiñano ulupya. 8 Maña pwu ikuvavunga umwene upwu itsova navwy upwu ita: Lola likwitsa ilitsuva, vwu iva untwa, pwu ndilimika ulwidiñano ulupya ulwa kwidiñana niñumba ja Isilaeli niñumba ja Juta. 9 Ulwene nalulave ndulwidiñano ulwu twidiñine navadadajiño ilitsuva ilyu ndivibatage ikivoko vwu ndita ndivahumyage nkilunga kya mu-Egipiti. Maña avene navalubadimi ulwidiñano ulwu twidiñine, nune pwu nandivavikili untima. Vwu iva untwa. 10 Maña ulwidiñano ulwu tulidikilanila nune niñumba ja Isilaeli vwu galutile amatsuva galya lwu ulwu: ndivika isimilitso tsango muñisagilo tsa vene, ndikutsivika panumbula tsa vene, pwu ndikwipelaga ukuva Nguluve va vene, pwu navene vipelage ukuva vanu vango. Vwu iva untwa. 11 Pwu nujunge nalambule inongwa numbadiñine va mwene uvi abadiñine nave. Pwu nujunge nalambule unine ilyakuta: Ukwa ummañage untwa. Maña pwu voni umwu vavelye valamaña une nundebe numbaha. 12 Pwu ndilavahogoila ulwu vali vuvule uvugolosu, pwu nuvutulanongwa vwa vene nimbivi tsa vene pwu nandilakumbuhitse lusiku. 13 Apene upwu ita "ulupya" pwu ululongotsi alutsovye baho ukuva lwu lulala. Maña akalalapye akagosipe vwu kahegelye pakujaga.

Kikinga, spoken in Tanganyika. A passage from the Book of Hebrews, in galley proof



Orokolo, a Papuan language spoken on the southeast coast of New Guinea. Phil. i, 1–15, manuscript page



Amharic, the national language of Ethiopia. Deut. xxv, 19–xxvii, 9

of ecclesiastical corruption; and the intensified movement of mystical pietism among the religious orders. A greater variety in sermon forms and varying attitudes toward scriptural citation and analysis make this a complex period to summarize. But it is significant that the psalter, in prose and metrical versions, received the greatest attention and that the mystic Richard Rolle of Hampole (d. 1349) produced an important translation of it with commentary.

John Wycliffe and Lollardy.—Later in the 14th century appeared the translations associated with the controversial figure of the learned Wycliffe (d. 1384), who had the authority and the energy to promote an English version that should stand with the Vulgate. It is a matter of nice scholarship to determine the part played in the two Wycliffite versions (one following the Vulgate closely, the other in more natural English style) by John Purvey, Nicholas of Hereford (both Lollard sympathizers and learned men) and Wycliffe himself. Nor is it possible in brief space to examine the text of the Vulgate available to them or their scholarly use of other manuscript material and of commentaries, including those of the influential Franciscan Nicholas of Lyra (d. 1349). Of more importance is the reaction of authority. Wycliffe's contemporary, the chronicler Knyghton, deplored a movement that ensured that the Bible, "the jewel of the church, is turned into the common sport of the people," a view repugnant to Wycliffe, who declared (echoing Jerome) that "ignorance of the Scriptures is ignorance of Christ." At Archbishop Thomas Arundel's instance the Synod of Oxford in 1408 forbade further translation into English without diocesan or provincial approval, and, at the dawn of printing and of the Reformation, the Scriptures in English became equated with dangerous heresy.

William Tyndale.—With the labours of Tyndale (d. 1536) the English Bible enters its richest century. The coincidence of the invention of printing with the meticulous critical scholarship to which classical texts were being subjected made it inevitable that translation should be vigorous and even revolutionary in implication. After graduating at Oxford Tyndale may have studied Greek under Erasmus at Cambridge, and certainly he entered into the humanist tradition of critical scholarship. Visiting Wittenberg he probably encountered Luther, whose German translation of the New Testament was published in 1522. To the massive urbane scholarship of J. Reuchlin and Erasmus now was added the fire of continental reform.

In 1525 Tyndale was in Cologne, where the first sheets of his English translation from the Greek New Testament were printed; then he had to move to Worms, where the work was completed in the next year. He was then free to begin work on his translation of the Old Testament from the Hebrew text, and when he was arrested at Vilvorde in 1535 he had reached the end of Chronicles. Of this only his Pentateuch was published, 1531 (new style; 1530, old style), the rest surviving in manuscript. He also translated Jonah (1531).

Tyndale's approach in producing his powerful and influential version can be gauged from his prefaces, "the pestylent glosses in the margentes" (so described by Henry VIII) and the quality of his vocabulary. He had declared that the theological judgment of ordinary man, in which he trusted, could not be informed "except the scripture were plainly laid before their eyes in their mother tongue," and to that end, borrowing where it pleased his judgment from the Vulgate or from Luther to amplify his reading of the original text, he produced a translation in sinewy contemporary English. Two linguistic problems (with their allied theological overtones) he tackled with vigour and originality. As late as 1542 Bishop Stephen Gardiner of Winchester judged it expedient that certain "ecclesiastical words" should be left as they appeared in the Vulgate, chief among them being *ecclesia, episcopus, caritas* and *gratia*. Tyndale had already settled the problem in his own way, translating them frequently against the sense of current orthodoxy, rendering the first of these terms as "congregation" rather than "church" and the third as "love" rather than "charity." At the same time he appealed to his readers' sense of the church year in the colloquial "good frydaye" (Matt. xxvii, 62), "ester holydayes" (Acts xx, 6) and "whitsontyde" (I Cor. xvi, 8). The pungency of his style was seen at its most provocative in the marginal comments (*e.g.*, on Gen. xxiv, 60: "To blesse a mans neyboure is to praye for him and to wissh him good: and not to wagge ii fingers ouer him") and in some of his single phrases, which, though not adopted later (*e.g.*, "babble not moche" for the "use not vain repetitions" of the Authorized version, Matt. vi, 7), established the tone and rhythms of the spoken word as the appropriate language of Scripture.

Miles Coverdale.—In 1534 King Henry VIII was petitioned by the Canterbury convocation to have the Bible translated, and in 1535 Miles Coverdale published his complete translation, dedicating it to the king. In the history of English translation this is an important mediating text. It has the scholarly cast of the humanists, for it was "purely and faythfully translated . . . out of fyue sundry interpreters": the Vulgate, Pagninus' Latin translation, Luther's and Zwingli's German versions and Tyndale's English one. Most important in establishing the temper and rhythms of these versions in the 16th century was Coverdale's undogmatic temper. He omitted or toned down Tyndale's offensive marginal notes and was less intransigent in translating such terms as "church" and "penance." Above all, the beauty of his prose in the psalter established his translation, still used in the Book of Common Prayer, as a central heritage of the English tongue.

"Official Bibles," of the 16th Century.—Official translations now began to show a determination to preserve, as nearly as linguistic and theological scholarship permitted, the words of former translations. This conservatism had notable consequences both in the history of biblical translation and in the more general history of the language. For the text became a slow, organic growth, by the very unobtrusiveness of its changes commending itself as a standard of spoken and written prose. The four Bibles known as Matthew's (1537), the Great (1539), the Geneva (1560) and the Bishops' (1568; rev. 1572) show the course of this tendency. Matthew's Bible, edited by John Rogers, is based mainly on Tyndale (*i.e.*, the unpublished translation of Joshua to Chronicles as well as the published Pentateuch and Jonah) and on Coverdale, with some revisions and additions influenced by the French Calvinistic version of Olivétan (1535). Matthew's Bible was in turn subjected to two revisions, that of R. Taverner in 1539 and that supervised by Coverdale under the patronage of Thomas Cromwell, which appeared as the Great Bible in the same year. Coverdale relied on Erasmus' Latin translation for the New Testament and on S. Münster's for the Old.

Meanwhile—and cutting across these conservative versions—Sir John Cheke, tutor of Edward VI, used his Greek scholarship to make a translation of Matthew and part of the first chapter of Mark (first published 1843) which returned to essentially native idioms and words. In technical vocabulary this verged on eccentricity, "crucified" being rendered as "crossed" and "proselytes" by the remarkably academic "freshmen." But its style was on occasion remarkable in simple dignity: "Come to me all that labour and be burdened and I will ease you" (Matt. xi, 28).

The main stream of conservatism, however, was continued in the Geneva Bible (1560), also called the Breeches Bible from its name for the first garments made for Adam and Eve (Gen. iii, 7). It was a new translation made from the original texts by English exiles at Geneva and was strongly influenced by the scholarship of Theodore Beza and Calvin. Its return to polemic in the marginal notes brought reaction in the Bishops' Bible, produced by the English bishops and based on the Great Bible, which became in turn the foundation of the King James or Authorized version.

Reims-Douai Version.—An important work of Roman Catholic scholarship, again conservative in its principles of translation, was the Reims-Douai version (N.T. 1582; O.T. 1609–10), prepared by Gregory Martin under the direction of William (later Cardinal) Allen of the English college at Douai. This version, made specifically for priests, was based mainly on the Vulgate (though the original texts were consulted also), of which it gave an authoritative rendering. But its Latinate forms were essentially unacceptable and it was more a scholarly instrument than a stylistic influence, though it was consulted by the translators of the King James version.

King James or Authorized Version.—The Hampton Court conference in 1604, at the urging of the Puritan John Rainolds, proposed a new translation of the Bible, and 54 translators were invited to undertake the work, at Oxford, Cambridge and Westminster. The translators' principles were important: the Bishops' Bible was to be altered as little as possible, though earlier versions were to be consulted; the old "ecclesiastical words" (as "church" for "congregation" and "charity" for "love") were to be kept; and the marginal comments were to be textual, not theological. The manuscript (since lost) was bought by the king's printer for £3,500. The Bible appeared in 1611, dedicated to James I, in large folio volumes, selling for 30*s.* bound.

It is difficult to exaggerate the influence of this translation, which came to be known as the Authorized version because it was "Appointed to be read in Churches" (in the United States it is more commonly called the King James version). It established the rhythms of spoken English as the standard for English prose; it gave a pattern of great variety, from bare clarity to the ornate parallelism of Hebrew poetry; it avoided uniform literalness of translation in favour of a rich use of synonym.

Later 17th- and 18th-Century Translations.—Subsequent modification in the authority of the Authorized version arose, more from increasing biblical scholarship than from changing values of English prose. Interesting experiments in colloquial translations took place in the next century and a half, but the main pressures for a new, authoritative version came about as a result of a second renascence of Greek scholarship and the 18th-century rediscovery of Hebrew poetry.

The Quaker A. Purver made a literal translation of the whole Bible from the original tongues (1764). The Greek New Testament was translated by two classical scholars, D. Mace, who made a colloquial version (1729), and E. Harwood, whose "liberal" translation is an expansion of the original (1768). John Wesley's English New Testament (1755) is based on the Authorized version.

Revised Version.—In the 19th century, further advances in biblical scholarship and the growing unfamiliarity of the language of the King James version made its revision imperative to both Great Britain and the United States. Though some scholars of the eminence of B. F. Westcott still advocated further radical work on the original Hebrew and Greek texts, a British revision committee consisting of two companies, one for each testament, was set up in 1870. The New Testament appeared in 1881, the Old in 1885; the Apocrypha were issued in 1895. A U.S. committee working in close co-operation with the British revisers brought out the American Standard version in 1901.

In considering the somewhat indifferent reception accorded the Revised version, its title is an important consideration. As a scholarly revision of the King James version in modified Jacobean English, it occupied a vulnerable position: it rejected many of the loved phrases and rhythms, it appealed to no living idiom and its detailed scholarship was continuously under question. Although accepted as more accurate than the King James version, for academic study in schools and universities, it rarely replaced the latter in public worship. Much the same may be said of the American Standard version.

20th Century.—Twentieth-century official translations have been prepared as well as various "private" versions, especially of the New Testament or of parts of it. Two American translations established new approaches; R. F. Weymouth's *New Testament in Modern Speech* (1902) took some tentative steps toward justifying its title, but James Moffatt's version (N.T. 1913; O.T. 1924; revisions 1935) was in a modern idiom and made use of the growing knowledge of Hellenistic Greek. After Moffatt the way was clear for thoroughgoing stylistic experiment, in which two versions have been outstanding: that by Ronald Knox (N.T. 1945; O.T. 1949), which is officially approved by the Roman Catholic Church; and *The New Testament in Modern English* (1958) by J. B. Phillips. Knox, who translated the Vulgate but consulted the Greek and Hebrew texts, is terse and scholarly, and while undertones remain from Jacobean speech the idiom is recognizably modern (*e.g.*, "I may speak with every tongue that men and angels use; yet, if I lack charity, I am no better than echoing bronze, or the clash of cymbals"; I Cor. xiii, 1). Phillips is racier, and on occasion he paraphrases rather than translates the original Greek, but he is triumphant in the intensely personal tones of the Pauline Epistles (*e.g.*, "Don't be under any illusion: you cannot make a fool of God!"; Gal. vi. 7). Another private modern translation is *The Bible, an American Translation*, with New Testament by E. J. Goodspeed (1923), Old Testament by J. M. Powis Smith (1935) and Apocrypha by Goodspeed (1938). A Roman Catholic revision of the Douai version is the Confraternity version (1963), by the Catholic Biblical Association of America in conjunction with the Confraternity of Christian Doctrine.

The copyright of the American Standard version was acquired in 1928 by the International Council of Religious Education (U.S. and Canadian, interdenominational), which in 1937 authorized a revision of the work that would "embody the best results of modern scholarship as to the meaning of the Scriptures, and express this meaning in English diction which is designed for use in public and private worship and preserves those qualities which have given to the King James version, a supreme place in English literature." (*Revised Standard Version of the Holy Bible*, copyrighted by the Division of Christian Education of the National Council of Churches [1946, 1952].) Thirty-two scholars served on the revision committee, and their work was reviewed by an advisory board of 50 representatives of the co-operating denominations. The Old Testament and New Testament groups, in addition, reviewed each other's work, and all changes were agreed upon by a two-thirds vote of the whole committee. In 1946 the Revised Standard version of the New Testament appeared, and in 1952 the Revised Standard version of the Bible, with both testaments; the Apocrypha were published separately in 1957. This version won wide acceptance in the U.S.

A British interdenominational committee, translating from the original Hebrew and Greek into modern English, published its version of the New Testament in 1961. (W. M. Me.)

OTHER EUROPEAN LANGUAGES

Gothic and German.—The earliest translation of the Bible into a Germanic language is Ulfilas' translation of the Septuagint and the Greek New Testament into Gothic (before 381). (*See* GOTHIC LANGUAGE.) Ulfilas was the first to coin a Germanic Christian terminology, some of which is still in use, though much has been replaced by expressions originally brought to north Germany by English missionaries such as St. Boniface.

German translations of the Vulgate dating back to the 9th century have survived. The impulse was given by Charlemagne, whose aim was to educate the Frankish clergy and to communicate some knowledge of Christianity to the people. English influence also can be traced in the German rendering *c.* 835 of the Latin translation of Tatian's *Diatessaron* (a harmony of the Gospels). In the following centuries only the translations of Notker Teutonicus (d. 1022) and Claus Cranc (14th century) are worth mention.

The first German printed Bible (1466), probably a reproduction of a text about 100 years older, was a literal translation from the Vulgate. It ran in revised form into 14 editions before 1518. But it was Martin Luther's rendering of the Bible from the original tongues that influenced subsequent translation almost everywhere. Even new versions in other languages often were based on his translation. His version of the New Testament, executed in 11 weeks in the Wartburg, was published in 1522 (the *September Bibel*), and his first complete Bible in the autumn of 1534. Throughout his life Luther was busy revising his translation.

He was helped by friends, especially Philipp Melanchthon and M. Aurogallus, who advised him on Greek and Hebrew philology. But it was Luther who did the actual work of translation. His remarkable handling of the German language, in conformity, as he asserted, with the speech of the common people, influenced and even shaped the development of modern German (*see* GERMAN LITERATURE). No other Protestant translation into German has been able to compete with the popularity of Luther's Bible, and it is still the official one of German Protestants.

In agreement with humanist theories Luther's two principles of translation were that the original languages (Hebrew and Greek)

must clearly be the basis of biblical translation; and that, since every language possesses its own peculiarities in construction and idiomatic usage, no merely literal translation is satisfactory. An elegant turn of phrase in one language must be transferred into another mode of thought without losing its original meaning. Instead of a word-for-word rendering Luther postulated a translation sense-for-sense. A translator who adheres to these principles must possess a thorough and detailed knowledge of the languages, and he must understand the original in all its details, both grammatical structure and contents.

This theory requires no explanation. It is a formula adopted by modern translators. Luther, however, saw the inherent difficulties. Clearly the translator must know the Bible and be well versed in all aspects of biblical studies, but this by itself is not enough, for it is only by the grace of God that God's Word can be understood in all its profundity.

> The interconnection between God's guidance and human endeavour is thus clearly established: the theologian cannot interpret Scripture without learning and the scholar is incapable of writing a commentary on the Bible unless God's grace has illuminatcd him and revealed the true meaning of the text (W. Schwarz, *Principles and Problems of Biblical Translation*, Cambridge University Press, 1955).

Luther was convinced that no translator could fully understand every word of the sacred text. Therefore he maintained that every translation contained shortcomings and even mistakes and that it could on no account replace the original. Thus only the original text could be the basis of exegesis and translation. But only the translator who has spiritual understanding of Holy Scripture and who possesses the necessary linguistic knowledge will be able to render not only the "letter that killeth" but also the spirit. He will not have to translate word for word, he will not be in "servitude to the words" but will be able freely to transform the peculiarities of the one language into idiomatic expressions of the other.

Roman-Catholic German Translations.—Luther's translation was attacked because it did not always tally with Roman Catholic tradition and because it lacked glosses to explain the text. Hieronymus Emser's translation of the New Testament from the Vulgate with glosses was intended to correct these faults, but it remained essentially a revision of Luther's work. J. Dietenberger's translation of the whole Vulgate (1534) was a revision of Emser for the New Testament and of Luther for the Old. In the revision of 1630 it circulated widely in Germany. H. Braun's translation (1788–1805) was revised by J. F. Allioli (1830), and other revisions were made later.

Switzerland.—Luther's translation of the New Testament was printed in 1524, and the complete Bible (*Zürcher Bibel*) in 1529. This version, for which Zwingli's follower Leo Jud had translated the prophets, is still in use. In 1560 J. Bifrun translated the New Testament from the Vulgate into the Romansh dialect of the Upper Engadine.

Dutch.—In the Netherlands medieval translations dating from the 13th and 14th centuries were followed by the Dutch so-called Delft Bible, actually only the Old Testament without the Psalms, translated from the Vulgate (1477). Subsequently two translations were of some importance, that of 1532, a rendering of Luther's translation, and that of 1554 based on Erasmus' Greek text of the New Testament. Until 1951 the so-called *Statenbijbel*, translated by a committee out of the original languages (1637), was accepted alike by the Reformed communities, the Remonstrants and the Mennonites and read in churches. It was superseded subsequently by a new official version, not a revision (N.T. 1939; O.T. 1951). A translation from the Vulgate by Nicolaus van Winghe, first published in 1548, was the accepted Roman Catholic version until 1926, when a new translation from the original languages came into use (Canisius Bible). Another new rendering based on the Greek and Hebrew texts was published in 1961.

Scandinavian Languages.—Little is known of pre-Reformation translations into the Scandinavian languages.

In Denmark Christiern Pedersen's New Testament, published in 1529, was translated from the Vulgate, Erasmus' Latin, and Luther. The complete Bible was commanded by King Christian III and published in 1550, its purpose being to follow Luther as closely as possible. The first version from the original languages, made by Bishop Hans Poulsen Resen in 1607, was often revised (last revision 1872). An entirely new translation of the Old Testament was published in 1931, of the New Testament in 1948.

Until the separation of Denmark and Norway in 1814 the Danish Bible of 1647, a revision of Resen's edition, was in general use in Norway. This was revised several times from 1819 onward. The first complete translation from the original languages was published in 1904 and revised in 1930 (in the so-called national language); since 1938 a version of the entire Bible in the so-called country-wide language also has been in use.

The first printed Swedish translation of the New Testament (1526) and of the complete Bible of 1541 was made from Luther's translation (*see* SWEDISH LITERATURE). It was revised in 1915.

Roman Catholic translations from the Vulgate were published in Denmark (1893, 1931), in Norway (1902, 1938) and in Sweden (1895).

French.—In the 12th century French translations gained great importance with the rise of the Cathari. Consequently vernacular versions were under suspicion of heresy and were prohibited in pastoral letters and decrees. Later biblical translation is the history of revisions of existing versions.

The first Roman Catholic translator was Jacques Lefèvre d'Étaples, whose edition of the Hebrew psalter (1509) and commentary on the Pauline Epistles with a translation made from Greek (1512) exerted a certain influence on Luther. Lefèvre published a translation from the Vulgate of the New Testament (1523) and of the complete Bible (1530) which was often revised and its explanatory notes rewritten until the 17th century. The most important version of the 17th century, again translated from the Vulgate, was that of Port-Royal, mainly by the brothers Lemaistre, especially Isaac Louis called de Sacy (N.T. 1667; Bible 1682–1702). This excellent translation was often revised. Modern translations from the original languages are *La Bible de Jérusalem* (1947–56), a version edited at the abbey of Maredsous (1950) and another under the patronage of Achille Cardinal Liénart (1951).

The Protestants used the version made by Olivétan (1535), a scholar who knew Hebrew well and who relied on Erasmus' Latin translation and on Lefèvre for the New Testament. This translation was re-edited and modernized until well into the 20th century by such men as Calvin, Theodore Beza and, most important of all, Jean Frédéric Ostervald of Neuchâtel (1724; revised 1744). The translation from the original languages by L. Segond (1874–80) is still very popular.

Italian.—The oldest Italian Bibles of which manuscripts are extant belong to the 14th century; they are in all probability connected with 13th-century translations that were influenced by the Provençal versions of the Waldenses.

Of the two translations from the Vulgate printed in Venice in 1471, the one by Niccolò Malermi was often re-edited (ten times before 1500), the latest edition being dated 1773. The translation by the humanist Antonio Brucioli (1532), following the Latin version of Erasmus for the New Testament and of Pagninus for the Old (1528), was destined with some alterations to become the Bible for Italian Protestants (printed in Geneva in 1562). The main Protestant version, translated from the original languages by Giovanni Diodati and first printed in Geneva in 1607, is still in use. In 1769–81 the archbishop of Florence, A. Martini, published the most important Roman Catholic version of the Vulgate.

Spanish.—Translation of the Bible in Spain shows one remarkable, even unique feature, a version of the Old Testament by Rabbi Moisés Arragel made from 1422 to 1430 at the request of Don Luis Guzmán, grand master of the Order of Knights of Calatrava. It contains biblical exegesis by Christian and Jewish authorities without, however, evaluating their merits. A Catalan translation from the Vulgate by Bonifacio Ferrer (1478) was destroyed by the Inquisition in 1498 and only a few fragments survive. The first printed Spanish translation of the New Testament was made by the Reformer Enzinas (Dryander) from the original Greek (1543). In 1569 C. de Reyna, also a Reformer, translated the Old Tes-

tament from the Hebrew with the help of Pagninus' Latin version, largely for the benefit of Spanish-speaking Jews. This was revised by C. de Valera in 1602. In 1793 a Roman Catholic translation of the Vulgate was produced. New translations were made from the original languages by E. Nácar and A. Colunga (1944) and by J. M. Bover and F. Cantera (1947).

Slavonic Languages.—The first translation of the Bible or of parts of it into Church Slavonic was made by Cyril and Methodius, who were sent as missionaries from Constantinople to Moravia in the 9th century. This version was made from the Greek Bible; that is, from the Septuagint and from the original Greek of the New Testament. The earliest extant Church Slavonic Bible, a manuscript of 1499 named after Gennadius, archbishop of Novgorod, contains books translated at different periods from Hebrew, Greek and Latin. Revisions of this Bible were published in 1581, 1663 and 1751.

The first translation of the New Testament into Russian was published together with the Church Slavonic version in 1821. It was made from the Greek original. Previously some books of the Bible had been published in White Russian, beginning with Job, which was translated from the Vulgate and the Church Slavonic versions. The first Russian translation of the whole Old Testament, made from the Hebrew, was published in 1875. Since the Revolution emigrants from Russia have made new Russian versions.

In the western half of the Slav territory, where the people embraced the Roman Catholic faith, the Vulgate was translated into the vernacular languages comparatively early. The Czechs as well as the Poles possessed translations in the 14th century, and John Huss, at the beginning of the 15th century, revised earlier Czech versions and modernized their antiquated language. The first printed Czech translation, made from the Vulgate, was published in 1475. In 1579–93 the Unitas Fratrum published the Kralitz (or Kralice) Bible, translated from the original tongues, which set a standard for the Czech language (*see* CZECHOSLOVAK LITERATURE; MORAVIAN CHURCH).

The first printed Polish New Testament (1553) was translated from the Greek original by J. Seklucyan, a friend of Luther. The first Polish Bible, translated from the Vulgate, was published in 1561 (the Cracow Bible).

Finnish.—The New Testament was first translated from Greek into Finnish by Bishop M. Agricola (1548), who also revised for publication the translation of the psalter by P. Justen (1551). The whole Bible was translated from the original tongues nearly a century later (1642). It has been repeatedly revised. Between 1820 and 1900 the four Gospels were translated into Karelian, the south Finnish dialect, for the use of Orthodox Finns.

Hungarian.—Parts of the Vulgate were translated in the 15th century, and the first book printed in the Hungarian language was a translation from the Vulgate of the Pauline Epistles (1533). In 1541 the Protestant J. Erdősi translated the New Testament from the original Greek, and in 1590 the whole Bible was published by G. Károli, who translated it from the original tongues. This version, which is of importance for Hungarian literature, has been frequently reprinted (*see* HUNGARIAN LITERATURE). The Roman Catholic translation from the Vulgate by G. Káldi (1626) also has been reprinted. (WE. S.)

NON-EUROPEAN LANGUAGES

Since 1800 the translation of the Bible into non-European languages has been closely related to the development of Protestant missions. Before 1800 the Bible in whole or in part had been translated into no more than 20 non-European languages. Of these, Syriac, Armenian, Coptic, Ethiopic, Georgian, Persian and Arabic were spoken in areas of the middle east and of the Nile valley where Christianity first penetrated. Nothing has remained of the translations made by the Orthodox monks at work in central Asia or by the Roman Catholic missionaries who followed the steps of the great explorers of the 15th century. The other extant pre-1800 translations resulted from the labours of pioneer Protestant missionaries, such as John Eliot, who translated the Bible (1663) for the Massachusetts Indians; B. Ziegenbalg and J. E. Gründler, who translated the New Testament (1715) into Tamil; and B. Schultze, who translated the Gospel of John (1758) into Dakhini (a form of Hindustani).

As against this almost static situation prior to 1800, translations of the Bible, in whole or in part, appeared in about 400 non-European languages between 1800 and 1900. And in the following half-century more than 500 were added to the list, so that by the end of 1960 some part of the Scriptures had appeared in a total of 1,005 non-European languages (the British and Foreign Bible society alone being editorially responsible for more than 600 of them): the whole Bible in 172 languages, the complete New Testament in 258 more languages, and at least one complete book of the Bible in a further 575 languages. At the same date it was reckoned that translation and revision work was in progress in nearly 500 languages, of which approximately 200 previously had had no translation of the Scriptures. The whole Bible then existed in languages understood by about 90% of the world's population, and either the Bible, the New Testament or a portion in languages understood by about 95%.

In order to help missionaries and nationals engaged in translation and revision work, many of whom had little or no knowledge of Greek and Hebrew (as is still the case), the British and Foreign Bible society as early as 1817 appointed a translation secretary and in 1830 established a specialized translation department. Other Bible societies, such as the American and the Dutch, followed with similar programs early in the 20th century. The tasks of such translation departments include: ensuring the best and most scholarly help to meet translators' problems; establishment of guiding principles for the benefit of translators and revisers; formation of local translation or revision committees with a suitable balance of denominational representation; occasional provision of financial support; training and sending out of translation and linguistic experts to help missionaries in the field; holding of translation conferences; preparation of "translational helps," etc. After 1950 this last activity received new impetus through the publication in London, under the auspices of the United Bible societies, of a quarterly, the *Bible Translator*.

In addition to the Bible societies, the Wycliffe Bible Translators (also known as Summer Institute of Linguistics) also specialize in work of Bible translation. This organization was founded in 1935 with the specific aim of training and sending missionaries to translate the New Testament into all of the estimated 1,500–2,000 languages and dialects of the world in which no part of the Bible had as yet appeared.

Translation work developed first in languages that already possessed a written literature, and in this group the pioneer translator was William Carey, who with his colleagues at Serampore produced 28 translations in Indian languages. The whole Bible was translated out of the original languages into Sanskrit by Carey (published 1822), into Chinese by Robert Morrison (published 1823) and into Burmese by Adoniram Judson (published 1834). Though most of these early translations were later revised, they were significant contributions to the literature of the languages, for they introduced to these areas an entirely new world of faith, thought and culture.

Translation into unwritten languages implies a host of special problems, including the preparation of adequate alphabets, the analysis of complex morphological and grammatical structures and the development of a "literary style" based on an oral tradition.

The pioneer work of missionaries in the field of translation was a major factor in the creation in the west of most of the schools and institutes of oriental and African languages. The British and Foreign Bible society, for example, has always maintained very close relations with the School of Oriental and African Studies of the University of London. The advice of their scholars has been constantly sought both in relation to specific questions raised by translators and to the quality of a translation awaiting publication.

In the United States, on the other hand, the growth of the science of descriptive linguistics during the first half of the 20th century led to a new development in biblical translation. This, together with a concentration of attention on symbolism and com-

munication in the related fields of anthropology, psychology and cybernetics, has resulted in significant advances in the whole field of communication through languages. The American Bible society and the Wycliffe Bible Translators have done pioneer work in this field as part of their endeavour to produce more adequate versions of the Scriptures. (*See* also BIBLE SOCIETIES.)

Bible translating is closely related also to literacy. On the one hand Scripture production has in many languages stimulated literacy; on the other hand the spread of literacy has led to demands for translations into more colloquial speech, especially in areas where the spoken language differs widely from the literacy standard, as Arabic, Japanese and Haitian Creole. The Japanese colloquial version published in 1955 is notable as the first revision in a major non-European language done entirely by nationals. Widespread literacy also has stimulated the production of translations into simple forms of language; *e.g.*, "popular Spanish" for Latin America and "simple French" for Haiti. (O. P. BE.)

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BIBLE SOCIETIES are nondenominational religious organizations concerned with the wider circulation of the Bible and parts thereof in the languages of all men at a price everyone can afford.

Early Societies.—At all times the Bible has been an expensive book to produce. For centuries it remained accessible only to the wealthy, yet again and again individuals and groups of people moved by evangelistic zeal made funds available for editions of the Holy Scriptures to be circulated at low cost. The Protestant attitude to the Bible as the property of all Christians, not merely of an educated elite, made more general the demand for cheap vernacular editions of the Bible, but it was not until 1710, with the establishment of the Canstein Bible institution (Cansteinsche Bibelanstalt) in Halle, Ger., that there was an organization devoted solely to the production of cheap editions of the Scriptures. This institution had three main characteristics that were to become paramount for the Bible societies a century later. First, its founders were concerned with the purity of the text. Second, a new method—already used in Holland for an English Bible—that of printing from standing type, was applied, by which the whole Bible was set at once and the composition kept for later reprints. Third, it was founded out of an evangelistic and social concern, being part of a series of social and educational institutions known as Francke's Orphanage (Waisenhaus), and deeply rooted in the biblical and pietistic revival of that time.

During the 18th century the evangelical movement spread all over Europe and even reached the new world. The best-known and most powerful evangelical organization was the Evangelical society, centred in Basel but with branches all over southern Germany and Switzerland. In Great Britain the evangelical movement gave birth to a series of organizations such as the Society for the Promotion of Christian Knowledge Among the Poor (1750); the Society for the Support and Encouragement of Sunday Schools (1785); a Bible society later called the Naval and Military Bible society (1780), specializing in Scripture distribution among soldiers and seamen; and a French Bible society (1792), for the supply of Scriptures to French people in France. Some of these societies had their counterparts in America. All of them were concerned at least in part with meeting the increasing demand for cheap Scriptures that had arisen as a result of the evangelistic revivals and of the contemporary spread of literacy among poor people. At the same time interest and concern for missionary work abroad was growing also as a result of the evangelical movements.

19th Century.—It is at the junction of these two concerns—to make the Scriptures available at a price all could afford and to all men all over the world in their own tongue—that the British and Foreign Bible society (B.F.B.S.), the first Bible society in the fullest sense, was founded in 1804 as a result of a proposal made by Thomas Charles (*q.v.*) and members of the Clapham sect (*q.v.*) to the committee of the Religious Tract society. To the evangelistic and social preoccupation of the founders of the Canstein Bible institution a new dimension was added, the world-wide missionary outlook.

The step taken in London was quickly imitated elsewhere. Soon each Protestant state in Germany, each Protestant canton of Switzerland had its own local Bible society, just as each main city of England and Wales had its auxiliary to the B.F.B.S. The movement also spread rapidly to Scotland, Scandinavia, the Netherlands, France, several of the states in the U.S., Canada, the main cities of India, Freetown in Sierra Leone, Belize in British Honduras, Cape Town, Mauritius and later Australia and New Zealand. In 1816 most of the local societies of the U.S. joined to form the American Bible society. All the time London was providing subsidies to encourage and help new societies to establish themselves. In less than 20 years the Protestant world was dotted with Bible societies and Bible society auxiliaries, many of them remaining heavily dependent upon the subsidies provided by London. Short-lived Roman Catholic Bible societies were established around this time in Pressburg (Bratislava) and in France. With the collaboration of the Orthodox Church an interconfessional Russian Bible society was established in 1814, replaced in 1828 after the withdrawal of the Orthodox by a Protestant Bible society, which closed down at the end of World War I.

Two features were particularly characteristic of this new type of organization as represented by the B.F.B.S. First, it was interdenominational. The wide circulation of the Scriptures "without note or comment" was the sole aim. Thus any person interested in the society's object could co-operate. Moreover an equal balance was maintained between the Anglican and the free churches in the membership of both general committee and staff. The international character of the society was also expressed by the presence in the committee of six representatives of the foreign churches established in London. Second, it was a lay society. All committee members were, and have remained, laymen of distinction from different walks of life. All Bible societies have maintained this characteristic, though a number of them also have opened their ranks to the clergy in the course of time.

The original fellowship within the Bible society movement was deeply shaken in 1826 by the decision of the B.F.B.S. to exclude formally from its program the circulation of the Apocrypha and to cease supporting or collaborating with societies that would not take a similar decision. This meant a break in relations with the majority of the continental European Bible societies. Cut off from their source of inspiration, hampered by the political and social struggles that were constantly shaking the continent and by a much slower economic progress than in Britain, the continental Bible societies for more than a century remained self-centred and paid little or no attention to work abroad. The Netherlands Bible society alone formed an exception and started work in Indonesia. The Stuttgart Bible institution (Privilegierte Württembergische Bibelanstalt) also deserves particular mention for its publication of R. Kittel's scholarly edition of the Old Testament in Hebrew, A. Rahlfs' of the Septuagint and E. Nestle's of the New Testament in Greek. In the meantime the B.F.B.S., the National Bible Society of Scotland and the American Bible society were continually expanding their fields of operation. Year after year new translations were published and new agencies were opened. By the 1820s, before the coming of the first evangelical missionaries, colporteurs related to those societies were working

throughout Latin America. In the following decade systematic colportage started in France, spreading to other countries in Europe and to the other continents. By 1900 nearly 2,000 colporteurs were at work on behalf of those Bible societies in almost all countries of the world.

20th Century.—The 20th century has been marked by five important developments. First, whereas contacts between the Bible societies in the British Isles, the United States and the Netherlands had been on the whole purely superficial and formal, business discussions became increasingly frequent after 1900. In order to avoid overlappings and frictions, "territories" were exchanged, countries divided into zones of activity—another form of the "comity" principle well known in missionary circles. Later, in the 1930s, joint agencies were formed, administered by one society, supported jointly by two or more. At the same time basic principles were worked out that regulated terms of co-operation in various technical matters such as translation, production, price calculation, etc. These principles subsequently were adopted by nearly all Bible societies throughout the world.

Second, in the first quarter of the century the local auxiliaries in the British dominions were federated to form national societies and received the status of independent Bible societies. After the 1940s former national agencies also were granted administrative autonomy in Japan, Korea, China, Indonesia, India, Belgium and Brazil, or, as in the case of France, Austria and Finland, were integrated in or closely associated to the national Bible society.

Third, the continental European Bible societies began by the middle of the century to emerge from their self-centredness and to recapture the world-wide missionary outlook that had inspired the Bible society movement at its inception.

Fourth, in 1946, under the name of the United Bible societies, a world fellowship of Bible societies was formed that soon embraced all the existing national Bible societies. Its main purpose was the furtherance of consultation, co-ordination and co-operation among the Bible societies in their common purpose of obtaining the widest possible circulation of the Holy Scriptures. Its creation broadened on a world-wide scale the agreements passed by the British, American and Dutch societies. It offered a place where supporting and supported societies could meet outside the realm of their mutual dependency, and it provided the impetus for the revival of the European continental societies.

Fifth, by a series of papal statements and encyclicals of which that of 1943 was the climax, the Roman Catholic Church encouraged the translation, study and reading of the Bible. A similar movement encouraging the reading of the Scriptures also took place in the Greek Orthodox (Zoë movement) and Coptic churches (Friends of the Bible).

When the B.F.B.S. was founded, the Bible in whole or in part had been printed in 72 languages. By 1960 the whole Bible had appeared in 219 languages and dialects, the whole New Testament in 271 more, one or more whole books of the Bible in 601 additional ones, a total of publication of 1,151 languages. About 1,200 Bible translators engaged in translation or revision, working singlehanded or in teams, were related to the Bible societies. Between 1950 and 1960 the average annual world circulation of Holy Scriptures by the Bible societies amounted to 3,037,898 Bibles, 3,223,986 New Testaments and 18,417,989 portions. As Scriptures are generally sold at a loss, or at most at the bare cost of paper, printing and binding, the cost of translation, composition and plates, handling, colportage and general overhead expenses had to be covered by donations. The average amount thus collected annually throughout the world from churches and individuals for the years 1955–60 was over £2,000,000. Bible societies are at work directly or through agencies and depositories in over 100 countries.

Parallel or complementary to the work of the Bible societies, various organizations originating mainly in Great Britain or the United States also have specialized in Scripture distribution. Some, like the Scripture Gift mission (1888), circulate in addition to Gospels and New Testaments a large variety of selections from the Scriptures. Others have specialized in specific types of distributions; among these is the Gideons International (1899), which supplies hotels, hospitals and prisons with free copies of the Bible or of the New Testament. Still others, which gained great momentum after World War II, such as the Pocket Testament league (1908), have engaged in extensive campaigns of Gospel free distribution. Finally, the Wycliffe Bible Translators Inc. (1935) have specialized in providing training for missionary translation and supervision of translating work with the aim of publishing one Gospel at least in every spoken language of the world. It was estimated in 1960 that there were 2,000 languages and dialects spoken by about 25,000,000 people into which no part of the Bible had yet been translated.

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BIBLIOGRAPHY is the anglicized form of the Greek *bibliographia*, which means "the writing of books" in the literal sense; the Greek *bibliographos* was a copyist of manuscripts. The word has passed through various meanings and still covers too many activities to be very exact in definition. However, in modern times the word bibliography is ordinarily associated with two sets of activities: (1) enumerative (or systematic) bibliography, the listing according to some system or reference scheme of books that have a formal relationship; and (2) analytical (or critical) bibliography, the examination of books as tangible objects with a view to the recovery of the details of the physical process of their manufacture, and the analysis of the effect of this production process on the physical characteristics of any specific copy of a book.

Analytical bibliography can be pursued independently of any limited objective; that is, it may be studied as a pure discipline concerned with recovering and interpreting evidence about production processes as preserved in the physical features of books of various periods. The application of such information, however, usually takes the form of (*a*) descriptive bibliography; or (*b*) textual bibliography.

Ancillary to analytical bibliography (in that evidence from these sources may on occasion be utilized to assist in the drawing of correct conclusions) are the numerous fields concerned with the study of printing and its processes both as art and as craft, and with the mediums for the distribution or publication of its products. These studies may range from the art of typography to formulas for printer's ink or the methods of manufacturing paper in different places and centuries; from biographical notices of printers, bookbinders and publishers to inquiries into the mechanical development of printing presses; from the publishing of book advertisements in 18th-century periodicals to the contract between a 20th-century author and his publishing firm. These studies may include histories of printing, of book illustration, bookbinding, book distribution, even of book collecting, and many more areas of association.

In this article "book" will be used loosely to denote any printing or facsimile reproduction. Manuscripts and their study are customarily removed from the province of bibliography, but this exclusion represents a false distinction, except in such matters as historical studies of paleography that do not properly concern bibliography. Since one of the functions of textual bibliography is the recovery of the characteristics of the lost manuscript that served as printer's copy, it is evident that bibliography has an intimate connection with certain forms of manuscript study. Moreover, the striking information yielded by analysis of the physical characteristics of manuscripts (as in certain Walt Whitman and Emily Dickinson documents) demonstrates that this investigation follows the same logical methods of analysis as the study of printed books and can scarcely be distinguished from it.

ENUMERATIVE (OR SYSTEMATIC) BIBLIOGRAPHY

Enumerative bibliography lists material according to some useful scheme of classification and provides conventional identifica-

tion of the books, articles or other material that it organizes. The purpose of this form of bibliography is to disseminate information by the systematized notation of material having some special purpose or sufficient common characteristics to be of significance to human knowledge when thus collected for reference. The operative word is "systematic"; that is, there must be some formal system or rationale for the association of the listed material in a bibliography.

Almost any attempt at classifying kinds of enumerative bibliographies will raise objection, since often there is considerable intermixture. However, as a working classification it may be possible to separate bibliographies into: (1) general, the listing of essentially miscellaneous material in which the relationship is merely chronological, geographical or linguistic, or according to some other external criterion; (2) association chiefly by the form of the material; (3) association by the subject, that is, some feature of the contents of the listed material; (4) association of material as the work by or about a single author.

General.—Here the material itself is miscellaneous and the principle of selection for listing is only in respect to the production of the material within a given span of time, or in a given geographical area, or language or the like. Thus the *Gesamtkatalog des Wiegendrückes* ("Complete Catalogue of Incunabula") proposes, on completion, to list, alphabetically by author, every book printed anywhere in the west before 1500 (*i.e.*, incunabula). Because of the enormous quantities of books and manuscripts produced since the "cradle" or incunabular period, few arrangements in which the central classification is purely chronological are practicable; and usually there is some further limitation, if no more than by nation or by language within the general chronological scheme. Thus in J. E. Wells's *A Manual of the Writings in Middle English, 1050–1400*, chronological limits are added to a linguistic criterion. In the Pollard and Redgrave *Short-title Catalogue of Books Printed in England, Scotland and Ireland and of English Books Printed Abroad, 1475–1640*, limits of time are added to the restriction of the listing to books printed in Great Britain in any language and to books in the English language printed abroad. The various annual national bibliographies in which the world's production of books is regularly recorded, such as *The English Catalogue of Books*, restricts the listing by national bounds within the general system of the calendar year. *Cumulative Book Index*, published in the United States, undertakes to list all books published in English, anywhere in the world.

Form.—In the bibliographies of miscellaneous material unified only by temporal, geographic or linguistic association, and the like, an external and indeed almost fortuitous consideration governs the selection for listing of material otherwise quite without association. A somewhat more organic principle restricts selection by association of materials in similar forms, or genres, even if for practical reasons the same limitations as in general bibliographies may be placed on the extensiveness of the enumeration. On the most literal level the periodic *Dissertation Abstracts*, or the W. Gregory *Union List of Serials in Libraries of the United States and Canada* or the same author's *American Newspapers, 1821–1936*, or R. S. Crane and F. B. Kaye's *A Census of British Newspapers and Periodicals, 1620–1800* select their material for listing on the initial criterion of form, as announced in the title, before imposing further limitation. In this grouping the similar form of the material may mask the widest variety of contents, as in Theodore Besterman's *A World Bibliography of Bibliographies* or R. Tanghe's *Bibliography of Canadian Bibliographies;* or the form may itself impose a considerable unity on the contents, as in A. Esdaile's *A List of English Tales and Prose Romances Printed Before 1740*.

Subject.—In the subject bibliography the unifying principle is internal since it is associated with the contents of the books enumerated; the association arises from within and is organic. The degree of unity varies widely, of course. Obviously the association of material is closer and more specific in a bibliography of material about fishing, say, than in *The International Bibliography of Historical Sciences* or *British Scientific and Technical Books, 1935–1952*.

One kind of subject bibliography associates books that are secondary material, such as critical or historical accounts concerned with some central subject matter, narrow or broad; an example is the *Annual Bibliography of English Language and Literature* issued by the Modern Humanities Research association, which does not list the primary new creative literature written each year but rather the scholarship and criticism devoted to the study of literature. Similar compilations are the annual "Check List of Bibliographical Scholarship" published in *Studies in Bibliography* or the annual "Victorian Bibliography" published in *Modern Philology*.

Another kind of subject bibliography may associate records of basic original documents with critical or historical accounts of these documents. The classic example here would be *The Cambridge Bibliography of English Literature*, which is certainly a subject bibliography in that it excludes all English books that are not classifiable as literature; however, it proceeds then to list the original and early editions of the selected writers of English literature together with secondary accounts of these authors and their writings both in particular and in general, as in critical material about literary forms, history of ideas, etc. Thus subject bibliographies, in a manner ordinarily not encountered in general or in form bibliographies, may treat only primary documents, or only secondary documents, or a mixture of the two.

Author.—Author bibliographies are accorded a separate heading chiefly because they represent a narrow kind of compilation and are very popular. Ordinarily they list the primary documents, that is, the author's works, and add to these a list of writings about the author and his works, or about the painter and his portraits, the musician and his compositions, etc. The description of the primary documents may become so detailed and definitive as to approach a descriptive bibliography that has extensive supplementary subject lists.

Other Lists and Guides.—The current products of historical, scientific, artistic or literary research are usually well served by periodic bibliographical subject lists, but artistic and literary creative work in the making is more difficult to follow since most bibliographical lists are highly selective of such material and are often aimed only at advising a general library on books suitable for purchase. However, something can be done with such aids as the *Subject Index to Periodicals*, the *Fiction Catalog* or the *Index of Plays, 1800–1926*, with their periodic supplements, the *Book Review Digest*, the *Library of Congress Subject Catalog*, the *British National Bibliography* and the *Reader's Guide to Periodical Literature*.

An enumerative bibliography may attempt to be complete within its particular field of limitation, or it may adopt some rationale of selection. It may sometimes offer annotations describing the contents or assessing the value of the material noticed. Because of some relative completeness or because of some features of special value, a few catalogues may be considered on an equal plane with enumerative bibliographies, despite the conventional differentiation that such catalogues list or describe only books in one collection and therefore have an arbitrary and not a reasoned method of selectivity for listed materials. However, no one could deny the prime importance, for instance, of such catalogues as the British museum's printed general *Catalogue* or the *Catalogue of Books Printed in the XVth Century Now in the British Museum*, because of their wide scope; or of William A. Jackson's *Catalogue of the Carl H. Pforzheimer Collection*, for its informative commentary and research.

There is an extensive group of reference materials peripheral to enumerative lists. Some are in the form of indexes; examples are the annual *New York Times Index, A Cumulative Index to Biographical Material in Books and Magazines*, first-line indexes to poems and the various dictionaries of quotations, pseudonyms and the like. Some take the form of guides to the use of reference material and of enumerative bibliographies; an example is Constance Winchell's *Guide to Reference Books*, based on the classic I. G. Mudge *Guide to Reference Books*. Other materials are designed to assist the student in mastering the technique of utilizing enumerative lists for definite scholarly research projects,

as A. G. Kennedy's *A Concise Bibliography for Students of English* or T. P. Cross's *A Bibliographical Guide to English Studies*. More general assistance is provided in such treatises as A. Esdaile's *A Student's Manual of Bibliography* and H. B. van Hoesen and F. K. Walter's *Bibliography: Practical, Enumerative, Historical*.

Various United Nations agencies contribute to bibliography. In 1953 the United Nations Educational, Scientific and Cultural organization (UNESCO) started a series of instructional manuals aimed at general improvement of bibliographical methods and designed to help with the creation of basic services; the series includes reports on bibliographical services throughout the world and international bibliographies on such subjects as economics, political science, sociology and social and cultural anthropology. Other UN organizations and the UN headquarters library publish subject bibliographies; the library also publishes indexes to proceedings of the general assembly and various councils.

ANALYTICAL (OR CRITICAL) BIBLIOGRAPHY

Analytical bibliography studies the physical evidence of printed books (and manuscripts) with a view to recovering the principles of the reproduction process and ultimately of applying information thus gained to the problems of specific books. The evidence utilized is circumstantial and physical, and would often be legally valid.

In its purest state analytical bibliography divorces itself completely from all literary, historical or critical-aesthetic considerations and confines its attention to the physical evidence of a book without regard for the nature, purport or intelligibility of the contents. For example, some copies of Gervase Markham's play *The Dumbe Knight* (1608) have a title page in which the author's name is present; in other copies the name is absent. A literary critic once argued that Markham was disgusted when he learned that his play was to be printed with additions not his own and demanded that his name be withdrawn from the title. An analytical bibliographer did not concern himself with motive and inference but instead ascertained the physical facts of the printing. These demonstrated that the title page without the name was the original, firmly conjugate with its opposite leaf in the folded sheet that made up the first gathering of the book. Consequently, the title page with the name was a substitute, or cancel, bound in after the original first leaf without the name had been excised. The physical facts about the printing demonstrated clearly that the name in point of time was added and not subtracted.

Physical evidence gained from identifying hundreds of pieces of slightly bent or broken type, and from following them in and out of the printers' cases as they were typeset, distributed and typeset again in different family groups on various pages, enabled C. J. K. Hinman to establish the fact that the Shakespeare First Folio was not composed and printed in normal order but instead in a leapfrog manner; the somewhat widely separated typeset pages had been forced to conform to an estimate of the space required for their contents marked off in advance in the printer's copy. Moreover Hinman, by following the varying contents of the printer's cases as indicated by these known types, added decisive evidence to that derived from analysis of characteristic spelling habits of the various workmen. He thus was able to identify positively the exact lines set by each of the five compositors of the First Folio. As a result, not only the workmen who set the type but the order of composition of each page and the order in which it went through the press can now be determined for English literature's most important single book. (*See* SHAKESPEARE, WILLIAM; *Textual Criticism.*)

Physical evidence enabled W. W. Greg to demonstrate that certain quartos of Shakespeare, known as the Pavier Quartos after their printer, were printed in 1619 and not a decade or so earlier. On the evidence that some lines of the title pages of these books were in an identical typesetting, though ostensibly printed years apart, it was established that they were the work of one printer in 1619 and not of various printers of earlier years. This discovery assigned the correct order to the early editions of some of Shakespeare's important texts that had been placed in a mistaken order on metacritical evidence.

Physical evidence enabled John Carter and Graham Pollard to establish that certain 19th-century pamphlets by prominent literary figures could not have been published according to the dates on their title pages since they were printed with type that had characteristics not yet developed and on paper containing esparto grass not yet in use at the alleged dates. On this sure factual foundation was reared the sensational exposure in the 1930s of the Thomas J. Wise forgeries. Wise, a British bibliographer, collector and book dealer, with considerable standing in the book world, in the 1890s forged and sold over 50 "first editions," several for substantial prices. The forgeries were done with great skill and are now becoming collectors' items in their own right. (*See* LITERARY FORGERY.) In method the foregoing examples have varied from studies of presswork, as in *The Dumbe Knight*, through studies of the typesetting, as in Hinman's First Folio investigations, to analysis of the chemical constitution of the basic material of the book, the paper, as in the Wise case. What they all have in common is the technique of investigating books as tangible objects without regard for their contents. This analytical bibliography and its study of physical printing evidence is the backbone of descriptive bibliography and of textual bibliography, in both of which it finds its most fruitful application.

DESCRIPTIVE BIBLIOGRAPHY

In at least one important fundamental, a descriptive bibliography differs from an enumerative bibliography: a descriptive bibliography has little point unless it confines itself to the ordered arrangement and description of primary documents, whereas an enumerative bibliography may list primary, or secondary documents or a mixture of both. To be precise, Sir Walter Greg's *A Bibliography of the English Printed Drama to the Restoration* lists only the primary documents; *i.e.*, the texts of the plays in their various editions, issues and states printed before 1660. On the other hand, *The Cambridge Bibliography of English Literature* enumerates a large selection of the pre-Restoration editions of these plays but adds a listing not only of modern editions of the texts but also of secondary documents about them; *i.e.*, the critical and historical studies that examine these works, their individual significance and their literary history.

If a descriptive bibliography is compared with an enumerative bibliography devoted to the same primary documents, however, three major differences may be discerned, all of which represent a greater rigour of scholarship devoted to the descriptive form: (1) a descriptive bibliography is usually more definitive in respect to the number of primary documents listed; (2) a descriptive bibliography is more definitive in the identification and arrangement of the material; and (3) a descriptive bibliography may contain information of interest to more purposes than the immediate one of identification.

Primary Documents.—Since the major purpose of an enumerative bibliography is the provision of a useful source of reference material, the compiler may content himself in some part by copying references in secondary sources such as catalogues, either to the exclusion of any other means of inquiry or as a supplement to personal examination of the documents listed. In either case, he cannot guarantee either completeness or accuracy. A descriptive bibliographer, on the other hand, must guarantee fullness and accuracy by relying exclusively on searching inquiry and personal examination, since his purpose is to create a permanent descriptive listing, that will never become outmoded, of important basic documents.

Identification and Arrangement.—An enumerative bibliography contents itself with the absolute minimum of identifying information. For modern books a short title and date of publication may be all that is required, since the user may then refer to any library catalogue for further information. The enumerative bibliographer has ordinarily performed his proper service by noticing the simple existence of such and such a title. Progressing farther into the past, the enumerative compiler may find that the possibilities of confusion are so increased as to call for somewhat more extensive identification, and some lists may add the place

of publication and even the name of the publisher or of the printer, publisher and seller. The descriptive bibliography, on the other hand, offers a series of relatively minute physical descriptions with the following aims: (1) to establish the physical form of the book listed; (2) to differentiate this physical form in the matter of variations within the edition, and then from the forms of other known editions; enough detail is given that a user presumably will be able to identify a specific copy held in his hand as either similar to an edition, issue or state described in the bibliography, as an imperfect copy, or else as a form that has not been seen by the bibliographer; (3) to provide a body of descriptive information to the general student of printing and publishing or of bibliographical practice.

In the process of contriving this physical description a descriptive bibliographer differentiates himself from a cataloguer, or enumerator, in two particular respects: First, the descriptive bibliographer is concerned to describe the "ideal copy" of any particular edition, with an account of all variations from this definitive ideal norm, whereas a cataloguer ordinarily confines himself to the description of a specific copy without inquiring whether this copy is truly representative of the edition as a whole. Second, the descriptive bibliographer, in the process of discovering the form of the "ideal copy" and its variants, must compare some numbers of duplicate copies, personally, in an effort to exhaust the possibility for the discovery of further, unknown variations. In this process, of course, he will not only learn and record issues and states within an edition not to be ascertained by less searching investigation but will also discriminate between closely similar editions previously confused, as the three 1670 editions of Dryden's *Indian Emperour*, lumped together as two before bibliographical inquiry began.

Variety of Information.—The illustrative notes often appended to descriptions may serve as a storehouse of information about the details of the printing as revealed by the analytical bibliographer's explanation of the process that produced the book and its variants under discussion, the identification of the printer and of his types and ornaments, the transmission of the text or the artistic values of the production, details of the contents, some account of the publishing history and a listing of the collections where the editions were consulted and the characteristics of their copies.

The physical description of a book may differ in the details chosen, though not greatly in the methods for describing these details, according to whether the book is an incunable (*i.e.*, printed before 1500), a later hand-printed book or a contemporary product of machine typesetting and presswork. In all cases the edition is chosen as the unit for description, and within each edition the variant issues and states are distinguished. Most descriptive bibliographies include as a minimum a transcript of the title page (preferably in quasi-facsimile form); a collational formula that describes the format, the number of gatherings and the signing and paging; and a listing of the contents in their formal sections. As much as possible, for precision and brevity, these details are presented in formulary terms. A typical brief description would be as follows:

A | TRAGI-COMEDY: | Called, | *Match mee in* LONDON. ‖ As it hath beene often Prefented; Firft, | at the *Bull* in St. IOHNS-ſtreet; and lately, | at the Priuate-Houſe in DRVRY-Lane, | called the PHŒNIX | *Si non, His vtere Mecum.* | Written by THO: DEKKER. | [printer's device] | LONDON. | Printed by B. ALSOP and T. FAVVCET, for H. SEILE, | at the *Tygers*-head in S^t. *Pauls* Church-|yard. 1631.

4°: A^2 B-K^4 L^2; $3 signed [A2, D1 in italic; missigning K3 as K2], 40 leaves, pp. [4] 1–53 45 54 56–76 [=76] (*variant:* misprinting 44 as 4, 54 as 46 instead of 45).

A1: title. A1^v: '*Drammatis Perſonæ*' (*var:* '*Dramatis*'). A2: [ornament] | 'TO THE NOBLE LOVER,' | (and deſeruedly beloued) of the Muſes, | LODOVVICK CARLELL' | . . . . (8-line initial), signed 'THO: DEKKER.' ‖ B1: [ornament] | 'MATCH MEE | IN LONDON.' ‖ ACTVS, I. ' ‖ (5-line initial). On L2^v: ‖ '*FINIS.*' ‖ (*var:* omitting second rule)

For a more complete description of this book, *see* W. W. Greg, *A Bibliography of the English Printed Drama to the Restoration*, no. 440 (1940); and for the methods by which such a description is contrived, *see* Fredson Bowers, *Principles of Bibliographical Description* (1949).

TEXTUAL BIBLIOGRAPHY

Textual bibliography is the backbone of textual criticism (*q.v.*). It may be defined as the application of analytical bibliography to the three major specific problems of the textual critic: (*a*) the analysis of the physical characteristics of an extant manuscript; (*b*) the recovery of the characteristics of a lost manuscript from the details of the print; and (*c*) the study of the transmission of the text. In each case the immediate purpose of the inquiry is to estimate the specific effect, on the correctness and completeness of a text, of the printing or inscription process as a whole and in any particular.

The range and variety of this complex form of bibliography are so great as to permit mention of only a few typical examples.

Physical Characteristics of Manuscript.—A careful study made by Thomas Johnson of the physical evidence of the papers and inks, plus the changing characteristics of the author's handwriting, offered relatively exact information about the dates of inscription of a number of Emily Dickinson manuscripts and thus provided a guide to the choice of texts.

Details of Print.—In Shakespeare's *1 Henry VI*, as printed in the First Folio of 1623, spelling tests and type-case evidence established that compositor A set most of the first half of the play and compositor B most of the second half. The variant spelling "Joane" and "Jone" for Joan of Arc has no immediate significance since it is established as a compositorial characteristic varying according to the bibliographical units of the typesetting by each workman: the "Joane" spellings all appear in pages set by A, and the "Jone" spellings all appear in pages set by B. However, in acts i and ii, "Burgundy" is spelled with a "d," but in act iii as "Burgonie"; and in act i Joan is referred to as "Puzel" but in act iii as "Pucell." In each instance the name spellings alter with the literary division act iii, and both forms appear in the pages set by each compositor so that variation is not bibliographical. In contrast to "Joane-Jone," therefore, these spellings can be established as noncompositorial and therefore as characteristic of the lost printer's-copy manuscript. It must follow that this manuscript was heterogeneous, inscribed by two hands, with the point of division at the start of act iii.

Transmission of Text.—The study of the transmission of the text can be associated with the effect of the printing process on the printer's copy, as in the foregoing example, or with the settlement of larger questions affecting the authentication of specific textual readings. For the first, the demonstration that in *Hamlet* act i, scene 2 the Second Quarto "sallied flesh" (meaning "sullied") is correct and the Folio reading "solid flesh" is corrupt ultimately came to rest on the bibliographical evidence that the second edition (Q_2) was set by two different compositors and printed on two presses. Hence the workman who set in type the debated "sallied" at i, 2^v, 129, was different from the workman who set in type the accepted "sallies" (for "sullies") at ii, 1, 39, and one could not have influenced the other; nor could both be the result of one workman's misreading a hypothetical malformation of the letters in the manuscript (*see* Allardyce Nicoll [ed.], *Shakespeare Survey*, vol. 9 [1956]).

For the second, the question of whether Hamlet's phrase is correctly "good kissing carrion" at ii, 2, 182, as in both Q_2 and Folio, or "god kissing carrion," as in Warburton's generally adopted emendation, will in some considerable part rest on whether it can be demonstrated that the printer's copy for the Folio was an independent manuscript or else a print of Q_2 scribally annotated and altered by comparison with some manuscript. In the first case, the concurrence of two independent authorities in the reading "good" would need to be explained complexly as some form of common error if Warburton's emendation were to be adopted; whereas in the second case, it would merely be assumed to have been an error in Q_2 which escaped the scribe-annotator's attention and was carelessly passed on to the Folio. If direct connection between Q_2 and the Folio printer's copy could thus be established, the emendation would need to pass far less severe scrutiny for acceptance. A number of other readings in *Hamlet* will be in-

volved in the settlement of this basic question of the transmission of the Folio text, especially when the readings differ in the Folio from those in the Second Quarto. The decision as to the exact nature of the transmission will rest only on a minute bibliographical analysis of the appearance or nonappearance in the Folio print of hundreds of Q_2 minor characteristics of spelling, capitalization and punctuation, as well as the question of the readings or words themselves, as these minor characteristics can be proved to filter through the known habits of the identified Folio compositors or not to appear when they should be expected.

In other periods, the bibliographical study of transmission may weed out errors as in the complex textual history of the Addison and Steele *Spectator* papers in the first three editions in folio, octavo and duodecimo as shown by Donald F. Bond, or in the Shelley *Posthumous Poems* of 1839 edited by Mrs. Shelley and long accepted as authoritative. Subsequent study of the text showed, however, that it incorporated errors from pirated editions of the 1824 first edition overlooked by Mrs. Shelley when she collated her proofs against her manuscripts.

Such study may even serve to establish the final wording of a modern text like that of Sinclair Lewis' *Babbitt* as indicated in its transmission history; it performs the further service of warning critics against any printing of this book after a duplicate set of plates was put into use that restored most of the errors of the first-impression state of the original plates (corrected in these original plates in the second, third and fourth impressions).

BIBLIOGRAPHY.—Bibliographical journals contain a considerable quantity of investigation of the kind treated in this article. The principal journals are *The Library, Studies in Bibliography* and *Papers of the Bibliographical Society of America*. The *Gutenberg Jahrbuch* specializes in bibliographical articles about incunabula. The principal textbooks are Konrad Haebler, *Handbuch der Inkunabelkunde* (1925), trans. by Lucy E. Osborne as *The Study of Incunabula* (1933); Ronald B. McKerrow, *An Introduction to Bibliography for Literary Students* (1927); Fredson Bowers, *Principles of Bibliographical Description* (1949). Because of the rapid rate of bibliographical investigation after World War II, earlier textbooks will need supplementing and updating from research published in bibliographical journals and the monographs issued by bibliographical societies, and such sources as the published Sandars, Lyell and Rosenbach lectures, or the various library journals like the *Harvard Library Bulletin*. Enumerative bibliography is treated in A. Esdaile, *A Student's Manual of Bibliography* (1932); H. B. van Hoesen and F. K. Walter, *Bibliography: Practical, Enumerative, Historical* (1928); Theodore Besterman, *The Beginnings of Systematic Bibliography*, 2nd ed. (1936). (F. T. B.)

BIBRACTE, an ancient Gallic town, the modern Mont Beuvray, 13 mi. W.S.W. of Autun, in the French *département* of Saône-et-Loire. It was the capital of the Aedui in the time of Julius Caesar and the site of his defeat of the Helvetii, the climax of his first campaign in Gaul (58 B.C.). The Helvetii were marching at first northwest along a route leading from the modern Macon to Autun, then bearing farther westward toward Toulon-sur-Arroux. Caesar, who had been pursuing at a deliberate distance of a few miles, was forced from lack of supplies to strike off northward to Bibracte, whereupon the Helvetii, discovering his difficulty, turned and harassed him until he had to give battle at a hill just short of the town. Posting two newly raised legions and the auxiliaries with the baggage on the crest of the hill, he formed the veteran legions in three lines. The Roman javelin throwing was effective in breaking up the assault and enabled the legionaries to press the Helvetii steadily back in the close quarter combat. But as the legions followed up the retirement of the Helvetii, they exposed the rear ranks. A large body of the allied Boii and Tulungi, who had been guarding the wagon park of the Helvetii, seized the opportunity to attack the Romans in the rear while the Helvetii returned to the attack in front; Caesar turned his third line about and after a long struggle repulsed the double attack now launched. The wagon park was eventually captured and a few days later the Helvetii surrendered.

Excavation has revealed remains of rectangular dwelling houses, a temple of Bibractis, and workshops of iron and bronze workers and enamelers. Augustus moved the inhabitants to his new town Augustodunum (Autun) in 12 B.C. to destroy the native traditions.

See T. Rice Holmes, *Caesar's Conquest of Gaul* (1911) and *The Roman Republic and the Founder of the Empire*, vol. ii (1923).

BIBULUS, a cognomen or surname of the Roman gens Calpurnia, of which the following are the best-known members.

MARCUS CALPURNIUS BIBULUS (d. 48 B.C.) was colleague of Julius Caesar (*q.v.*) as aedile in 65, praetor in 62 and consul in 59 B.C. Bibulus voiced the conservative element in the senate that was opposed to Caesar's legislation. During his consulship he was overpowered by physical violence in an attempt to veto Caesar's agrarian proposals in the senate, whereupon he tried to stop them becoming law by announcing that he was looking for omens (an act which, according to the constitution, should have brought all public business to a standstill). Caesar, however, disregarded this, and Bibulus did not emerge from his house for the remaining eight months of his consulship or take any part in public business beyond issuing edicts against Caesar's proceedings.

When Caesar and Pompey quarreled Bibulus supported Pompey and joined in proposing his election as sole consul (52 B.C.). In 51 he went to Syria as proconsul. In 49 Pompey gave him command of his fleet in the Ionian sea, but he proved unsuccessful and died soon afterward.

He married Porcia, daughter of M. Porcius Cato (Uticensis) and later wife of M. Junius Brutus.

LUCIUS CALPURNIUS BIBULUS (d. *c.* 32 B.C.), youngest son of the above, surrendered to Antony soon after the battle of Philippi (42 B.C.) and was by him appointed to the command of his fleet. He died while governor of Syria. L. Bibulus wrote a short memoir of his stepfather Brutus, which was used by Plutarch.

BICAMERAL SYSTEM. The phrase "bicameral system" means a legislature consisting of two houses. Historically, the modern bicameral system dates back to the beginnings of constitutional government in 17th-century England and to the later 18th-century on the continent of Europe. The English parliament became bicameral in recognition of the distinction between the nobility and clergy and the common people. When the British colonies were established in America, the colonial assemblies were likewise bicameral because there were two interests to be represented: the mother country, by the governor in council, and the colonists, by their chosen deputies. After the Declaration of Independence, bicameral systems were established in all the states but Georgia, Pennsylvania and Vermont. In these three states single-chamber legislatures were set up, but these were replaced by bicameral legislatures in 1789, 1790 and 1836, respectively. All the new states subsequently admitted into the Union came in with two-house legislatures. Although the Continental congresses and the congress of the confederation had been unicameral, the federal convention of 1787 decided that the new national legislature should consist of two branches in order to preserve the identity of the separate states, safeguard the influence of the smaller states and protect the interests of property.

With the extension of constitutional government throughout the world, most countries set up bicameral legislatures on the English or U.S. models, with large first chambers chosen by popular vote and smaller second chambers whose members were either elected or appointed and often represented political subdivisions such as the Swiss cantons. The bicameral plan is usually found in federal governments such as Argentina, Australia, Brazil and Canada. Bicameralism was also the prevailing governmental pattern in the cities of the United States during the 19th century.

Theoretically, this dualism is justified as an application of the principle of checks and balances. A bicameral system is desirable, it is argued, to avoid hasty and harsh legislation, limit democracy and secure deliberation. The expanding role of the U.S. senate as critic and overseer of the administration is particularly regarded as vindicating the design of the founding fathers. The senate, said Woodrow Wilson, is "one of the effectual checks, one of the real balances, of our system."

Although bicameralism remained the prevalent practice, the 20th century witnessed a reaction against it both in the United States and elsewhere. Unicameral councils or commissions came to predominate in U.S. cities and were credited with marked improvements in the quality of municipal government. Widespread dissatisfaction with state legislatures led to numerous proposals for a single-chamber system during the second decade of the

century, but the adoption of a unicameral legislature by Nebraska in 1934 marked the only departure from the bicameral system among the U.S. states.

Constitutional trends after World War II, meanwhile, reflected a growing preference for the unicameral system in nonfederal states of the world. Unicameral national legislative bodies were set up in Bulgaria, both Chinas, Czechoslovakia, Denmark, Finland, Greece, Hungary, Israel, New Zealand, Spain, Turkey and several Latin American countries. In England, where the house of lords had been weakened, and in France, where the council of the republic (renamed senate in 1958) was practically impotent, the government operated in effect on the unicameral principle. Genuine coequal bicameralism appears to be incompatible with a cabinet system of government which cannot tolerate deadlocks between its branches.

In the United States both houses of congress had substantially the same representative character after adoption of the 17th amendment in 1913, while the need of a second chamber as a means of curbing democracy and protecting property rights was no longer felt. Thus, the decline of bicameralism was a worldwide phenomenon, but most of the modern constitutional states still retained two chambers. (G. B. Gv.)

BIBLIOGRAPHY.—George B. Galloway, *The Legislative Process in Congress* (1953); Walter H. Mallory (ed.), *Political Handbook of the World* (1958); Harrison Boyd Summers, *Unicameral Legislatures* (1936); Arnold J. Zurcher (ed.), *Constitutions and Constitutional Trends Since World War II* (1951).

BICARBONATE, in chemistry, an acid carbonate, a salt in which one only of the two hydrogen atoms in the molecule of carbonic acid has been replaced by metal. Na_2CO_3 is the formula of normal sodium carbonate, washing soda; $NaHCO_3$ is that of sodium bicarbonate, or baking soda. *See* CARBONATES.

BICEPS, the name given to one of the muscles of the upper arm, from which the latter derives its rounded appearance in front. It has two heads or origins, the shorter attached to the coracoid process of the shoulder blade, the longer to the edge of the glenoid cavity of the shoulder joint. The two heads unite to form a central portion or belly, which ends in a tendon, the distal end of which is inserted on the radius in the forearm. The muscle on contraction has the effect of bending the forearm and assisting in the rotation of the hand. *See* MUSCLE AND MUSCULAR SYSTEM.

BICESTER, an urban district in the Henley parliamentary division of Oxfordshire, Eng., 13 mi. N.N.E. of Oxford by road. Pop. (1961) 5,513. It lies in pastoral country on the northern edge of the open plain of Ot Moor. The name may derive from *beorna* and *ceaster,* meaning "fort of the warriors"; *ceaster* does not mean that the district was the site of a Roman camp.

There are records of the settlement (Berncestre, Burencestre, Bissiter) from the time of Domesday. In 1182 Gilbert Basset founded an Augustinian priory which was the centre of industrial life until its dissolution in 1538. Richard II granted a fair and a Monday market, and in 1440 an additional market was granted, to be held in that part of the town called Bury-End, from this date known as Market-End. In the 16th century the cattle market was especially famous; it is still held on Mondays. The church of St. Edburg contains examples of Norman and each succeeding style, and the vicarage dates from the 13th century. There are scanty remains of the Augustinian priory.

Bicester never possessed any manufactures of importance, though a large army ordnance depot nearby has brought many employees into the area. It has considerable agricultural trade and is famous as a hunting centre, the hunt now known as the Bicester and Warden Hill hunt becoming well known in the 1780s. The urban district was extended in 1932.

BICHAT, MARIE FRANÇOIS XAVIER (1771–1802), French anatomist and physiologist whose systematic study of human tissues helped found the science of histology, was born at Thoirette (Jura) on Nov. 14, 1771, the son of a physician. He studied anatomy and surgery under M. A. Petit (1766–1811), chief surgeon to the Hôtel Dieu at Lyons. The revolutionary disturbances drove him to Paris in 1793. He there became a pupil and then assistant of P. J. Desault, who died in 1795.

He completed the fourth volume of Desault's *Journal de Chirurgie,* to which he added a biographical memoir of its author. He then wrote the *Oeuvres chirurgicales de Desault, ou tableau de sa doctrine, et de sa pratique dans le traitement des maladies externes* (1798–99), in which, although he professes only to set forth the ideas of another, he develops them with the clearness of one who is a master of the subject.

In 1797 he began a course of anatomical demonstrations, and then began to lecture on operative surgery and physiology. His *Anatomie générale* (1801) contains the fruits of his most profound and original researches. His *Anatomie descriptive* (1801–03), in which the organs were arranged according to his peculiar classification of their functions, was completed by his pupils, M. F. R. Buisson (1776–1805) and P. J. Roux (1780–1854).

Before Bichat had attained the age of 28 he was appointed physician to the Hôtel Dieu, a situation that opened an immense field to his ardent spirit of inquiry. He engaged in a series of examinations with a view to ascertaining the changes induced in the various organs by disease. A fall from a staircase at the Hôtel Dieu resulted in a fever, and he died on July 22, 1802.

See ANATOMY, MICROSCOPIC: *The Rise of Histology.*

BICKERDYKE, MARY ANN (1817–1901), variously called "Mother Bickerdyke," "General Bickerdyke" and "the General in Calico," was the organizer and chief of nursing, hospital and welfare services for the western armies under the command of Gen. U. S. Grant during the American Civil War. Born Mary Ann Ball on July 19, 1817, in Knox county, Ohio, she attended Oberlin college and later studied nursing. Before the Civil War, Mrs. Bickerdyke, a widow and the mother of several children, set herself up as a "botanic physician" in Galesburg, Ill. Early in the war she attracted Grant's attention with her vigorous attack on filth, malnutrition and disease at the Cairo (Ill.) military installations, and he thereafter supported her work with military authority. She followed Grant's army down the Mississippi, setting up rear-area hospitals as they were needed.

Mrs. Bickerdyke later served with Gen. W. T. Sherman's 15th army and made extensive and careful preparations for Sherman's march through Georgia to the sea. There was no dropping off of tired or ill men during that campaign. Provisions were made for frequent medical examinations and for transporting men who were unable to walk. Under Mrs. Bickerdyke's supervision, about 300 field hospitals were built, staffed and equipped with the help of U.S. sanitary commission agents.

After the war, at the age of 50, she became a pension attorney for veterans, and also organized a veterans' homestead plan. Mrs. Bickerdyke died in Bunker Hill, Kan., on Nov. 8, 1901.

See Florence S. Kellogg, *Mother Bickerdyke* (1907); Marjorie Barstow Greenbie, *Lincoln's Daughters of Mercy* (1944).

BICKERSTAFFE, ISAAC (*c.* 1735–*c.* 1812), British playwright whose farces and comic operas were popular in the late 18th century, was born in Ireland *c.* 1735. There is no apparent connection between his name and the pseudonym earlier adopted by Swift and also used by Addison and Steele for the *Tatler.* The real Isaac Bickerstaffe is said to have been a page to the lord lieutenant and to have become an officer in the royal marines. His first theatrical success, *Love in a Village* (1762), was followed by many others, including *The Maid of the Mill* (based on Richardson's *Pamela*), *The Padlock* and *The Hypocrite.* A frank plagiarist, he depended for his success on his lively lyrics and his sparkling dialogue.

Bickerstaffe's future appeared bright when in 1772 he was forced into exile by allegations of sodomy, then a capital offense. He lived in great poverty for many years, probably in France. The exact date and place of his death are unknown.

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BICKERSTETH, EDWARD (1786–1850), English clergyman, a leader of the evangelical party in the Church of England, was born on March 19, 1786, at Kirkby Lonsdale and ordained in 1815. Prolific as author and preacher, he worked for the Church

(LEFT) MUSÉE DE CHALON-SUR-SAONE; (CENTRE AND RIGHT) BRITISH CROWN COPYRIGHT, SCIENCE MUSEUM, LONDON

FIG. 1.—(LEFT) NIEPCE'S CÉLÉRIPÈDE, 1816; (CENTRE) MACMILLAN'S HOBBYHORSE, ABOUT 1839; (RIGHT) MICHAUX'S VÉLOCIPÈDE, 1865

Missionary society as secretary from 1816 to 1830, compiled a popular hymnbook, *Christian Psalmody* (1833), and vigorously attacked the Oxford movement and the Roman Catholic Church. He was rector of Watton, Hertfordshire, from 1830 until his death there on Feb. 28, 1850. His son, EDWARD HENRY BICKERSTETH (1825–1906), bishop of Exeter (1885–1900), was famous as a hymn writer.

See T. R. Birks, *Memoir of Edward Bickersteth* (1851).

(G. F. A. B.)

BICYCLE, a light, two-wheeled steerable vehicle propelled by human power. The wheels are mounted in line in a steel frame and the front wheel is held in rotatable forks. The rider, sitting on a flexible saddle and steering by handle bars attached to the forks, turns a driving sprocket attached to two cranks which he rotates with his feet. Power is transmitted from this sprocket to a second sprocket on the rear wheel by means of an endless chain running over both sprockets.

Bicycles are the most numerous class of vehicle on the roads of England, France, Germany, the Netherlands, Italy, Belgium and Denmark, and they are widely used in North America and elsewhere. The bicycle is easily mastered and can be ridden with little effort at 10–12 m.p.h. by any normal person. Being easy to house and carry, inexpensive to purchase and maintain, and simple in construction, it is a valuable instrument of self-transport, and provides pleasant recreation and exercise even while being used for purposes of utility. Cycle touring is most widely practised in England, but has a large and increasing number of followers in Germany, France and other European countries. Bicycles are also widely used for racing in France, Germany, Belgium and to a lesser extent in England and the United States (*see* CYCLING).

Experiments in adding engines to bicycles to render them independent of human propulsive power began in the 1880s. For a discussion of these powered devices, *see* MOTORCYCLE.

Early Types.—The first ridable bicycle was made by Kirkpatrick Macmillan of Dumfriesshire, Scot., in 1839, but many less efficient and similar inventions had preceded his work. Early devices lacked any form of steering and had to be propelled by pushing the feet against the ground. Machines of this type appear on bas-reliefs in Babylon and Egypt and on frescoes in Pompeii. Another picture of an early bicycle in a stained glass window, dated 1580, in the parish church at Stoke Poges, Buckinghamshire, depicts a cherub astride such a crude machine. A *célérifère* of this type, demonstrated by the comte de Sivrac in 1791, consisted of a wooden bar connecting two wheels, on which the rider sat. A velocipede built by M. Blanchard and M. Masurier in 1779 was described in the *Journal de Paris*.

In 1816 J. N. Niepce of Paris and in 1817 Karl von Drais de Sauerbrun produced steerable devices; Niepce's machine was called a *céléripède*, and Drais' device a *laufmaschine*. The enterprising Drais' machine became popular under the name of draisine and within a year or two Dennis Johnson of London was manufacturing it for the regency dandies—including the prince regent—under the name of dandy horse or hobbyhorse. Several varieties of these machines were made in the United States but the vogue did not last long. After five years of experimenting, Macmillan produced a hobbyhorse which could be propelled without the rider's feet touching the ground. He had added reciprocating cranks at the front, which were connected by rods to the rear wheels. The machine had wooden wheels with iron tires, the leading wheel being about 30 in. in diameter and the driving wheel about 40 in. in diameter. It was copied in the 1840s by Gavin Dalzell of Lesmahagow, Lanarkshire, who later made several of these bicycles.

Bicycle design was retrogressive during the next two decades, because the next type to be introduced employed rotating cranks integral with the front hub. This type of machine was built by Pierre and Ernest Michaux of Paris following an experiment with a hobbyhorse in 1861. They adapted the idea from the crank handle of a grindstone, according to the account written by Henry Michaux in 1893. In 1862 Karl Kech of Munich built such a machine (it is preserved in the Deutsches museum, Munich). In 1861 the Michaux family produced two *vélocipèdes*, in 1862, 142, and by 1865 they were making 400 bicycles a year. In 1866 one of their mechanics, Pierre Lallement, became disgruntled by their treatment of him and emigrated to the United States, where, with James Carrol of Ansonia, Conn., he took out the first bicycle patent in the United States.

The Michaux concern had placed France in the forefront of bicycle development, and new companies for their manufacture sprang up rapidly. One of these, Tribout and Meyer, is said to have produced a chain-driven bicycle as early as 1869. In this year the first cycle show (in Paris) and the first cycle road race (from Paris to Rouen) took place. The 83-mi. road race was won by an Englishman, James Moore. At the show, primitive forms of freewheel and speed-change mechanisms were also displayed. Meanwhile Rowley Turner, the Paris agent of the Coventry Sewing Machine Co., persuaded the company to begin making the *vélocipèdes* in Paris, and in 1868 he rode one from Coventry station to the factory, as a demonstration. An order for 400 bicycles was obtained from France and work was started under a new name, the Coventry Machinists' Co. Ltd. However, when only a few "bone shakers" (as they came to be called) had been delivered, the Franco-German War began and the firm was obliged to find a market for the bicycles in England, where the new machines were accepted and races began.

The "Ordinary" Bicycle.—Many men, such as Thomas Humber, Henry Sturmey and Dan Rudge, began to make bicycles at this time, but the man who is known as the "father of the cycle industry," James Starley, became associated with cycling indirectly, as a 67-year-old foreman at the Coventry Sewing Machine Co. His inventive brain soon thought of improvements which were incorporated in the bicycle. In 1870 Starley patented a tension-spoked wheel in which the rim and the hub were connected by looped wire spokes. By rotating the hub in relation to the rim, equal tension could be obtained over the whole wheel. That same year he designed a light bicycle with a large driving wheel and a smaller trailing wheel, which established the shape of the bicycle for the next ten years. Introduced in 1871, his Ariel bicycle could be equipped with a gear which allowed the wheel to revolve at twice the speed of the cranks. This was the "ordinary" bicycle, known colloquially as the "penny-farthing." The ordinary bicycle gained ground even more rapidly than its predecessors because of its simplicity and because, as improvements such as tubing were incorporated, it became lighter in weight.

The next great improvement was the patent by W. J. Grout of London for spokes which were threaded into eyed nipples, followed in 1874 by his patent for threaded nipples, as on the modern bi-

cycle, and Starley's patent for the tangential spoked wheel. These inventions greatly improved the performance of the ordinaries because their immense driving wheels were so hard to turn at first. In 1873 four riders traveled from London to John o'Groats, about 690 mi., in 15 days, demonstrating the reliability of the ordinary.

An average ordinary weighed slightly less than 50 lb., but some were made which weighed only 21 lb. Front wheels varied between 40 and 60 in. in diameter according to the leg length of the rider. The machines were unstable and falls were frequent. Because of the peculiar skill needed and because of the smooth "ride" of the huge front wheel, however, ordinaries endeared themselves to riders and were widely used for some years after the introduction of the safety bicycle. But the fact that only long-legged men could attain any real speed meant that cyclists of average build turned to other forms, such as the tricycle.

The Safety Bicycle.—This was the name given to the first chain-driven bicycle, which was designed by H. J. Lawson in 1874. It had two medium-sized wheels of equal diameter, the rear wheel being driven by a chain running on two sprockets. Further experiments followed in England and France and it was about this time that the cycle industry was established in the United States; in 1877 Col. Albert A. Pope of Boston, Mass., organized the Pope Manufacturing company to produce ordinary and, later, safety bicycles, and it was with this company that the pioneer Lallement ended his working career.

The safety did not become fully established until the advent of the Rover safety in 1885. This, the first practical production machine, was manufactured by John K. Starley, a nephew of the original Starley. After its successful introduction, the days of the ordinary were numbered. In four years the safety dominated the market and within another few years no more ordinaries were being made.

An invention which made the bicycle a more comfortable means of transport was that of the pneumatic tire by John Boyd Dunlop, a Belfast veterinary surgeon, in 1888. Although a patent specification had been filed in 1845 by R. W. Thomson, Dunlop's was the first application of the idea. He met with opposition, but racing proved the worth of the new tires and, as the methods of attaching tires to the rims improved, the pneumatic tire became established until, within five years, solid tires and the semihollow cushion tires had been virtually eliminated.

The combination of the pneumatic tire and the stable safety bicycle gave the industry an immense impetus. During the 1890s the young cycle industries of Europe and the United States boomed; then came a slump and the industry was reorganized to build inexpensive, practical machines. By 1893 the design of the bicycle had been stabilized into the modern diamond frame with roller-chain drive and pneumatic-tired wheels. Thereafter, only accessory changes were made.

The Modern Bicycle.—A contemporary bicycle can be expected to carry up to ten times its own weight and can be bought equipped with four gear ratios, constant-voltage lighting, internal expanding or caliper brakes (see *Brakes*, below), a completely protected transmission, and full weather and touring equipment. It will run with a minimum of attention for many years. Bicycles vary from about 15 lb. to nearly 40 lb. depending on the needs of the rider; the lightest are only suitable for special tracks.

Frames.—There are three types of bicycle frame. The commonest is the diamond pattern, formed by three triangles of steel tubing. One triangle is formed by a horizontal (top) tube joined to a nearby vertical (seat) tube, the two ends being linked by the tube which forms the third side. The seat tube is also the base for the other two triangles, which project rearward from it in a narrow V. They are formed by the seat stays, which project downward from the top of the seat tube, and the chain stays, which are nearly horizontal and which project from the base of the seat tube. At the top and bottom of the seat tube are the saddle and the driving sprocket. The apex of the forward triangle holds the steering forks and that of the rear triangles holds the rear wheel. Each tube is subjected only to compressive stresses along its length, with the exception of the steering forks, which are deliberately arranged so as to afford a measure of springing.

The second type of frame is the cross, a single main member, usually made of pressed steel, to which are attached the steering forks and the seat tube. This type of frame is frequently used for motor-assisted bicycles, popular on the continent of Europe.

The third frame is the loop type, in which the top tube and down tube of the diamond frame are curved in parallel to give clearance for women's skirts. It is commonly found in the United States in a compact form.

Frames are built either by brazing or by welding, the latter being cheaper and stronger. The Dayton Cycle Co. developed a system of electrically fused joints, employing the resistance created at the junction of two tubes and using no solder. In brazing, the tubes are fitted into lugs or sockets which can be obtained in a variety of angles, generally about 70°, which is upright enough for the bicycle to be light and easy to steer while still sloped enough for the forks to be self-centring. The tubes are first cut to the correct shape so that there is a mitred joint between upright and horizontal tubes. Then the tubes are fitted into the shaped lugs—usually made of pressed or cast steel—and heated, and the slight space between the lug and the tube is filled with a molten brass alloy. In welding the same preparatory steps are followed, but no lugs are used; the tubes are directly joined with molten steel rod instead of brass. Welding gives a joint which is actually stronger than the tubes it joins, but it is not often found on mass-produced frames in Britain, although it is common elsewhere in Europe and in the United States. Some frames are assembled partially by using bolted seat stays made from D-shaped seamed tubing, but this method is used only for cheap frames.

Bicycle tubing is seamless and frequently butted at each end to a heavier gauge to provide extra strength at the joints. Mild steel was originally used but this has largely been replaced by special alloy steels; as a result, most contemporary bicycles are lighter and more responsive than their pre-World War II counterparts.

Accessories.—Bicycle accessories are usually made so that they may be clipped or bolted onto the frame, but in continental Europe small lugs are frequently brazed onto the frame to form permanent brackets for extra fittings. In this way a clean outline is preserved and the fittings cannot shake loose. Typical items which may be attached to brazed lugs are pannier (basket) carriers, mudguards and chain guard, lamps, gear cables and brake cables, a *dérailleur*

(LEFT AND CENTRE) BRITISH CROWN COPYRIGHT, SCIENCE MUSEUM, LONDON; (RIGHT) RALEIGH INDUSTRIES LIMITED

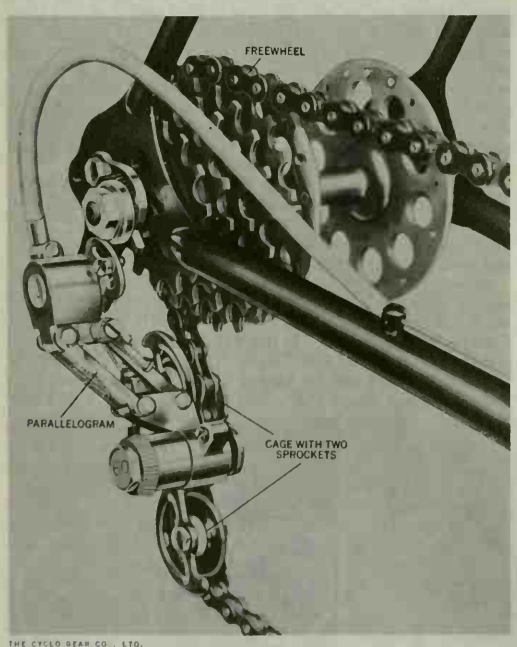
FIG. 2.—(LEFT) ORDINARY BICYCLE, 1883; (CENTRE) ROVER SAFETY BICYCLE, ABOUT 1885; (RIGHT) MODERN TOURING BICYCLE

gear and even brake levers. In Britain, items like this are fitted with small spring or bolted clips, which reduces the cost of frame building while making the range of attached accessories more flexible.

Wheels.—Wheels consist of rims attached to central hubs by tensioned wire spokes; the spokes are threaded at one end and screwed into nipples in the rim so that tension may be maintained. Any combination of spokes—in multiples of four—may be used; in England 32 are put in a front wheel and 40 in the rear, though elsewhere 36 are used in both wheels. Other combinations are used for some racing machines. Spokes are usually made from 15-gauge wire, but on many bicycles rustless spokes are used which have only the ends made of 15-gauge, the centres being thinner. Extra-heavy machines use heavier-gauge spokes.

Rims are made from steel or aluminum alloy and are frequently hollow. There are three patterns. The largest is the Westwood, which is so shaped that the stress from the brake shoes is in the same direction as the stress imposed on the spokes by the nipples. It is made from steel strip rolled over at the edges to provide two shoulders to contain the wired edges of a tire. The Endrick pattern, square in cross section with the brake shoes pressing against the vertical sides, is often similarly rolled, but may be of extruded aluminum alloy. The third shape of rim is formed from an extruded tube with a shallow depression worked into its periphery to hold a one-piece tire. The tube is frequently reinforced by the insertion of specially shaped washers or a wooden strip. Light alloy and stainless steels are easily kept clean, and plain steel rims are usually chromium plated. Westwood rims are more common when "balloon" section tires are used or when internal expanding brakes are fitted, as in the United States. Rims are made in 26- and 27-in. sizes, the size being the total diameter of the wheel when the tire is inflated.

The hub consists of a steel or light alloy, barrel flanged and drilled at each end to accommodate the spoke heads. Through the barrel passes a hardened steel spindle equipped with two cones which bear on balls running in cups pressed into the barrels. Adjustment is effected by screwing the cones on the spindle.



THE CYCLO GEAR CO., LTD.

FIG. 3.—DÉRAILLEUR VARIABLE TRANSMISSION. WHEN THE PARALLELOGRAM IS STRAIGHTENED BY PULLING THE CABLE, THE TWO SPROCKETS MOVE SIDEWAYS, ALLOWING THE CHAIN TO BE DERAILED FROM ONE TO ANOTHER OF THE FIVE SPROCKETS ON THE FREEWHEEL

The rear hub is threaded to hold the driving sprocket or freewheel. Where the sprocket is fixed, two threads, right- and left-hand, are used to provide for a locking ring to secure the sprocket. Most hubs are threaded only on the right-hand side, but some have both types of thread, or twin threads of the same type. Almost universal acceptance of variable gears has led to the disappearance of the single-fixed-sprocket hub, except in highly specialized bicycles.

There are three specialized hubs; one contains an epicyclic variable gear, one has the freewheel mechanism built in and the third is the coaster or back-pedaling brake employing a phosphor-bronze expandable ring actuated by a tapered member sliding on a quick thread. The cyclist may freewheel, but if the sprocket is moved backward relative to the frame, to which the other side of the hub is bolted, then the taper slides across to force the ring against the hub shell and stop the wheel.

Variable Transmission.—Devices to improve the speed of the machine for a given pedaling rate are of two types: the *dérailleur*, which requires movement of the chain from sprocket to sprocket, and the epicyclic, which alters the speed of the driving sprocket relative to the rim.

A *dérailleur* is simple, strong and easily varied in range for different types of terrain. It consists of a mechanism which can move ("derail") the chain from one sprocket wheel to another of different size. By varying the relative size of the driving sprockets, the rear wheel can be made to pass through more or fewer revolutions for each turn of the crank. Cyclists can use up to six sprocket wheels on the rear freewheel and three on the cranks, providing up to 18 different ratios. For the tourist, who may encounter long, steep climbs and long descents, this type of gear can be invaluable. Save for one or two special types of race—as on a track—racing cyclists invariably employ five or ten gears by use of a *dérailleur*. The mechanism is spring loaded to absorb the chain slack and is controlled by cable from the frame or handle bars. Gears may be fitted to the chain stays or screwed into a lug integral with the fork end.

An epicyclic gear is more complex and fragile, but since it is totally enclosed it is less susceptible to accidental damage. It employs constant-mesh epicyclic gear trains working on this principle: The driving sprocket is connected to a central "sun" wheel in the hub. The hub barrel has cogs in the form of an annulus ring on its inner surface. Between the sun wheel and the annulus are "planet" wheels. As the driving sprocket is turned, the annulus ring (*i.e.*, the hub) revolves in the same direction. If the planet wheels are allowed to revolve round the sun, the hub revolves more slowly than the driving sprocket. If the planet wheels are fixed, it revolves more quickly. If the whole mechanism is locked with a dog clutch, the hub revolves at exactly the same speed as the driving sprocket. Thus three speeds are obtained with a single hub. The use of a second epicyclic train provides four speeds, an extra-low gear being available. This principle has been used in many types of gear, both in the rear hub and in the crank axle. It has proved to be the most popular and was patented by J. J. H. Sturmey and J. Archer under a variety of headings between 1901 and 1906. It weighs, in hub form, about 2 lb. and can be obtained in three- or four-speed form with the gear ratios widely, moderately or narrowly spaced to suit the rider's preference. The four-speed form uses two epicyclic trains linked and was developed in the late 1930s. These hubs are made in combinations—gear and dynamo, gear and internal expanding cable-operated brake, and gear and coaster brake. The epicyclic gear can also be combined with a *dérailleur* gear to give a selection of eight gear ratios. (*See* GEARS.)

Tires.—Pneumatic tires made under the patent of J. B. Dunlop are invariably fitted to modern bicycles. They are in two sections, the inner tube and the outer cover. Inner tubes were for years made from pure rubber, but research initiated during the rubber shortages of World War II led to the development of butyl, a synthetic rubber which has about one-tenth the porosity of natural rubber and does not deteriorate with age. The outer cover is

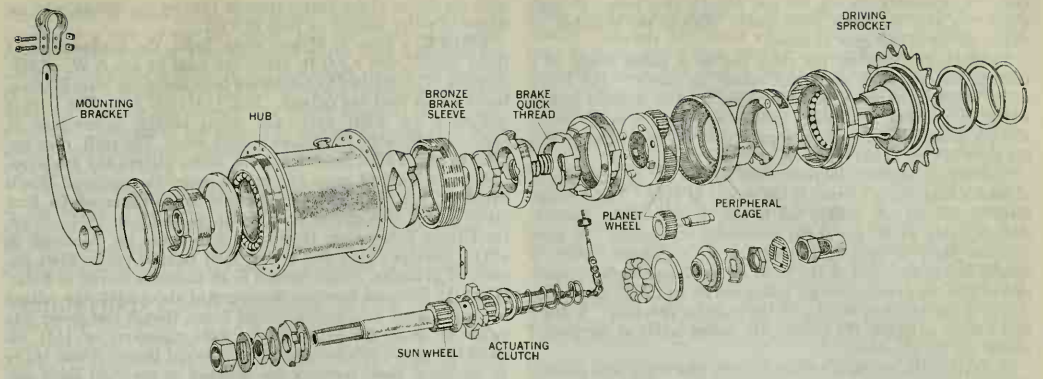


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FIG. 4.—EXPLODED VIEW OF A STURMEY-ARCHER EPICYCLIC GEAR COMBINED WITH AN INTERNAL EXPANDING BRAKE. THE SLEEVE EXPANDS AS IT IS FORCED ONTO A TAPER BY THE QUICK-THREAD CAM WHEN THE DRIVING SPROCKET IS REVERSED. THE GEAR IS OPERATED BY A CABLE WHICH MOVES THE ACTUATING CLUTCH

made from cotton, nylon, silk or similar tough fabric on which is molded a tread of butyl or of rubber having a high carbon content. Outer covers have stiff wire rings molded into the inner perimeters. These rings are the same size as the rim and are forced against the shoulders of the rim by the pressure of the air. The rim includes a well which enables the tire to be moved eccentrically during fitting.

Some tires, made for racing bicycles, are fitted with outer covers that do not have wired edges. These tubular tires have sewn or glued edges, so that the complete tire presents the appearance of being in one piece. They are attached to the shallow tubular racing rim with adhesive and, since they constrict on inflation, so long as they are correctly applied and inflated there is no danger of them coming off. They are built with narrow treads and usually have sides of waterproof fabric instead of being all rubber. Light fabrics are used, such as sea-island cotton or silk, and the tires can weigh as little as $3\frac{1}{2}$ oz. each. (*See* TIRE.)

Brakes.—Brakes function in two ways: either externally, by the contraction of calipers containing brake shoes against the rim of the wheel, or internally, by the expansion of similar shoes against a drum mounted on the hub or in the hub itself.

The simplest of the internal brakes is the coaster hub, which needs no maintenance and has no part which could be damaged in a minor accident. With little adjustment such a brake will last the probable lifetime of a bicycle. For this reason, and for the fact that it is probably the most powerful brake, it is popular for utility use in the United States and in Europe. Other internal brakes with special drums are used in the manufacture of small powered bicycles and in some touring machines, where their advantage of being unaffected by water makes them particularly useful for faster traveling, or on heavily loaded machines.

External brakes are operated either by stirrups or calipers. Stirrup brakes are applied by rods on Westwood rims and are positive in action, but impede the rider when he has to remove a wheel. Caliper brakes are applied by cable and press brake shoes against the flat sides of Endrick or tubular rims. Another cable-operated brake, patented in 1929, is the cantilever, which employs twin bell crank levers and a duplex cable. The brake shoes on this type of brake are extremely long and it is the most efficient of the external brakes.

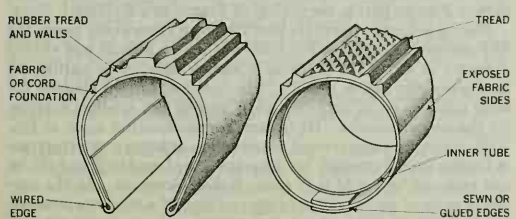

FIG. 5.—PNEUMATIC TIRES: (LEFT) WIRED-ON TIRE COVER FOR ROAD USE; (RIGHT) TUBULAR TIRE WITH INNER TUBE FOR RACING

Transmission.—Though shaft-driven bicycles have been made, transmission normally consists of a chain and two sprockets. The chain is made of steel plates $\frac{1}{2}$-in. long linked by rivets of hard steel; the rivets are bushed on rollers which turn freely when pressure is applied. The width of the driving surface is normally $\frac{1}{8}$ in.; however, heavy bicycles, such as mopeds (motor bicycles) and commercial carrier machines, employ $\frac{3}{16}$-in. chain, and racing bicycles with a *dérailleur* gear employ a specially made flexible chain with driving plates $\frac{3}{32}$ in. apart.

The chain runs over a front driving sprocket attached to the cranks. The cranks are on a hardened steel axle mounted on ball bearings running in cups which screw into a cylindrical barrel at the junction of the down and seat tubes and the chain stays. In the United States the two cranks and the axle are in one piece, and this method is favoured in Europe on utility bicycles. The cranks are usually forged, and the front sprocket or chain wheel screws onto a thread on the cranks.

In England and on touring or racing machines in Europe the cranks are separate from the axle and the chain wheels bolt onto arm extensions of the crank. More and more commonly cranks are made from heat-treated aluminum alloy forgings which fit on square tapers on the axle, forming a light, firm and rigid driving unit which is easily removed in the case of racing machines. When the cranks are made of steel, they are fitted with a cotter pin, which is a bolt having a wedge action against a flat area on the axle. Such cranks are invariably chromium plated. Cranks are 6–7 in. long to suit the rider.

The rear sprocket may be in the form of a freewheel of two concentric members, one carrying the thread and the other the cogs. The outer member runs on ball bearings and incorporates a ratchet against which spring-loaded cams play so that drive can only be in one direction. Freewheels are made in combinations up to six sprockets having from 13 to 28 cogs each.

Projecting from the extremities of the cranks at right angles (*i.e.*, parallel with the hubs and the axle) are the pedals, consisting of footrests mounted on hardened axles with ball bearings. The axles screw into the cranks with right- and left-hand threads so that the pedaling action is self-tightening.

Thus, to drive the bicycle, the rider places his feet on the pedals and rotates the cranks. This turns the driving sprocket, which usually has about 48 cogs. The chain runs over this and the rear sprocket, which usually has about 18 cogs. For each revolution of the cranks, therefore, the chain is pulled forward 48 links. Since

each link represents one cog, the rear wheel is thus turned through about two and two-thirds revolutions. This is the principle on which the *dérailleur* gear is based.

Saddles.—For comfort the rider sits on a saddle made of a resilient material such as leather, rubber or plastic. The frame of the saddle is either made from spring steel or it holds springs which act as shock absorbers. Saddles are made in many shapes and are probably the most important part of the machine from the point of view of the rider.

Lighting.—Originally bicycles were lighted by an oil lamp or at least a lamp using a flame as the source of light. The development of the dry-cell battery led to simple, lightweight, battery-electric lights which are cheap and easily replaceable. A more common form of lighting is provided by a dynamo, which is usually bolted onto one of the forks with a spring-loaded connection so that the dynamo driving pulley can be set to rub against the side of a tire and thus revolve as the machine proceeds. A single lead suffices to supply the current, the frame acting as the ground return for the electricity.

In England the Sturmey Archer concern, which had been producing light, compact dynamo equipment, introduced in 1937 a hub which incorporated a dynamo. This combination, though turning relatively slowly and producing only 25-cycle alternating current, was virtually frictionless and waterproof. The dynamo is also produced in combination with an epicyclic gear. After World War II the manufacturer removed the obstacle of 25-cycle "flutter" by fitting a voltage regulator connected to a dry-cell battery so that the lighting is constant instead of fluctuating with the speed of the bicycle.

Luggage Accommodation.—Luggage is carried in containers, usually leather or canvas bags slung on the bicycle. The most common mounting is that of a bag slung from two loops in the rear of the saddle frame. Baskets are frequently slung from the handle bars. Touring bicycles have additional accommodation in the form of a steel- or light-alloy frame mounted over the rear wheel which enables two bags to be slung vertically, one on each side of the rear wheel. This has the advantage of lowering the centre of gravity when loads are heavy.

Multiple Bicycles.—Though at one time these were common, the only type left is the tandem, on which two riders sit one behind the other, the front one steering. Most parts are duplicated on the machines, even to the extent of a separate hub brake operated by the foot of the rear rider. Tricycles and even tandem tricycles are found, mainly in Great Britain. The development of the tricycle contributed materially to automobile design through the invention of the hub brake and the differential.

See C. F. Caunter, *The History and Development of Cycles: As Illustrated by the Collection of Cycles in the Science Museum London* (1955–). (AL. H. G.)

BICYCLE RACING: *see* CYCLING.

BIDA, a town in the Niger province of the Northern Region, Nigeria, Africa, and a former Fulani emirate capital, lies at 400 ft. above sea level in the broad valley of the Niger in wooded savanna country. Pop. (1960 est.) 22,222. The town, which is well shaded by trees, is divided roughly into four by two main streets, and the mud houses are grouped into customary family compounds. The town wall encloses about 5 sq.mi. The emir's palace, outside the west gate, is in traditional northern architectural style, and the few modern buildings include a hospital and a secondary school. Bida is 10 mi. W. of the Baro-Minna branch of the Lagos-Kano railway and on the main road from Jebba to Jos and the east. There is a landing strip for light aircraft north of the town.

Bida is famous for its native crafts: brass, copper and white metal work (notably the Bida goblets), glass beads and bangles, straw hat and mat weaving and cloth dyeing. The craftsmen work by hand on their own premises and are organized into close-knit guilds which originated in the military requirements of the emir.

Bida was founded by the Nupe in the 15th century and conquered by the Fulani in the 19th century. Under the Fulani emirs, the Nupe people continued to dominate this stretch of the Niger until the defeat of the Fulani army in 1897 by the British, who assumed effective control of Bida in 1901.

BIDAR, a town in Mysore state, India, the headquarters of Bidar district, lies 2,300 ft. above sea level 68 mi. N.W. of Hyderabad. It is reached by northward branches of the main Hyderabad-Bombay road and railway. Pop. (1951) 31,341. The town is celebrated for Bidri ware—gun metal articles damascened in floral and geometric designs with silver wire. The craft, once applied to sword hilts, produces bowls, flasks, salvers and ash trays.

Bidar, a place of some importance under the medieval Hindu dynasties, was captured by the Muslim prince Fakhr-ud-din Juna (later Sultan Mohammed ibn Tughlak of Delhi) in 1324. When the Deccan broke away from the sultan under the Bahmanis in 1347, Gulbarga (*q.v.*) was at first their capital; but in 1430, because of ill-health, Sultan Ahmad Shah Bahmani moved to Bidar. When the Bahmani kingdom disintegrated about 1492, the sultans retained a small principality around Bidar, though real power was in the hands of the Barid family, their ministers; by 1531 Ali Barid had openly proclaimed himself sultan of Bidar. About 1619–20 the Barid Shahi territory was annexed by the 'Adil Shahi sultanate of Bijapur. Bijapur held Bidar, with one interruption (1624) when it was pillaged by troops from Ahmednagar, until its capture by the Mogul viceroy Aurangzeb in 1657. In 1686 it was formally annexed to the Mogul empire. On the breakup of that empire about 1724 Bidar fell to the nizam of Hyderabad. When Hyderabad was partitioned under the 1956 linguistic reorganization of states, Bidar town and district were transferred to Kannada-speaking Mysore.

Ahmad Shah Bahmani's fortress at Bidar has a triple moat, strong laterite walls and a ditch. Within are the remains of the Rangin Mahal or "painted palace," so called from its decoration with coloured Persian tiles; the Takht Mahal or throne room; and other palaces. There are also the Jami Masjid or great mosque and the Sola Khumba or "Sixteen-pillar" mosque, typical Bahmani buildings without minarets or prominent domes. Another notable Bahmani monument is the great *madrasa* or college built in 1472–81 and now a massive ruin. Northwest of the town are the splendid domed tombs of 12 Bahmani kings, and to the west the royal necropolis of the Barid Shahi sultans.

BIDAR DISTRICT, the northernmost of Mysore, has an area of 2,072 sq.mi. Pop. (1961) 656,590. The main crops are *jawar* (millet), wheat, oilseeds and pulses. Soapstone, red ochre, red and yellow laterite and black basalt building stone are extracted, also a gypsumlike mineral used for waterproofing flat roofs. Kalyani, 42 mi. W. of Bidar town, was the capital of the second Chalukya dynasty (*q.v.*) in the 10th–12th centuries A.D.

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BIDAULT, GEORGES (1899–), French statesman distinguished as a foreign minister in the fourth republic, was born at Moulins (Allier) on Oct. 5, 1899, and educated at the Jesuit college in Turin, Italy, and at the faculty of letters in the University of Paris. A history teacher, he entered politics as a writer for the Christian Democratic paper *L'Aube*. Active in the resistance to the Germans during World War II, he became president of the national council of the Résistance in 1943. In Sept. 1944, when Gen. Charles de Gaulle appointed him foreign minister, he started to play a major part in the revival of France as a diplomatic force.

Having helped to found the new Christian Democratic party, the Mouvement Républicain Populaire (M.R.P.), Bidault was elected a deputy in Oct. 1945 and was a leading member of parliament throughout the fourth republic. He remained foreign minister for more than two years, until Dec. 1946, serving also as prime minister for the last six months. He became foreign minister again in Jan. 1947, but as the supporters of conservatism at home and integration in Europe gained strength his influence waned, and in July 1948 he was replaced by his M.R.P. rival, Robert Schuman. In the economic crisis of autumn 1949 he proved himself a mediator between the Socialists and the other centre parties and was prime minister again for seven months. After his defeat in June 1950 he was a

vice-premier in three of the subsequent cabinets. He was still considered a man of the left-centre, but after returning to the foreign ministry in Jan. 1953 he moved to the right, accepting the settlers' *coup d'état* in Morocco and vigorously supporting the war in Indochina. In June 1954 the fall of Joseph Laniel's government ended his career as a minister of the fourth republic. He became a vigorous advocate of the settlers in Algeria and was associated with the movements that caused the collapse of the fourth republic. (*See* FRANCE: *History.*)

In the fifth republic Bidault, now out of sympathy with many in the M.R.P., created a new Christian Democratic movement, supported by former Vichyites holding views on Algeria similar to his own. Re-elected a deputy in Nov. 1958, he vehemently opposed General de Gaulle's Algerian policy because of its liberalism.
(P. W. C.)

BIDDEFORD, a city of York county, Me., U.S., on the west bank of the Saco river, 15 mi. S.W. of Portland.

In 1630 Capt. Richard Vines led the first settlers to the site. After 1718 the town was called Biddeford for the home of early settlers who came from Bideford, England. In 1762 the communities on the two sides of the river separated, that on the east bank becoming Saco. Biddeford received its city charter in 1855.

The abrupt drop of the Saco river furnished power for Biddeford's economic development. The milling of lumber and, after mid-19th century, the manufacture of cotton textiles have been important industries.

For comparative population figures *see* table in MAINE: *Population.*
(WM. B. W.)

BIDDING PRAYER, the name applied to various sets of prayers in Anglican and Lutheran usage, in which the minister tells the people what to pray for. Such formulas of exhortation are of great antiquity in both eastern and western churches. One of the oldest surviving forms is that traditionally appointed for Good Friday. Bidding prayers include intercessions for the church, the state, the Jews and the ministry of the church. Originally "bid" meant "to pray," but this has become obsolete and the "bidding" has come to mean the exhortation itself. (J. J. PN.)

BIDDLE, JAMES (1783–1848), United States naval officer, and nephew of Capt. Nicholas Biddle of the Continental navy, was born in Philadelphia, Pa., on Feb. 18, 1783, and in 1800 was appointed a midshipman in the navy. His early training was under Thomas Truxtun on the frigate "President." Retained in 1801 when the navy was reduced, Biddle served on the "Constellation" in the Mediterranean in 1802. He had the misfortune to be on the "Philadelphia" when that frigate ran on the rocks off Tripoli, and spent 19 months in prison there with William Bainbridge, David Porter and other officers. Following the Barbary Wars, he secured leave and made a voyage as a mate in the China trade. Upon his return he was promoted to lieutenant and was second in command of the "Wasp" when that vessel took the "Frolic" in one of the famous single-ship actions of the War of 1812. When a British 74-gun ship captured the "Wasp" and retook the "Frolic," Biddle had a second experience as a prisoner of war. When he was exchanged, in 1813, he found himself a master commandant and in command of the brig "Hornet." In this vessel he engaged the "Penguin," of equal weight of metal, and on April 27, 1815, escaped an enemy ship-of-the-line for the last naval engagement of the war. In 1817 Biddle, serving in the Pacific, took formal possession of the Oregon territory. Subsequently he served in the South Atlantic, Mediterranean and Gulf of Mexico. In 1846 he negotiated the first treaty between the United States and China and during the Mexican War was in command on the Pacific coast. He died at Philadelphia on Oct. 1, 1848.

See *Charles Biddle's Autobiography* (1883); Brown's *American Naval Heroes* (1899); Theodore Roosevelt, *The Naval War of 1812* (1882).
(W. B. CR.)

BIDDLE, JOHN (1615 or 1616–1662), often called the father of English Unitarianism, was born at Wotton-under-Edge, in Gloucestershire. He was educated at the grammar school of his native town and at Magdalen hall, Oxford, being subsequently appointed to the mastership of the free school in Gloucester. A treacherous friend obtained the manuscript of his *Twelve Arguments Drawn out of Scripture, Wherein the Commonly Received Opinion Touching the Deity of the Holy Spirit Is Clearly and Fully Refuted*; and in Dec. 1645 he was summoned before the parliamentary committee then sitting at Gloucester, by which he was committed to prison. He was released on bail after a short imprisonment but in July 1647 was called before parliament, which desired to inquire into his views. After tedious proceedings Biddle was committed to custody, and his *Twelve Arguments*, which he had now published, was ordered by parliament to be seized and burned. Biddle's tracts attacking the doctrine of the Trinity were suppressed, and the Westminster assembly of divines eagerly pressed for the death penalty for heretics like him. This was resisted by the army and by many of the Independent parliamentarians, and after the death of the king Biddle was allowed to reside in Staffordshire under surveillance. In Feb. 1652 the general act of oblivion gave him complete freedom, and his adherents soon began to meet regularly for worship on Sundays. They were called Biddellians, or Socinians, or Unitarians, the name which has now become associated with their opinions. Biddle was not left long in peace. He translated some Socinian books, among others the *Life of Socinus*, and published two catechisms which excited a fury of indignation. He was summoned before the parliament in Dec. 1654 and imprisoned. The dissolution of that body again set him at liberty, but he was presently rearrested and was only rescued by Cromwell, who sent him (Oct. 1655) to one of the Scilly islands, allowed him 100 crowns a year, and in 1658, on the solicitation of many friends, released him. For a few years he lived and taught in the country, but, returning to London, he was again arrested, in June 1662, and fined £100. As he was unable to pay this sum, he was at once committed to prison, where he died of fever on Sept. 22, 1662.

The "Unitarianism" of Biddle professed to be a restoration of primitive biblical teaching, but with his stress upon the Bible he combined a rationalism that showed affinities with the Deism of his time. Thus his overt attacks were directed against the traditional doctrine of the Trinity of persons in the Godhead, but the ultimate issues at stake were the Christian understanding of salvation and the Christian doctrine of revelation. *See* also UNITARIANISM.

See J. Toulmin, *A Review of the Life, Character and Writings of the Rev. John Biddle, M.A.* (1791).
(J. J. PN.)

BIDDLE, NICHOLAS (1786–1844), U.S. financier and litterateur who, as president of the Second Bank of the United States from 1822 to 1836, made it the first effective central bank in U.S. history, was born in Philadelphia, Pa., on Jan. 8, 1786. A precocious student of the classics and of French literature, he completed his studies at the University of Pennsylvania at the age of 13, and at 20 he contributed to *Port Folio*, the first United States literary periodical, of which he later was editor. From their notes, he wrote the *History of the Expedition of Captains Lewis and Clark*.

Making law his profession, he had an early career in diplomacy, becoming secretary of the U.S. legation in London (1806) under James Monroe, with whom he formed a lifelong friendship. In 1815, then a member of the state senate, Biddle prepared Pennsylvania's reply to the address of the Hartford convention, which had proposed a number of amendments to the federal constitution limiting the power of congress and of the executive. In 1819 Biddle completed for the U.S. department of state *Commercial Regulations*—a digest of foreign legislation affecting United States trade.

As president of the Second Bank of the United States, Biddle helped to develop the theory and practice of central banking. Among the bank's accomplishments were regulation of the supply of money; restraint of the expansion of bank credit; government of the exchanges; safeguarding of the investment market; protection of the money market against disturbances arising from treasury operations and imbalance in international and interregional payments; facilitation of treasury operations; organization of the discount market; and provision of a safe depository for government moneys.

However, the Jacksonians, assisted by Biddle's political ineptitude, were able to unite elements opposed to the bank's

restrictive policies and terminate it in 1836 (for the issues in this controversy, *see* BANKING: *History of Banking: The United States*). It was rechartered, by Pennsylvania, with Biddle as president, but expired in 1841, partly because of his poor business judgment.

In 1839 Biddle retired to Andalusia, his country estate, subsequently celebrated for its *salons*. He died in Philadelphia, Feb. 27, 1844.

See Bray Hammond, *Banks and Politics in America, From the Revolution to the Civil War* (1957). (J. J. S.)

BIDEFORD, a municipal borough, market town and small port of north Devon, Eng., 9 mi. S.W. of Barnstaple by road, lies mainly on the left bank of the wide Torridge estuary in the centre of Bideford bay. Pop. (1961) 10,265. The small harbour is dry at low tide. Near it the stone bridge across the Torridge has 24 uneven arches and replaced an earlier wooden one of about the 15th century. There are some old houses, a museum and an art gallery. Bideford's few industries include timber importing, boatbuilding, the making of gloves and concrete products, and tourism. In Domesday Book the town appeared as Bediforda and from the days of William II to 1757 the manor (now owned by the borough council) was held by the de Granville (or Grenville) family, to which Sir Richard Grenville, the naval commander, belonged. Like Barnstaple, Bideford had a large woolen trade (chiefly serges) until the 18th century and a shipbuilding industry in connection with it; pottery was also made. The town received its main charter in 1573 and prospered early in the tobacco and salt fish trade with America. After the railway came in 1856 Bideford became less seafaring and more agricultural and residential, as well as a holiday resort, with the romantic associations fostered by Charles Kingsley's writings. One of his novels gave its name to the "little white town" of Westward Ho, which lies 3 mi. N.W. and has a long, sandy beach on the Atlantic coast.

BIDJUGO (known also as BIJOGO or BISSAGO), an African people of the Ilhas dos Bijagós (Bissagos Islands), off Portuguese Guinea, west Africa, numbering 9,211 (1950 census) and speaking an individual language of the western Atlantic group. They are very different from the mainland tribes, whom, for centuries, they used to raid in remarkable war-canoes. The Bidjugo have great artistic skill, especially in wood carving, and perform animal dances in masks. They are divided into clans, and women have considerable freedom and influence, especially the priestesses, who have sometimes been queens. A largely animistic religion strictly regulates their individual and social life, and they exist chiefly on palm tree products. Very conservative, they have assimilated much less European influence than the other tribes of Portuguese Guinea.

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BIDPAI, FABLES OF, the name under which a famous collection of Indian fables has become known in Europe. They are called after an Indian sage Bidpai, the narrator, and illustrate practical wisdom under five heads in the form of animal stories. The original Sanskrit work composed about A.D. 300 is lost. The oldest known Indian version is the *Tantrakhyayika* ("Book on Cases of Wisdom") and there is another version, the *Panchatantra* ("Five Cases of Wisdom"), and a recension of this, the *Hitopadesa* ("Book of Good Counsel").

The original five stories, together with some later Indian additions, were translated into Pahlavi (middle Persian) by the Persian royal physician Burzoe in the 6th century. Although this work also is lost a Syriac translation of it has survived, together with the famous 8th-century Arabic translation by Ibn al-Muqaffa known as *Kalila wa-Dimna* after the two jackals that figure in the first story. The *Kalila wa-Dimna* led on to various other versions, including a second Syriac version and an 11th-century version in Greek, the *Stephanites kai Ichnelates*, from which translations were made into Latin and various Slavonic languages. The 17th-century Turkish translation, the *Humayun-name*, was based on a 15th-century Persian version, the *Anwar-i Suhayli*.

In Europe a version was written in Latin hexameters by the fabulist Baldo in the 12th(?) century and in the 13th century a Spanish translation was made on the orders of Alfonso X of Castile. It was the 12th-century Hebrew version of Rabbi Joel, however, that became the source of most European versions. First translated into Latin by John of Capua as the *Liber Kelilae et Dimnae* or the *Directorium Vitae Humanae*, it led to various European versions including another Latin version, the *Liber de Dina et Kalila* by Raimond of Béziers, in the 14th century and the *Buch der Beispiele der alten Weisen* by A. von Pforr in the 15th century. Sir Thomas North's *The Moral Philosophie of Doni* (1601) is a translation of A. F. Doni's 16th-century Italian version.

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BIÉ-CUANDO CUBANGO, the largest district (area 101,826 sq.mi.) of Angola, Africa, covers the central and southeastern regions of that Portuguese overseas province. Pop. (1950) 474,491, which included 4,211 Europeans and 2,412 persons of mixed race. It includes five *concelhos* (counties): Bié, Chinguar, Andulo, Camacupa and Menongue; and four circumscriptions: Alto Cuanza, Cuito-Cuanavale, Baixo Cubango and Cuando. The capital is Silva Porto (pop. [1955 est.] 12,146), and other more important towns are Nova Sintra, Andulo, Vila General Machado, Chinguar, Vila Serpa Pinto, Chitembo and Cuangar. The four northern *concelhos* (the first four mentioned above) are served by the Benguela railway and are very productive; crops grown on the settlers' *chitacas* ("farms") include wheat, maize (corn), rice, broad beans, potatoes, peanuts, sisal, coffee, vegetables and fruits. The Africans cultivate cereals, tobacco and sugar cane and gather honey and beeswax. Livestock is also abundant. Industries are agricultural: milk products, hides and skins, rice husking, oil extraction, milling and pork products. The southern areas lack communications and are sparsely inhabited. They produce some cereals, oilseeds, fruits, honey and beeswax, hides and skins, etc. The economic potential of Baixo Cubango, Cuando and Cuito-Cuanavale is great, but development awaits the continuation of the Moçamedes—Vila Serpa Pinto railway. (A. A. G. P.)

BIEDERMEIER STYLE, in art and design, echoed the tastes of the middle classes, especially in Germany, Austria and the Scandinavian countries, during a period of economic impoverishment from the late 1820s to the late 1830s. It ended when the so-called Second Rococo or Louis Philippe style was introduced in France after 1830.

The term Biedermeier, derived from a political caricature in *Fliegende Blätter* and later featured in satirical poems by Ludwig Eichrodt published about 1850, described a Philistine ignorant of art and poetry. The furniture derives from the Empire style, developing more sober and utilitarian shapes, mostly executed in fruit woods and avoiding the use of bronze ornament. The painting, either genre or historical, antiromantic and yet not realist, is sentimentally or humorously anecdotal. The best representatives are F. Kruger, F. G. Kersting, J. Oldach, C. Spitzweg and F. Waldmüller. Biedermeier style owes its appeal to its simple and cheerful unpretentiousness.

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BIEL, GABRIEL (*c.* 1425–1495), German scholastic philosopher, theologian and economist, was born at Speyer and studied at Heidelberg and Erfurt. Having been cathedral preacher at Mainz (1466), he entered the Order of the Brothers of the Common Life in 1467 and became prior of Urach (1482), professor of philosophy and theology at Tübingen (1484) and prior of Schönbuch (1492). His *Collectorium*, a commentary on Peter Lombard's *Sentences*, gives a clear and methodical exposition of the teaching of William Ockham and was so influential that Ockhamists at the universities

of Erfurt and Wittenberg were known as Gabrielistae. Left unfinished by Biel, it was completed by his follower W. Steinbach at Tübingen in 1520 and the complete work printed at Brixen in 1574, after many incomplete editions.

Biel, in addition to theological treatises, also wrote a progressive work on economic theory, *De potestate et utilitate monetarum* (printed 1516; Eng. trans., *Treatise on the Power and Utility of Moneys*, 1930). He has been called *ultimus scholasticorum* ("the last of the scholastics"), a title which ignores outstanding scholastics who came after him.

See P. Bohner, *G. Ockham: Quaestio prima principalis prologi in primum librum Sententiarum cum interpretatione Gabrielis Biel* (1939); E. Bonke, "Doctrina nominalistica de fundamento ordinis moralis apud Gulielmum de Ockham et Gabriel Biel," *Collectanea Franciscana* (1944). (S. J. C.)

BIEL (Fr. BIENNE), an important industrial town in the Swiss canton of Bern, at the northeastern end of Lake Biel, where the Suze or Schüss river issues from a deep cleft (the Taubenloch) in the Jura range, 30 km. (19 mi.) N.E. of Neuchâtel, and 34 km. (21 mi.) N.W. of Bern. The population, which in 1850 was but 3,589 and rose in 1960 to 59,216, was mainly Protestant and two-thirds German-speaking. The parish church of St. Benedict dates from 1451 but was restored in 1775; it has some fine 15th-century painted glass. In the town is the Schwab museum, chiefly notable for its fine collection of objects from the pile-dwellings. The West Cantonal Technical institute gives instruction relating to the industries carried on in the town.

To the northwest, two funicular railways lead up to Évilard (or Leubringen) and Macolin (or Magglingen), both situated on the slope of the Jura. Biel's chief industries are watchmaking, chainmaking and the manufacture of machines for use on railways and in other industries.

First mentioned in the 12th century, Biel was for centuries under the jurisdiction of the prince-bishop of Basel. In 1279 (permanently in 1352) it made alliance with Bern, in 1334 and 1344 with Solothurn, and in 1311 and 1382 with Fribourg. It failed to gain admission into the Swiss confederation, though after it adopted the Reformation in 1528 it was closely associated with the Protestant cantons. In 1798 it was seized by the French, but in 1815, with the greater part of the bishopric of Basel, it became part of the canton of Bern. (*See* BERN.)

Lake Biel (LAKE OF BIENNE OR BIELERSEE) is situated at the foot of the Jura range. It is 7½ mi. long, 2½ mi. wide, 243 ft. deep, 1,407 ft. above the sea and has an area of 15 sq.mi. In it is the Isle of St. Pierre with many traces of lake dwellings. It receives the Suze and Thièle or Zihl rivers (from the Lake of Neuchâtel). The Hagneck canal leads the waters of the Aare river into the lake and the Nidau conducts them out again.

BIELEFELD, a town of Germany, which after the partition of the nation following World War II was located in the district of Detmold in the *Land* (state) of North Rhine-Westphalia, Federal Republic of Germany. It is situated on the northern edge of the Teutoburger Wald, 111 km. (69 mi.) W.S.W. of Hanover. Pop. (1959 est.) 174,752. During World War II Bielefeld was occupied by the Allies in April 1945. The town, which sustained considerable damage, was rebuilt after the war and a subway was constructed under the central Jahnplatz. The Altstädter Nikolaikirche (14th century), with a carved Flemish altar, was restored after the war. The Neustädter Marienkirche (14th century) contains the tombs of Count Otto III of Ravensberg and Count Wilhelm von Jülich. Other historic buildings include the Jodokuskirche, the Grest'sche Hof (now a grammar school), the Spiegel'sche Hof, the Gothic Crüwell house and the Renaissance house in the old market place, now a bank. Cultural institutions include the Rudolf-Oetker Concert hall, the municipal opera and playhouse, the farmhouse museum, the playing card museum and several libraries. Bielefeld is on the main railway line from Hanover and Minden to Hamm and the Ruhr. The town is the centre of the Westphalian linen industry which dates from the 13th century; the first mechanical mills were established in 1854. There are silk and plush weaving mills. Manufactures include clothing, sewing machines, bicycles, cash registers, adding machines, machine tools, cereals, food products and pharmaceutics.

First mentioned as Bilifelde in the biography of Bishop Meinwerk of Paderborn between 1015 and 1036, the old town was probably founded in 1214 by Count Hermann of Ravensberg. The so-called "new town" arose from a charitable foundation settlement around the Marienkirche toward the end of the 13th century. In 1250 Count Ludwig of Ravensberg built Sparrenberg castle for the protection of the town. The towns were united in 1520. In the 14th century Bielefeld joined the Hanseatic league, and in 1346 the town, with the countship of Ravensberg, passed to the margravate and later the duchy of Jülich and in 1609 to Brandenburg (made definite in 1666). (U. N.)

BIELLA, a city of Vercelli province, Piedmont, northwest Italy, is situated on the Cervo river at the foot of the Alps, with the flat Po valley to the east, 72 km. (45 mi.) N.E. of Turin. Pop. (1957 est.) 46,167. Biella is divided into the upper (Piazzo) and lower (Piano) town, joined by a cable railway. There are many medieval and Renaissance houses in the upper town while in the lower town is the 15th-century cathedral adjoined by the 9th-century baptistery. To the south are the Renaissance basilica of San Sebastiano, the modern city, the art gallery and a park with a fine collection of rhododendrons. On Alpine slopes above the town are the Santuario d' Oropa, a pilgrim resort, and a winter sports station. The industries of Biella are wool, silk and cotton manufactures. Biella was occupied in prehistoric times and became in turn a Gallic and Roman city. On the committee of Vercelli during the middle ages, Biella passed to Savoy in 1379. It became part of Italy in 1860 and during World War II was occupied by the Allies in April 1945. (P. To.)

BIELSKO-BIALA, the chief town of the district of the same name in the *wojewodztwo* (province) of Katowice, Pol., lies 60 km. (37 mi.) from Katowice on the border of the Carpathian mountains and the sub-Carpathian plain. Pop. (1960) 76,000. It is a communications centre for tourists in the western Carpathians. Until 1951 Bielsko-Biala consisted of two separate towns divided by the Biala river, a tributary of the Vistula. Bielsko, in Silesia, was the seat of the Sulkowski entail and obtained town rights in the 18th century; Biala, in the Cracow *wojewodztwo*, obtained its rights at the same time. Both towns were once under Austrian rule: as part of Silesia, Bielsko became Austrian in 1526, while Biala passed to Austria in 1772. They were returned to Poland in 1919.

Sheep-rearing in the nearby mountains provides raw materials for the weaving industry, which developed in Bielsko as early as the 16th century. Bielsko-Biala became one of the largest centres of the textile industry in Poland, and produces high-grade wool which is widely exported. The town is on a branch railway line from Katowice via Oswiecim, and is linked by main road with Krakow and Brno, Czech. (K. M. WI.)

BIERCE, AMBROSE GWINNETT (1842–1914?), U.S. newspaperman, misanthrope, wit, satirist and author of sardonic short stories based on themes of death and horror, was born on June 24, 1842, in Meigs county, O., and reared in Kosciusko county, Ind. After about a year in high school, he became printer's devil on a Warsaw paper, then moved to Elkhart. In April 1861 he enlisted in the 9th Indiana volunteers, was in action at Shiloh, Corinth, Stone's River, Chickamauga and Nashville, was seriously wounded at Kenesaw mountain in 1864 and served until Jan. 1865. Rising from private to first lieutenant, he received a merit promotion to major in 1867. In 1866 Bierce served as engineering attaché to the expedition of Gen. William B. Hazen. In San Francisco he soon began contributing to periodicals, particularly the *News Letter*, of which he became editor in 1868. In Dec. 1871 he married Mary Ellen Day, and from 1872 to 1875 the Bierces lived in England, where he wrote for the London magazines *Fun* and *Figaro* and edited the *Lantern* for the exiled empress Eugénie. English friends called him "Bitter Bierce."

In 1877 he became associate editor of the *San Francisco Argonaut*, but left it in 1879–80 for an unsuccessful try at placer mining in Rockerville, in the Dakota territory. Thereafter he was editor of the *San Francisco Wasp* for five years. In 1887 he joined the staff of Hearst's *San Francisco Examiner* and continued that association for 20 years. In 1900 Bierce moved to Washing-

ton, D.C., where he continued newspaper and magazine writing. In 1913 he joined the army of Pancho Villa in Mexico and in December sent the last word received from him. His end is a mystery, but a reasonable conjecture is that he was killed during the siege of Ojinaga in Jan. 1914.

A troubled man, Bierce separated from his wife, lost his two sons and broke many friendships. As a newspaper columnist he specialized in critical attacks: on amateur poets, clergymen, bores, dishonest politicians, money grabbers, pretenders, frauds of all sorts. His principal books are: *In the Midst of Life* (1891), *Can Such Things Be?* (1893) and *The Devil's Dictionary* (1906). The first two were collections of tales, grim, vivid, often sardonic, and often with ingenious surprise endings. The last is a volume of ironic definitions. His *Collected Works* was published in 12 volumes, 1909–12.

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BIERSTADT, ALBERT (1830–1902), U.S. landscape painter, whose pictures of the western part of the United States, and particularly the Rocky mountains, made him widely popular, was born in Solingen, Westphalia, Ger., on Jan. 7, 1830, and was taken to the United States when about a year old. In 1853–56 he studied painting at Düsseldorf. His "Estes Park, Colorado" was bought by the earl of Dunraven. His "Sierra Nevada" (1878) is in the Corcoran gallery in Washington, D.C., and "The Valley of Yosemite" in the Metropolitan museum in New York.

He rendered panoramic views with a certain ability, though his work was somewhat more topographically correct and impressive than artistic. He was a member of the National Academy of Design of New York, and is represented by two historical paintings, "The Discovery of the Hudson River," and "The Settlement of California," in the Capitol in Washington. He died in New York city on Feb. 18, 1902.

BIGAMY is the unlawful contracting of a marriage by or with a person who is already married to another. In earlier times it was dealt with by ecclesiastic courts. After the Reformation the English parliament, followed by the American states, enacted statutes defining and punishing the offense. The statutes vary in form and substance. Typically, they forbid marriage by or with any person "having a husband or wife living," with specified exceptions for cases where the earlier marriage was invalid or was terminated by divorce, or where the prior spouse has disappeared and is believed dead.

The principal problem arising under this legislation in modern times is what shall be done in case the earlier marriage has ended in divorce but the divorce turns out to be invalid. This problem is acute in the United States because of the great diversity of divorce laws and the frequency of "migratory" divorce, *i.e.*, where a resident of one state goes temporarily to another state or foreign country to take advantage of its lax divorce law. If the circumstances and duration of the sojourn in the divorcing state fall short of the legal requirement of "domicile," the migratory divorce may be treated as a nullity in other states. Thus, where two residents of North Carolina went to Nevada to divorce their respective spouses, married each other in Nevada and returned to North Carolina to live as man and wife, they were convicted of bigamous cohabitation in North Carolina. In a leading decision, *Williams* v. *North Carolina*, 325 U.S. 226 (1945), the supreme court of the United States refused to set aside this conviction, notwithstanding its recognition that the parties' divorces and remarriages were valid under Nevada law. The federal constitutional obligation upon the states to give "full faith and credit" to the laws and judicial proceedings of other states was held inapplicable to dissolution of marriages by a state in which the parties were not "domiciled."

Where a person is legally domiciled may be a difficult question, and it will often happen, as in the Williams case, that a person remarries in the erroneous but good-faith belief that his former marriage was dissolved. This raises the problem whether bigamy (commonly punishable in the U.S. as a felony by imprisonment up to five years) can be committed in innocence or whether it is a defense that the person acted in good faith. Most states allow no such defense, but recent revisions of penal laws tend to limit the offense to remarriage by one who is aware of his ineligibility. Some states do not excuse even for reasonable belief that a missing spouse has died, unless the missing spouse has been absent for a period of years specified in the bigamy statute. The contrary was held in the famous English decision, *Regina* v. *Tolson*, 23 Q.B.D. 168 (1889). Nearly all statutes make it clear that an unmarried person entering a marriage which may be bigamous because his partner is already married cannot be convicted without proof that the accused knew of the bar.

In English statute law bigamy is defined by s. 57 of the Offences Against the Person act, 1861. It is punishable by seven years imprisonment. There is a very important proviso to the definition of the offense, excluding its application to "any second marriage contracted elsewhere than in England or Ireland by any other than a British subject"; to cases where a spouse has been continuously absent for seven years and was not known by the person accused to be alive; or to a person whose former marriage has been dissolved or declared void by a court of competent jurisdiction.

See also MARRIAGE, LAW OF; ANNULMENT.

See American Law Institute, *Model Penal Code, Tentative Draft no. 4*, sec. 207.2 and comments (1955); C. S. Kenny *Outlines of Criminal Law*, ed. by J. W. Cecil Turner, pp. 170–176 (1952). (L. B. S.)

BIG BERTHA. The original Big Berthas were 42-cm. howitzers produced at the Skoda works in Austria-Hungary and used by the Germans in battering the forts at Liège and Namur, Belg., in 1914. It was assumed that this artillery originated from the Krupp works in Germany—hence the nickname, after Frau Bertha von Bohlen, head of the Krupp family. In 1918, when the Paris gun began shelling the French capital from the forest of Coucy at a range of 76 miles, newspaper correspondents resurrected the title and applied it to this gun. The bombardment began March 23 and extended over 140 days, firing taking place about every third day. In all, 256 people were killed; the most serious loss was caused on Good Friday, March 29, when 156 were killed or wounded in the church of St. Gervais. The Paris gun was a high-velocity piece of 8.26-in. calibre (later retubed to larger bore), was about 110 ft. long, weighed 142 tons, and fired a 264 lb. shell.

BIG DIPPER or GREAT DIPPER, popular names for a group of seven stars in the circumpolar constellation of Ursa Major (*q.v.*) in the northern hemisphere. The two end stars of the dipper's "bowl," α and β, are called the Pointers; an imaginary line drawn through them and extended about five times toward the north pole will pass approximately through Polaris, the North star.

BIGELOW, ERASTUS BRIGHAM (1814–1879) U.S. inventor and industrialist who developed power looms for the manufacture of carpets, was born in West Boylston, Mass., on April 2, 1814. His family was in poor circumstances and he was obliged as a child of ten to seek employment as a farm hand and clerk, and to forgo his ambitions for a formal education. Naturally adept in mathematics and mechanics, he was only 23 when he invented his first loom for the manufacture of lace. This device was followed by other power looms for the weaving of a variety of figured fabrics—counterpanes, ginghams, silk brocatel and tapestry carpetings. In 1839 he began experimental work at Lowell, Mass., which led to invention of the first power loom for weaving carpets of an ingrain type. From 1845 to 1851 he developed the greatest of his inventions, a power loom for the manufacture of Brussels and Wilton carpets. In 1843 he and his brother, Horatio Bigelow, established a mill for the manufacture of ginghams, and around this plant grew the town of Clinton, Mass. Several years later he founded the Bigelow carpet mills in the same town.

His inventions provided an enormous impetus to the manufacture of carpets not only in the U.S. but in Europe, where his looms for a while gave English manufacturers an important advantage over their French competitors. Bigelow was also an economist of note and was one of the small group of men who incorporated

the Massachusetts Institute of Technology at Boston in 1861. He died at Boston on Dec. 6, 1879.

BIGELOW, JOHN (1817–1911), U.S. diplomat, editor and journalist, was born in Malden, N.Y., Nov. 25, 1817. He graduated from Union college, Schenectady, N.Y., at age 17, practised law in New York city, wrote for liberal magazines, was active in New York prison reform in the 1840s, and became part owner and managing editor under William Cullen Bryant of the *New York Evening Post* (1849–61). He made his greatest public contribution when as American consul in Paris, 1861–64, he prevented the delivery to the Confederate states of warships constructed for them in France with the knowledge of the French government. If delivered, they might have broken the Union blockade. His record of this episode in *France and the Confederate Navy* (1888) is an exciting account of diplomatic sleuthing. As consul he influenced skilfully French opinion on the American Civil War by cultivating the liberal press and writing *Les États-Unis d'Amérique en 1863* to show French businessmen the importance to them of northern commerce. As minister to France, 1864–67, he handled with discretion the negotiations leading to the withdrawal of the French from Mexico.

In later life he became editor of the *New York Times* (1869), then secretary of state of New York, 1875–77. In the 1880s and 1890s he helped establish the New York Free Public library and advised Philippe Bunau-Varilla during negotiations leading to the Panama Canal treaty. He died in New York on Dec. 19, 1911.

His editions of Benjamin Franklin's long-lost autobiography (1868) and of Franklin's complete works (1887–88) were his principal literary achievements; of use to historians were his biography of Samuel J. Tilden (1895) and editions of Tilden's works (1885, 1908); of special interest to Swedenborgians were his religious writings, as *The Bible That Was Lost and Is Found* (1893) and *The Mystery of Sleep* (1897). An autobiographical work, *Retrospections of an Active Life,* appeared in three volumes in 1909, and two volumes in 1913.

See Margaret Clapp, *Forgotten First Citizen: John Bigelow* (1947). (Ma. Cl.)

BIG GAME HUNTING: *see* Hunting.

BIGGLESWADE, an urban district and market town of Bedfordshire, Eng., 11 mi. E.S.E. of Bedford by road, lies on the Ivel, a tributary of the Great Ouse, in a plain noted for market gardens. Pop. (1961) 8,047. The Romans made a ford there for their road, part of which is now the main street of Biggleswade (Biccel's wade or ford). An ancient borough by prescription, Biggleswade was the scene of many fairs, but only the horse fair on St. Valentine's day survives in the market place. Straw-plaiting and lace-making have been replaced by engineering, brewing and the manufacture of trailers and agricultural implements. Biggleswade lies on the main railway line from London through Peterborough. The Ivel was navigable almost to the town until the 20th century.

BIGHORN (Mountain Sheep), either of the two species (*Ovis canadensis; O. dalli*) of sheep native to North America. The body is compact and muscular; the muzzle narrow and pointed; the ears short and pointed; the tail very short. Both sexes have massive, transversely ribbed, spirally curved horns, which in the male may exceed 45 in. along the outer curvature. The fur is not wooly as in domestic sheep but is more like that of a deer; it is usually a shade of brown, but in the Dall sheep may be white to almost black.

Bighorns live in the remote crags and cliffs of mountainous areas but formerly occurred also in the foothills, whence they have been driven by man and his livestock. Formerly the Canadian bighorn ranged from northern Mexico to the Canadian Rockies. Now it is reduced to small bands protected by inaccessible habitat or by refuges. The Dall sheep ranges from Alaska to northern British Columbia.

The bighorns' food consists mainly of grasses, herbs and tender shoots, but in the desert mountains of the southwest they eat shrubs and even cacti. They are exceedingly sure-footed, leaping from rock to rock and climbing seemingly sheer cliffs. The cloven hooves, resembling hard rubber in elasticity, are sharp-edged and concave, forming suction cups. One small lamb—sometimes two—is born in the spring after a gestation period of six months. Bighorns are gregarious, but in the summer the rams live separately from the ewes and lambs. They reach their prime in about eight years. (K. R. Kn.)

BIGHORN MOUNTAINS, a U.S. mountain range extending in a great anticlinal arch for 120 mi. in a northwest-southeast direction across north-central Wyoming; to the north the range reaches into southern Montana. These mountains consist of a partially exposed Pre-Cambrian core with Paleozoic and Mesozoic sedimentary rocks dipping away on the east and west flanks. The range lifts abruptly 4,000 to 5,000 ft. above the Great Plains and Bighorn basin that surround it. The average height of the mountains is from 11,000 to 13,000 ft. above sea level; Cloud peak at 13,165 ft. is the highest in the range. The Bighorn National forest, with headquarters at Sheridan, Wyo., includes a gross area of more than 1,000,000 ac.; it has many camp and picnic areas and several winter sports areas. (H. B. Ha.)

BIGHORN RIVER, the largest tributary of the Yellowstone, drains west-central Wyoming and a small area of south-central Montana. Topographically, it includes three subbasins, known in downstream order as the Wind river in Wyoming, the Bighorn in Wyoming and Montana, and the Lower Bighorn in Montana.

Wind river, master stream of the upper basin, originates in the high areas of the Wind River and Absaroka mountains in northwestern Wyoming. Flowing southeast to a lowland area in west-central Wyoming it is joined by the Popo Agie and Little Wind rivers near Riverton. Turning north it passes out of the upper basin through Wind River canyon, a deep and spectacular gorge through the Owl Creek mountains. Boysen dam is located in the upper portion of the canyon.

Below the canyon the stream name is Bighorn river. Continuing northward it flows through the Bighorn basin—collecting its two principal tributaries the Greybull and Shoshone rivers—to the Wyoming-Montana boundary where it turns northeastward through Bighorn canyon to cross the Lower Bighorn basin and empty into the Yellowstone at Bighorn, Mont.

Little Bighorn river joins the main stream at Hardin, Mont., in the lower basin. It was near the mouth of this stream that Col. George A. Custer and the officers and men of five companies of the 7th U.S. cavalry were annihilated, June 25, 1876, in action against the Indians of the Great Plains. Custer Battlefield National monument marks the site of this historic incident. (G. V. Sk.)

BIGNONIACEAE, a family of dicotyledonous (having two seed leaves) plants, chiefly shrubs, trees and vines, mostly with large showy flowers. The family is particularly developed in tropical America, although also fairly well represented in tropical Africa and in the Indo-Malaysian region. A few genera, *Catalpa, Campsis, Incarvillea,* occur in temperate regions. There are about 100 genera and more than 800 species many of them cultivated in tropical countries for ornamental or other purposes. The tropical American calabash tree belongs in *Crescentia,* the sausage tree to the African genus *Kigelia* and the African tulip tree to *Spathodea. Jacaranda* is widely planted in subtropical regions as an ornamental shade tree. *Campsis radicans,* the common trumpet creeper, is a well-known ornamental climber throughout most of eastern United States. (E. D. Mt.)

BIGOD, the name of an English family conspicuous for its opposition to the crown in the 12th and 13th centuries. Descended from a modest Norman family, the founder of the English line, Roger Bigod (d. 1107), acquired soon after 1066 extensive estates around Framlingham castle in Suffolk and in Norfolk where he was among the greatest of the lay landowners. His heir, William, was drowned in the wreck of the "White Ship" in 1120, and Roger was succeeded by his second son, Hugh (*c.* 1095–1177). Despite his rebellion against King Stephen in 1140, Hugh was created earl of Norfolk (Dec. 1140 or Jan. 1141) by Stephen, and fought with him at the battle of Lincoln in Feb. 1141. Soon afterward he deserted to Matilda, the rival claimant for the throne, and later joined Geoffrey de Mandeville in ravaging eastern England (1144). He grew restless under the rule of Henry II, and was a leader of the rebellion of 1173–74, which in England was centred on his estates.

But he was restored to favour before his death on about March 9, 1177. His son ROGER (d. 1221), who was not recognized as earl until 1189, proved a faithful servant of Richard I, but joined the barons against King John in 1215, and was among the lords elected to maintain Magna Carta.

The short-lived 3rd earl, HUGH (d. 1225), enriched his family fortunes by marriage to Matilda, coheiress of William Marshal, earl of Pembroke. Matilda brought their son ROGER (*c.* 1212–70), 4th earl, the marcher lordship of Chepstow, and in her right he was recognized marshal of England (1246). He was prominent among the barons who between 1258 and 1265 wrested control of the government from Henry III and who assisted Simon de Montfort. Roger's brother HUGH (d. 1266) was justiciar for the baronial regime from 1258 to 1260. The brothers gradually drew apart from De Montfort, and Hugh fought for the king at the battle of Lewes in 1264. Roger died childless and was succeeded by Hugh's son ROGER (*c.* 1241–1306), 5th earl of Norfolk and marshal of England.

This Roger is best known for his quarrel with Edward I (1297), whom he defied with the stubborn pride characteristic of his family. With the constable, Humphrey de Bohun, earl of Hereford, he refused to serve abroad unless the king personally led the expedition, and to the angry king's threat "By God, earl, you shall either go or hang," Bigod retorted "By the same oath, king, I will neither go nor hang." (Walter of Guisborough's *Chronicle,* ed. by H. Rothwell, 1957.) Self-interest was not Bigod's only motive, for the two earls, with considerable public spirit, led the movement which forced Edward I to confirm the charters (1297). His finances drained by the dispute, the childless marshal granted his estates to Edward I in 1302 and received them back for life only, but was relieved of his debts. Roger's death in Dec. 1306, therefore, brought his estates and titles to the crown. His lands were given (1310) by Edward II to his own younger brothers, Edmund and Thomas. Thomas was later created earl of Norfolk (1312) and marshal of England (1316). Although a cadet branch of the family long survived in Yorkshire, at Roger's death the Bigods disappeared from high politics. (C. D. R.)

BIGSBY, JOHN JEREMIAH (1792–1881), English geologist and physician who carried out extensive and important geological researches particularly in the fields of stratigraphy and paleontology of Canada and New York state, was born at Nottingham on Aug. 14, 1792. Educated at Edinburgh, he joined the army medical service and in 1817 was stationed at the Cape of Good Hope. He moved to Canada in 1818 and in the following year was appointed to report on the geology of Upper Canada. In 1822 he became British secretary and medical officer to the Boundary commission, contributing papers to the *American Journal of Science* and other scientific journals. He returned to England in 1827. His *Thesaurus Siluricus* was published with the aid of the Royal society in 1868 and the *Thesaurus Devonico-Carboniferus* in 1878. In 1877 he founded the Geological Society of London's Bigsby medal to be awarded biennially as an acknowledgment of eminent services in any department of geology, the recipients not to be over 45 years old. He died in London on Feb. 10, 1881.

BIG STONE LAKE, source of the Minnesota river, is located on the Minnesota-South Dakota boundary about 300 mi. W.N.W. of Minneapolis. Its name comes from red granite outcrops in the vicinity. Its waters are impounded in a narrow glacial spillway by the delta of the Whetstone river. The lake is 26 mi. long and ¾ to 1½ mi. wide. Its level is regulated by water diversion from the Whetstone river and by a dam at the lake outlet with spillway altitude of 964 ft. The lake is used as a storage reservoir for spring flood waters which might inundate the Minnesota valley. (H. A. C.)

BIHAR (BEHAR) is one of the constituent states of the Republic of India. Bihar was the heart of the empire of Asoka (*q.v.*) and later under the British regime it long formed part of Bengal Presidency. In 1912 the province of Bihar and Orissa was separated from Bengal and was divided into separate provinces, Bihar and Orissa, in 1936. When India became independent in 1947 the province of Bihar became a group A or governor's state with an area of 69,745 sq.mi. In 1948 the small states of Saraikela and Kharsawan (623 sq.mi.) were absorbed. At that time the northeastern corner of Bihar adjoined East Pakistan, thus separating the state of West Bengal into a main southern part and a detached northern part. To remedy this, at the major reorganization of state boundaries of Nov. 1, 1956, parts of Purnea were transferred to West Bengal together with parts of Manbhum. Bihar state thus has a present area of 67,198 sq.mi. The state stretches from the borders of Nepal in the north to Orissa in the south and is bordered on the east by West Bengal and on the west by Uttar Pradesh and Madhya Pradesh. The state capital is Patna (*q.v.*) on the south bank of the Ganges (Ganga).

Physical Geography.—Apart from the foothills of the Himalayas, built up of folded Tertiary sediments, in the extreme northwest, the whole of the northern part of the state is part of the great monotonous alluvial plain of the Ganges and its tributaries. The Ganges itself flows from west to east near the southern margin of the plain. It is joined just above Patna by the Gandak draining from Nepal and farther upstream on the opposite bank by the Son from the southwest. Farther west the Ghaghra (Gogra) joins the Ganges from the northwest and for some distance both rivers form the state boundary, the angle of land between them being part of Uttar Pradesh (formerly United Provinces). Another important tributary joining the Ganges from Nepal much farther east is the Kosi. The southern half of the state is very different in character, coinciding with the main part of the Chota Nagpur plateau and ranging from 1,000 to 4,000 ft. above sea level. This plateau is part of the great gneissic-schistose plateau of peninsular India. In late Paleozoic times it was partly covered by lower Gondwana rocks, including coal-bearing strata, which subsequent faulting have preserved in down-faulted basins. The main coal fields lie partly in West Bengal, partly in Bihar, notably along the Damodar valley. The principal field Jherria (Jharia)-Asansol-Raniganj, shared by the two states, yields up to nine-tenths of India's coal. Interbedded lavas as well as dykes of igneous rock also occur and the Chota Nagpur plateau is characterized by a succession of flat-topped hills, partly structural in origin, partly due to the development of erosion platforms at different levels. The scenery of the eastern part of the plateau has been transformed both by the development of coal mining and industry and by the creation of a series of lake-reservoirs forming part of the Damodar valley scheme (*see* DAMODAR).

Climate.—Nine-tenths of the total rainfall comes in the summer monsoon from June to October. The middle Ganges plain in Bihar is intermediate between the dry upper Ganges plain in Uttar Pradesh, where irrigation is needed, and the very wet delta lands of West Bengal and East Pakistan. The total fall in Bihar ranges from about 40 to more than 60 in.; irrigation is not essential but is a valuable insurance against delayed or inadequate rains and enables the season of cultivation to be extended. The Chota Nagpur plateau also enjoys a moderate rainfall, above 40 in. and reaching 50 to 60 in. in the central parts. Temperatures on the plains may fall almost to freezing point and rise above 110° F. on occasions, but on the whole the plains escape both the extreme heat of districts farther west and frost. On the plateau cloud cover by day tends to limit rises of temperature while elevation results in a generally lower average.

Vegetation and Animal Life.—On the northern margins of the state adjoining Nepal are stretches of Terai country, a marshy jungle still the haunt of tigers, but over the densely peopled and well-cultivated plains the natural vegetation has almost entirely disappeared. The natural vegetation of the plateau is a deciduous monsoon forest, the trees losing their leaves in the hot season from February to May. These forests are the home of the sal (*Shorea*), yielding a valuable timber. The Chota Nagpur plateau still has some of the least accessible forest country of India and this is the main reason for the continued existence of primitive forest tribes such as the Santal as well as for a rich mammalian fauna. There is a national park and game reserve 3 mi. N. of Hazaribagh. (L. D. S.)

History.—The state of Bihar roughly corresponds to the ancient kingdoms of Videha, north of the Ganges, and Magadha, south of the river. References to it occur in the Ramayana and

the Mahabharata but the first authentic dynasty is that of the Saisunagas of Magadha, who became important under Bimbisara in the 6th century B.C. It was during this period that Vardhamana Mahavira, the founder of Jainism, and Gautama, the founder of Buddhism, preached against the sacerdotalism and social exclusiveness of Brahmanism. Magadha became the paramount power under the Mauryas from Chandragupta to Asoka (*c.* 322–232 B.C.). A pillar inscription of Asoka still survives at Rampurva in northern Bihar. With the decline of the Maurya empire after the death of Asoka the history of Bihar becomes obscure for many centuries. During the 4th and 5th centuries A.D. it formed part of the great Gupta empire of northern India. The rule of the Guptas witnessed the revival of Brahmanism and is known as the golden age of Hinduism. A description of Bihar has been left by Fa-Hsien (*q.v.*), the Chinese Buddhist pilgrim who resided for three years at Pataliputra (Patna) during the reign of Chandragupta II and traveled extensively throughout the Gupta empire between 405 and 411. In the first half of the 7th century Bihar was annexed to the kingdom of Harsha, of whose reign a detailed description has been recorded by Hsüan Tsang (*q.v.*), another famous Chinese Buddhist pilgrim. From the death of Harsha (A.D. 647) little is known of Bihar until the end of the 8th century when the Gurjara-Pratiharas of Kanauj, the Rashtrakutas of the Deccan and the Palas of Bengal began their three-cornered struggle for paramountcy. About the middle of the 8th century Magadha was conquered by Gopala, who founded the imperial dynasty known as the Palas of Bengal. They were zealous Buddhists, and under them Magadha was once more an active centre of Buddhist influence. Mahendrapala I (885–*c.* 910) enlarged the Gurjara-Pratihara kingdom at the expense of the Palas. From his inscriptions, which extend as far east as Paharpur, it may be inferred that he controlled the greater part of Magadha.

In 1194 Bihar was overrun by Muslim invaders. The monasteries and universities of Uddantapura, Nalanda and Vikramasila were ruthlessly sacked and the monks slaughtered. It remained part of the sultanate of Delhi until the disintegration of the Tughlak empire in the second half of the 14th century. In 1529 it was wrested from its Lodi rulers by Babur, the first of the Mogul emperors. At the beginning of Akbar's reign Bihar was ruled by an Afghan, Sulaiman Kararani, but by 1576 both Bihar and Bengal had been annexed to Akbar's extensive empire and remained under Mogul rule until the decline of that empire in the 18th century. Bihar came under British rule in 1765 when the province was united with Bengal (*q.v.*). (C. C. D.)

People and Administration.—Next to Madhya Pradesh state, Bihar contains the largest tribal population in India, constituting about 10% of the national total. There are 29 scheduled tribes, of whom the Oraon (*q.v.*), Munda, Santal (*q.v.*) and Hol are the chief. The majority of the peoples of Chota Nagpur division are either Munda or Oraon. The remainder are principally those who speak the Bihari language (*q.v.*). The chief occupation is agriculture, particularly in the Ganges valley. In south Bihar there is a rapidly growing industrial and mining population, drawn from both inside and outside the state.

Population.—The total population at the 1951 census (corrected to the present boundaries) was 38,783,778 and 46,457,042 in 1961. The largest towns are Patna ([1961] 362,817), the iron and steel town of Jamshedpur (332,134), Gaya (150,884), Bhagalpur (143,994), Ranchi (139,437), Muzaffarpur (108,759), Darbhanga (103,106) (*qq.v.*).

Administrative Divisions.—Bihar is divided into four administrative divisions and 17 districts, listed below with the names of district headquarters in parentheses.—Patna division: Patna (Patna); Gaya (Gaya); Shahabad (Arrah). Tirhut division: Muzaffarpur (Muzaffarpur); Saran (Chapra); Champaran (Motihari); Darbhanga (Lahariasarai). Bhagalpur division: Bhagalpur (Bhagalpur); Monghyr (Monghyr); Purnea (Purnea); Santal Parganas (Dumka); Saharsa (Saharsa). Chota Nagpur division: Ranchi (Ranchi); Hazaribagh (Hazaribagh); Palamau (Daltonganj); Singhbhum (Chaibassa); Dhanbad (Dhanbad). *See* also separate articles on most of the districts. (S. Ch.)

Social Conditions.—In the early 1960s about 30% of the male population and 7% of the female population were literate, the result of extended free compulsory primary education (*see* India: *Education*). Social welfare facilities are provided through welfare extension projects and welfare centres for industrial workers and through such special ameliorative measures as the construction of wells, free hostel facilities, loans and subsidies to people of scheduled castes, tribes and other backward groups. (S. B. L. N.)

The Economy.—*Agriculture and Industry.*—On the fertile alluvial soils of the northern plain rice is the chief crop, normally occupying more than half the land in crops. About 20% of the cultivated land is double cropped. In the plateau region rice is grown on the terraced valley sides and, as a result of the Damodar valley scheme, on formerly flooded valley floors. Other crops in the plain include maize, with wheat and barley of increasing importance toward the drier west and jute on the wetter Bengal margin especially in the Purnea district. Bihar ranks second only to Uttar Pradesh in the production of white sugar, and in the early 1960s supplied one-quarter of India's total. Tobacco cultivation increased after the Peninsula Tobacco company erected one of the largest cigarette factories in the world at Monghyr. Oilseeds are important.

Coal mining is the leading mineral industry, 20,000,000–23,000,000 tons of coal being produced annually, approaching two-thirds of India's total. The coal fields in Dhanbad district, continuous with those of West Bengal, underwent the greatest development but in the 1950s new fields were developed at Ramgarh, Bokaro and Karanpura in Hazaribagh district. In the old crystalline rocks of this latter area are also the mica-bearing deposits which make this the most important mica-producing region in the world, including the neighbouring parts of Gaya and Monghyr districts. The juxtaposition of rich iron ore deposits with good coking coals, in the Singbhum or Chaibassa district and the southern border of the state, led to the establishment in 1911 of modern blast furnaces by the Tata family at Jamshedpur (*q.v.*), where a former village is now a large city. Subsidiary industries have been established and the comprehensive development under the Damodar Valley authority is leading to much industrialization on and near the coal field and main lines of communication. Other minerals in Bihar include bauxite, kyanite, copper ore, manganese ore and chromite; Singbhum district is especially rich. Cement is produced from the limestone deposits of Palamau and Shahabad districts. The production of lac and the manufacture of shellac is an old-established industry in the forest districts. There is a large output of timber and wood fuel, especially from the 15,000 sq.mi. of reserved forests.

Communications.—As elsewhere in India little use is now made of waterways but the Ganges remains a serious obstacle to both rail and road. The plains north of the river are served by the narrow-gauge lines of the North Eastern railway. South of the Ganges the main line of the broad-gauge Eastern railway runs from Howrah (Calcutta) through the main coal field and across the corner of the plateau, via Gaya or northward via Patna, to the famed bridge at Moghul Sarai opposite Benares (Banaras; Varanasi) and so to Delhi. The direct line from Howrah to Bombay runs via Jamshedpur and across the northern part of the state. As in other parts of India road development came later but has done much to open areas of the plateau which were among the most primitive parts of India. The Grand Trunk road from Calcutta to Delhi and to the old northwest frontier followed roughly the line of the Howrah-Benares railway route. An important north-south trunk road runs from the Ganges opposite Patna (at Hajipur) northward to Katmandu, capital of Nepal, while southward from Patna it passes through Ranchi to Cuttack in Orissa. Patna (at Bankipore) has an international airport.

See also Index references under "Bihar" in the Index volume. (L. D. S.)

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BIHARI LANGUAGE (properly *Bihārī*), the most western speech of the eastern group of modern Indo-Aryan languages,

spoken by about 40,000,000 people. "Bihari" means the language spoken in the state of Bihar in India. To the west it extends over the district of Agra as far as the longitude of Benares, and to the south it covers nearly the whole of the region of Chota Nagpur. It is also the language of the inhabitants of the neighbouring Tarai districts of Nepal. While an outer language, it shows points of contact with the intermediate ones. In declension and conjugation, Bihari follows Bengali more closely than Eastern Hindi. Bihari has three main dialects, which fall into two divisions. The eastern division includes Maithili or Tirhutia and Magahi. Magahi is considered to be the modern representative of Magadhi Prakrit. It is closely related to Maithili. Maithili is the dialect of the old country of Mithila or Tirhut, famous from ancient times for its learning. It has retained numerous antiquated forms, and parts of its grammar are extraordinarily complex. The western division consists of the Bhojpuri dialect which has extended southeast into the southern half of Chota Nagpur. Very few words in the Bihari vocabulary are borrowed from Persian, Arabic or other languages. (Abbreviations: Mth. = Maithili, Mg. = Magahi, Bh. = Bhojpuri, B. = Bihari, Bg. = Bengali, Skr. = Sanskrit, Pr. = Prakrit, Mg.Pr. = Magadhi Prakrit.)

Phonetics.—The stress-accent of Bihari follows the usual rules of modern Indo-Aryan vernaculars. As a general statement we may say that Bihari spelling is not fixed.

The Bihari language is adverse to the existence of a long vowel more than two syllables from the end of a *tadbhava* or evolved word. This is subject to various subsidiary rules. The principle is most important in all Indo-Aryan vernaculars, but it is carried out with the greatest thoroughness in Bihari. The whole system of declension and conjugation is subject to it.

Declension.—Bihari has a stronger sense of gender than the other languages of the eastern group. In the modern language the distinction is in the main confined to animate beings. Except in the case of the interrogative pronoun, there is no neuter gender—words which in Skr. and Pr. were neuter being generally treated as masculine. The plural can everywhere be formed by the addition of some noun of multitude to the singular. Case relationships are indicated, as elsewhere, by suffixing postpositions to a general oblique base. The agent construction, as in Hindustani, is not used, the subject of all tenses of all verbs being always in the nominative. Every noun can have three forms, a short, a long and a redundant. The short form is weak or strong. Occasionally both the weak and strong forms occur for the same word. The long and redundant forms are familiar and often contemptuous. In the feminine they are much used to form diminutives. The singulars of the personal pronouns have fallen into disuse. The plurals are used politely for the singulars, and new forms are made from these old plurals to make new plurals. All the pronouns have numerous optional forms.

Conjugation.—In all three dialects the verb makes little distinction of number, but there is a distinction between nonhonorific and honorific forms. In Mth. and Mg. this distinction applies not only to the subject but also to the object.

Forms in which the object is nonhonorific may be, as in the case of nouns, short, long or redundant.

There are numerous irregular verbs. There is a long series of transitive verbs, formed from intransitives and of causal verbs formed from transitives. Compound verbs are numerous.

The Bh. conjugation is simple. In the first and second persons the plural is generally employed for the singular, but there is no change in the verb corresponding to the person or honour of the object. The termination of the present changes in sympathy with the old present to which it is attached. Irregular verbs, the formation of transitive and causal verbs and the treatment of compound verbs are on the same lines as in Mth.

Literature.—In all three dialects there are numerous folk epics transmitted by word of mouth. The only dialect which has any real literature is Maithili. The earliest writer is Vidyāpati Ṭhakkura (Bidyāpati Ṭhākur), who lived at the court of Rājā Śiva Simha of Sugaona in Tirhut in the 15th century. His fame rests chiefly on his dainty lyrics in Maithili dealing with the loves of Rādhā and Krishna. These have exercised an important influence on the religious history of eastern India. They became the home poetry of the Bengali-speaking lower provinces. The most admired of Vidyāpati's successors is Manbōdh Jhā, who died in 1788. He composed a *Haribans*, or poetical life of Krishna. Many dramas have been composed in Maithili.

Since 1947 there has been an increasing interest in Maithili literature and culture. A number of literary organizations have been active both in Bihar and in other parts of India, among them the All-India Maithili Parishad of Darbhanga.

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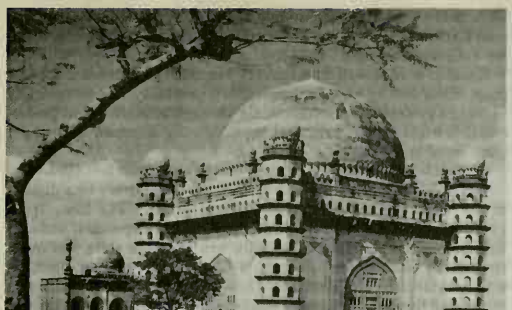
For Bhojpuri, *see* J. Beames, "Notes on the Bhojpuri Dialect of Hindi spoken in Western Bihār," *Journal of the Royal Asiatic Society*, n.s., vol. iii, pp. 483 ff. (1868); A. F. R. Hoernle, *A Grammar of the Eastern Hindi Compared With the Other Gaudian Languages* (here "Eastern Hindi" means "Western Bhojpuri") (1880); J. R. Reid, *Report on the Settlement Operations in the District of Azamgarh* (1881), containing, in appendices, full grammar and vocabulary of Western Bhojpuri.

No special works have been written about Magahi. (Er. B.)

BIJAPUR, a town in Mysore state, India, and headquarters of Bijapur district, lies 250 mi. S.E. of Bombay. Pop. (1951) 65,734. The capital of the Yadava kings for over a century before its conquest by the Delhi Khaljis in 1294, it became a small Muslim outpost with its only Muslim buildings (mosques, guardrooms) constructed out of temple spoil. During the Bahmani rule of the Deccan, Bijapur's importance increased, but in 1489 Yusuf, an alleged son of the Ottoman sultan Murad II, established his independence and built his citadel in Bijapur, taking for his dynasty the name 'Adil Shah. The dominions were extended to include Goa, where a navy was maintained. In 1565 the combined Bijapur, Ahmednagar and Golconda armies defeated the Hindu Vijayanagara forces at the battle of Talikota. The Maratha leader Sivaji (*q.v.*) attacked Bijapur and seized many fortresses between 1646–48, and in 1686 Aurangzeb conquered Bijapur which remained annexed to the Mogul power until in 1724 the Nizam became independent in the Deccan and included it in his dominions. It was ceded to the Peshwa in 1760, passing into British hands in 1818.

The 'Adil Shahi sultans were patrons of the arts, and especially developed building; theirs is structurally and aesthetically the most satisfactory of the Deccan styles. There are thus more significant and excellent buildings in Bijapur than in any other Indian city except Delhi. There are two main phases: firstly rubble-and-plaster, steadily progressing to finely sculptured stonework. Most noteworthy features are the doming system with a striking treatment of pendentives; profuse employment of minarets and pinnacles as ornamental features; elaborate cornices; and reliance on mortar of extreme strength. Domes were first hemispherical, later three-quarter spheres, on tall drums, with their springing surrounded by a ring of vertical foliations so that the whole resembles a bud surrounded by petals. A characteristic façade decoration is the filling of the arch spandrels by medallions on a flat bracket-shaped device. The arches themselves are struck from two centres, the curves stopping some way from the crown, continued to the apex by straight tangents. The building stone is the local brittle trapstone. There is evidence to show that architects were imported from north India and that free use was made of local Hindu craftsmen. In the reign of 'Ali I (1558–80) were built the city walls, suburbs and his great Jami mosque (418 by 251 ft.), sparsely decorated but dignified in its severity. The palace complex dates from 1582 in the reign of Ibrahim II, but in 1599 this monarch proposed moving his capital three miles west to where the water supply was better; this new town, Nauraspur, was sacked in 1624 before its completion. The 'Adil Shahis' greatest work was



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GOL GUMBAZ, THE TOMB OF SULTAN MOHAMMED 'ADIL SHAH, BIJAPUR; 1626–56

the mausoleum of Ibrahim and his family, the Ibrahim Rauza; completed 1626: within a garden 420 ft. square stand a tomb and mosque on a common plinth, perfectly balanced, in elaborately sculptured gray stone. An exquisite building of the end of Ibrahim's reign is the Mihtar-i-Mahall, really a mosque gateway, narrow of façade (vertical double-square), rich in stone diaper patterns, with balconies supported on long stone struts, superb cornices and elaborate minarets, all richly carved. In the reign of Mohammed (1626–56), the style deteriorated through attenuation of drum and dome, but Mohammed's own tomb, the Gol Gumbaz (familiar to many from the old six-anna stamp) is one of the supreme triumphs of Islamic building: on a 156-ft. cube, with pagodalike octagonal corner turrets, rests a hemispherical dome of 144 ft. external diameter, supported by intersecting arches; the floor area, over 18,200 sq.ft., is the largest in the world covered by a single stone dome.

Curious in the Bijapur coinage is the larin or "fish-hook" money, a standard currency in 16th-century Indian ocean trade.

The town is the seat of Vijay college (1945), connected with Karnatak university.

BIJAPUR DISTRICT was formed in 1864, with an area of 6,590 sq.mi., and had in 1961 a population of 1,658,453. There is grain and cattle trading and some cotton milling. Cotton, millet and wheat are the chief crops. The district was transferred from Bombay to Mysore state in the 1956 redistribution.

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BIJNOR, a town and district in the Rohilkhand division of Uttar Pradesh, India. The town lies 75 mi. N.E. of Delhi, with which it has rail and road connections, and is situated about 3 mi. E. of the Ganges river. Pop. (1951) 30,646. It was controlled in turn by the Moguls, the Marathas and the East India company, to which it was ceded in 1801.

BIJNOR DISTRICT, roughly triangular in shape, is bounded on the west by the Ganges and on the northeast by the foothills of the Himalayas, and has an area of 1,866 sq.mi. It is mainly a level plain but the northern part rises somewhat, the greatest elevation being 1,342 ft. above sea level. The Khoh and Ramganga are the principal streams. In 1961 it had a population of 1,186,001. The chief towns are Najibabad, Nagina and Kiratpur. Most parts of the district are watered by streams, supplemented by a series of small canals; irrigation from wells is also important. Rice, wheat, sugar cane, pulses and barley are the main crops. Sugar is produced in quantity, and there are three sugar factories in the district. (S. S. BH.)

BIKANER, a town and district and a former princely state in Rajasthan, India. The town, now a divisional headquarters, is 240 mi. W. of Delhi. Pop. (1961) 150,494. The city is surrounded by a stone wall, 6 ft. thick, 15 to 30 ft. high and 3½ mi. in circumference, with five gates and three sally ports. The citadel, ½ mi. N.E. of the city, is surrounded by a rampart with bastions and contains an interesting series of palace buildings of different periods, and a fine library and collections of Rajput paintings. Bikaner carpets are famous, and fine blankets and sugar candy are also manufactured. The educational institutions include five colleges connected with the University of Rajasthan.

BIKANER DISTRICT (pop. [1961] 444,183; area 10,501 sq.mi.) is a desolate tract overspread with undulating sand hills that rise 20 to 100 ft. above the plain and are so loose that men and animals stepping off the beaten track sink as if in snow. There are no permanent streams, and water is very scarce and is raised from wells of from 150 to 340 ft. in depth. A few shallow salt lakes are filled by rain water, but they dry up in hot weather, leaving a thick crust of salt on their beds, which is used for commercial and domestic purposes. The inhabitants live chiefly by pasturage, rearing camels, horses and sheep. The other industries are sugar refining, ivory carving, gold, iron, brass and copper work, stone masonry, tanning, weaving, dyeing and carpentry.

BIKANER STATE. In the 15th century the territory which later formed the princely state of Bikaner, of which the modern district is part, was occupied by Rajput clans, partly Jats, partly Muslims. About 1465 Bika, a Rathore Rajput, sixth son of Rao Jodha, chief of Marwar, started out to conquer the country. By taking advantage of the rivalries of the clans he succeeded; in 1485 he built the small fort at the capital which still bears his name, and in 1488 began building the city itself. He died in 1504, and his successors gradually extended their possessions. In the reign of Akbar the chiefs of Bikaner were loyal adherents of the Delhi empire, and in 1570 Akbar married a daughter of Kalyan Singh. Kalyan's son Rai Singh, who succeeded him in 1571, was one of Akbar's most distinguished generals and the first raja of Bikaner; his daughter married Selim, afterward the emperor Jahangir. Wars between Bikaner and Jodhpur raged intermittently through the 18th century. On May 9, 1818, a treaty was concluded, and order was restored in the country by British troops.

During the 19th century unrest continued, centring on the rebellious behaviour of the thakurs, or subsidiary chiefs, and leading up to the permanent location at Bikaner of a British political agent in 1883, when the state was made subject to the Rajputana agency. Its military force included the famous camel corps, which distinguished itself in China in 1900 and in the middle east during World War I.

After India became independent, Bikaner was incorporated into the enlarged state of Rajasthan (March 30, 1949) and divided into the three districts of Bikaner, Churu and Ganganagar.

(S. M. T. R.)

BIKINI, the sitè of several atomic bomb tests conducted by the United States, an atoll in the Ralik chain of the Marshall Islands in the Pacific ocean, 6° N. of the equator, about 190 mi. E. of the island of Eniwetok and 225 mi. N.W. of Kwajalein. The atoll is a coral ring of more than 20 islands, of which the principal one is Bikini Island. It was known before World War II as the Escholtz atoll.

The tests of July 1946, called Operation "Crossroads," the first peacetime atomic weapons tests, were held to obtain precise data on the effects of atomic explosions, particularly on naval vessels. The targets included battleships, aircraft carriers, submarines and landing craft, anchored in careful arrangement in the 25-mi.-long lagoon so that the effects of the explosions could be measured at different distances. Thousands of simple and complex instruments, along with pigs, goats and rats, were placed on the ships and on the islands. About 42,000 men participated in the tests. Operation "Crossroads" was observed by representatives of news organizations of the United States and of the 11 countries represented on the United Nations Atomic Energy commission.

The first test of Operation "Crossroads" took place on July 1, 1946. An atomic bomb, with an energy yield equal to approximately 20,000 tons of TNT, was dropped from an airplane and exploded in the air over the target ships. Five of the 90 target ships

were sunk. The second test, held on July 25, was the first underwater atomic explosion. A bomb of the same energy yield was suspended beneath a ship anchored in the lagoon and was there exploded. Nine ships were sunk. Radioactive water thrown into the air from the underwater burst drenched the other ships and contaminated them. While damage to the hulls from this explosion was about as predicted, the level of radioactivity was higher than expected and was a major problem on the target ships for several weeks after the test.

Much valuable information was obtained from Operation "Crossroads," particularly as to the effects of atomic explosions upon naval ships and other military equipment. Important data on radioactivity were obtained from remotely controlled, unmanned airplanes and boats which were moved into the centre of the explosion area as soon as possible after the detonation.

When Bikini atoll was chosen for the tests the 166 natives on the island, of mixed Melanesian-Polynesian stock, were moved with their belongings to Rongerik Island, 130 mi. E. of Bikini. The natives were later moved to the larger Ujelang Island, 290 mi. S.E. of Bikini and 400 mi. W. of Rongerik.

On March 1, 1954, a very powerful nuclear device was exploded at the Bikini atoll. Radioactive fallout seriously contaminated an area about 240 mi. long and 40 mi. wide. An unexpected shift of wind occurred after the detonation with the result that 31 U.S. test personnel and 236 Marshall Islanders on Rongelap and Utirik islands were exposed to radiation from the fallout. They were immediately evacuated. Some suffered skin burns and temporary loss of hair. The last of the evacuated natives were returned to their home island in June 1957. A series of medical examinations extending over a period of years after the explosion showed that there was no reason to expect permanent aftereffects upon the health of these people. Not until mid-March of 1954 was it realized that the 23-man crew of the Japanese fishing vessel "Fukuryu Maru" (Fortunate Dragon) had been in the area about 85 mi. from the explosion. All of the crew were hospitalized for a year from the effects of radiation, and one died as a result of complications.

In 1956 Bikini was the site of the test of the first hydrogen bomb dropped by a U.S. airplane.

Bikini has been administered by the United States since 1947 as part of the United States Trust Territory of Pacific Islands under United Nations trusteeship. Since 1953 the atoll has been part of the Eniwetok proving ground, site for further testing of United States atomic weapons. *See* also ATOMIC ENERGY.

(F. DU.)

BIKOL (BICOL), the fifth largest cultural-linguistic group in the Philippines, whose homeland is commonly considered all of "Bicolandia," a region comprising six provinces in the Bicol peninsula and neighbouring islands of southeast Luzon. Field studies indicate that the Bikol-speaking area is actually more restricted: its core is Albay, Camarines Sur and Catanduanes, while Masbate and southern Sorsogon are more closely allied to adjacent Bisayan areas, and northern Camarines Norte, to the Tagalog. Despite regional dialect differences, inhabitants of the Bikol area, who numbered about 1,560,000 in 1957, recognize as standard the speech of Naga (about 66,000), Bicolandia's political, ecclesiastical, educational and commercial centre since the founding of the city (1571) by the Spaniards.

The Bikol area is largely agricultural and rural. Of the gainfully employed 70% are in primary industries, especially rice, coconut and abaca farming (35% of farm operators are tenants); 20% engage in tertiary industries such as commerce and government service. The concentrations of population at Naga, Legaspi City, Daet, Sorsogon and Tabaco should not obscure the fact that 80% of the people live in barrios (about 840) and that only 15 out of 74 towns have more than 5,000 residents (1948 census). The average density is about 4 persons per hectare, or 1,000 persons per square mile, of cultivated land. The area is nearly self-sufficient in basic food production.

In 1948 only 31% of the people spoke the national language (basically Tagalog), while 39% spoke English; there is not, however, any manifest antipathy to Tagalog. The literacy rate is 57%, slightly lower than the Philippine average. The percentage of Roman Catholics (98) is one of the highest area averages in the country (the national figure is 83%).

Kinship is reckoned bilaterally. Marriage is monogamous and most often locally endogamous. Social mobility in the basically two-class system is achieved mainly through education and preferential job placement arranged especially by kinsmen and upper class ritual sponsors.

See Frank Lynch, *Social Class in a Bikol Town* (1959). (F. LY.)

BILASPUR (KAHLUR), a town and headquarters of a district of the same name in Himachal Pradesh, India. The town (pop. [1961] 7,424) was the capital of the former independent state of Bilaspur in the Himalayan foothills. In 1814 the state was overrun by the Gurkhas and its raja, a Chandel Rajput, expelled; he was reinstated by the British in 1815 and from 1846 the state was controlled through the Lahore residency. From 1948 Bilaspur was administered through a chief commissioner; on July 1, 1954, it became a district of Himachal Pradesh.

BILASPUR DISTRICT (pop. [1961] 158,806; area 448 sq.mi.) is crossed by the valley of the Sutlej and its geography and agriculture resemble those of other parts of Himachal Pradesh (*q.v.*). Upon the completion of the Bhakra dam (*see* PUNJAB [India]) in the neighbouring district of Hoshiarpur in the Punjab, all land under 2,000 ft. above sea level will be submerged; this will include the town of Bilaspur and virtually all agricultural land in the district. A decision on the future boundaries of this and neighbouring districts had not been reached by the early 1960s. (B. AL.)

BILASPUR is a town and district in Madhya Pradesh, India. In 1961 the town, which is the headquarters of the district, had a population of 86,706. It is a railway junction, and has three commerce and arts colleges connected with the Saugar university (1959). Until captured by the Marathas in the 18th century, the town was the capital of a Gond kingdom. Its size and importance have grown with the development of the railways.

BILASPUR DISTRICT (area 7,615 sq.mi.; pop. [1961] 2,021,793) occupies the northern portion of the upper Mahanadi basin. It forms part of the Chhattisgarh plain, being closed in on the north, west and east by ranges of hills. On the north the Maikal hills, rising to 3,370 ft. at Amarakantak, contain the sources of the Narmada (*q.v.*) and Son (Sone; *q.v.*) rivers. It is well cultivated and closely dotted with villages surrounded by mango groves. The Mahanadi, with its tributaries Seonath and Hasdeo, drains the area. Flowing north from Raipur this river later turns east forming the southern boundary of Bilaspur district for 25 mi. The rainfall averages about 50 in. annually, and forests chiefly of sal occupy about one-third of the district. These are the home of various tribal groups including the Gond and Baiga. Rice occupies about three-fourths of the remaining cultivated land, and the district produces about 15% of India's lac and contains most of the lac factories of Madhya Pradesh. Coal is found around Korba, where it is worked in small quantities and where the installation of an electric generating plant was begun in 1959. *Tasar* (tussah) silk is produced by a small-scale cottage industry. (S. S. BH.)

BILBAO, a city and port in northern Spain, is 12 km. (7.5 mi.) from the Cantabrian coast at the point where the Nervión or Ibaizábal river becomes tidal and navigable and is encircled by mountains. Bilbao is the capital of Biscay, one of the three provinces forming the Spanish Basque country. Pop. (1960 est.) 267,293, the second largest urban concentration in Spain. Bilbao has an old and a modern part. The old town is on the right bank of the river, its nucleus being formed by the Siete Calles (Seven Streets), a series of parallel streets leading to the river bank. These formed the limits of Bilbao during the middle ages until, breaking through the walls which enclosed the Siete Calles, the town expanded into the surrounding areas, but without crossing to the other side of the river. In this part of the town are the oldest churches: those of Santiago (a cathedral since the creation of the bishopric of Bilbao in 1949) in Gothic style with a fine 15th-century cloister; San Antonio; Santos Juanes; and San Nicolás. There are also many houses bearing coats of arms, and the Plaza Nueva, constructed during the early part of the 19th century, deserves mention.

On the left bank of the river the township of Abando, once independent, was annexed to Bilbao in 1890. This was the period of the town's great expansion to the other side of the river where the new Bilbao grew up with wide streets and spacious plazas. The Gran Vía cuts across the new part of the town and is the commercial and banking centre of Bilbao, and the site of the enormous offices of the provincial government. The town hall is on the river bank. There is the largest of the town's parks, within which is the Fine Arts museum, specializing in modern Spanish paintings. Another museum is that of ethnography and archaeology, devoted to the history and folklore of the Basques. The six bridges which link old and new Bilbao were all reconstructed after the civil war. Bilbao has had since 1955 a faculty of economic sciences attached to the University of Valladolid. There is also a technical school for industrial engineers, and a school of mining and mercantile studies, together with a centre for training lawyers and economists run by the Jesuits in the Deusto district. Three other towns, Begoña, Deusto and Luchana-Erandio, close to Bilbao, were annexed to the municipality after Abando in 1890 to form, with it, the modern extension of the town. Begoña possesses the most venerated Marian shrine in Biscay—that of the Virgin of Begoña. Deusto and Luchana-Erandio are both industrial areas.

Bilbao is one of the most important ports in Spain, with an average daily entry of 15 ships. The Santurce breakwater and the countermole at Las Arenas-Algorta, engineered by Evaristo Churraca, ended the danger to shipping from the Portugalete bar. The Abra or exterior port can handle big transatlantic ships. Economically Bilbao is important as one of the biggest concentrations in Spain of heavy and chemical industries and as a financial centre. Metallurgical industries predominate; the metal industry was founded in the 19th century, based on the rich iron ore deposits to the west of Bilbao. The export of ore to England and the commercial activities of the inhabitants provided the basis for its modern industry. The chemical industry became prominent in the second half of the 20th century. Other aspects of the economic life of the port include the fishing industry, conducted at the neighbouring ports of Santurce, Bermeo and Ondarroa, and shipbuilding and repairing.

History.—Bilbao originated as a settlement of seafaring people on the banks of the estuary, from which they began the export of iron ore and the products of their ironworks. The latter were very well known, and Shakespeare refers to the excellent swords of "bilbos" made from the steel of Bilbao. The sea captains and mariners of Bilbao were famous in the middle ages as the best freight carriers of the Cantabrian coast. To this settlement of mariners and ironworkers Diego López de Haro, lord of Biscay, in 1300 gave the charter and privilege of self-government in an independent municipality. Other Castilian monarchs awarded privileges and franchises to Bilbao. Burgos used Bilbao for the export of wool from the interior of Castile to Flanders. In 1511 Bilbao obtained the right, like Burgos, to possess a consulate or commercial tribunal which could issue laws in the form of ordinances. The last of these, issued in 1737, formed the basis of the first Spanish commercial code in 1829. In the 18th century Bilbao enjoyed great prosperity, dealing intensively with the produce of the American colonies. In the 19th century the town was involved in the Carlist wars and was besieged four times—1835, 1836 (twice) and 1874. These struggles produced a strong communal spirit which, after 1874, directed itself toward industrialization.

(M. B. F.)

BILBERRY (Blaeberry or Whortleberry), known botanically as *Vaccinium myrtillus* (heath family, Ericaceae), a low-growing shrub, found in open woods, copses and on heaths, chiefly in hilly districts of Great Britain and northern continental Europe and Asia. The stiff stems, from 6 in. to 18 in. high, bear small ovate leaves with serrated margins, and small, globose, rosy flowers tinged with green.

The berries, ripening in July and August, are dark blue, with a waxy bloom, and are about one-third of an inch in diameter; they are used for tarts, preserves, etc., and are a principal food of the grouse. The berries are borne singly in contrast to those of the cultivated blueberries of the United States (different species of the same genus), which are borne in racemes, hence being much more productive than the bilberry. *V. myrtillus* is frost susceptible, in part at least self-sterile and has been hybridized with *V. prunus idaeus*.

Cowberry, mountain cranberry, partridgeberry, foxberry or whimberry is a circumpolar allied species, *V. vitis-idaea*, growing in similar situations. It is distinguished by its evergreen leaves and red acid edible berry. *See* Blueberry; Cranberry; Vaccinium.

(G. M. D.)

BILDERDIJK, WILLEM (1756–1831), Dutch poet whose ideas had great influence, not only on poetry, but on the intellectual and social life of the Netherlands. Born in Amsterdam, Sept. 7, 1756, of a strongly Calvinist and monarchist family, he had a crippled foot and spent a precocious childhood among books. After studying law at Leiden, he practised as an advocate at The Hague until 1795, when, as an Orangeist, he was forced into exile by his refusal to take the oath of allegiance to the republic established by the French. He went to Germany and then to London, where he met Katherina Schweickhardt, herself a poet, whom he married in 1802 after divorcing his first wife. In 1806 he returned to the Netherlands. After the restoration he hoped in vain for a professorship at Amsterdam. In his later years he was a disappointed man, feeling that he had been overlooked. He died at Haarlem, Dec. 18, 1831.

Bilderdijk was a romantic personality. To him emotion was the mainspring of life and poetry a divine gift, the poet being a prophet. His romantic arrogance was sometimes in conflict with the humility enjoined by his Christian belief. He regarded himself as a descendant of the Knight of the Swan and in his attitude to marriage considered himself above the civil law. As a historian he had a romantic conception of the monarchy and rejected the idea of government by the people. His contempt for the oligarchs who ruled the Netherlands during the golden age of the Dutch republic is expressed in his *Geschiedenis des Vaderlands* (1832–51). His extreme view of the importance of authority enables him in his unfinished epic, *De ondergang der eerste wareld* (ed. 1820), to condemn forcibly the rebels against God. His own submission to God is expressed in his famous poem *Gebed* (1796).

Bilderdijk began to write at the period of the Gothic revival and his early poems and letters showed the influence of ballads and romances and of the songs of Ossian. Later he attacked the poetic rules of the neoclassicists, while honouring Homer as the greatest poet of all time. In his didactic poem *De Kunst der Poezy* (1809) he recalled his fight for poetical freedom. Other didactic poems are *De ziekte der geleerden* (1807) and *De Dieren* (1817). Like many Romantics, Bilderdijk was haunted by the idea of his own death and wrote about it in several poems, notably *Afscheid* (1811) and *Uitvaart* (1827).

See R. A. Kollewijn, *Bilderdijk, zijn leven en werken* (1891); H. Bavinck, *Bilderdijk als denker en dichter* (1906). (J. C. B. C.)

BILECIK, a town of northwestern Turkey and centre of an *il* (province) of the same name, lies on the upper slopes of the valley of the Karasu, a tributary of the Sakarya (Sangarius). Pop. (1960) 7,535. Taken by the Turks at the close of the 13th century, the town was important as the first capital of the Ottomans. Some 14th-century mosques still exist. Bilecik became prosperous and was a centre of the silk industry up to the time of the Turkish war of independence (1920–22) when it was heavily damaged and lost its economic importance. The town consists of the remains of the old town on a hill and the modern quarter around the railway station on the Ankara-Istanbul line. It is also linked by road with Ankara through Eskisehir (53 mi.) and with Istanbul.

The *il* includes some rough country lying between the Marmara and central Anatolia regions. It had a population in 1960 of 145,747 and an area of 1,829 sq.mi. Stock raising is the principal occupation; crops include cereals and, in the valleys, vines, cotton and vegetables. (N. Tu.; S. Er.; E. Tu.)

BILE DUCTS, the tubes by way of which bile is carried from the liver to the gall bladder and from both liver and gall bladder to the duodenum. *See* Gall Bladder; Gall Bladder, Biliary Tract and Liver, Diseases of; Liver.

BILFINGER (Bielfinger or Bülfinger), **GEORG BERNHARD** (1693–1750), German philosopher, mathematician and statesman, whose importance lies not in his mathematical, astronomical, physical, botanical and theological investigations but in his position in "Leibniz-Wolffian philosophy." He was born on Jan. 23, 1693, at Canstatt in Württemberg, Ger. Bilfinger studied at Tübingen university and then under Christian Wolff at Halle, where he concentrated on mathematics. Returning to Tübingen, he was appointed court preacher and, in 1721, extraordinary professor of philosophy there; and in 1724 he was appointed ordinary professor of moral philosophy and mathematics. In 1725 he went to St. Petersburg as professor of logic, metaphysics and moral philosophy, becoming at the same time a member of the St. Petersburg academy.

The Paris academy awarded Bilfinger the highest prize for his dissertation *De causa gravitatis* (1728). In 1731 he returned again to Tübingen as professor of theology. He was granted a pension (because of his book on fortifications) and became superintendent of the theological seminary (1731); privy councilor (1735) and president of the consistory (1737). He died at Stuttgart on Feb. 18, 1750.

Bilfinger was one of the most accomplished men and one of the acutest intellects of his time. Although he was the pupil, friend and defender of Wolff, it was rather on Leibniz that he concentrated his attention, whether critically or favourably. Two points of difference from Leibniz are especially important. Whereas Leibniz had held each monad to be at once body and spirit, Bilfinger insisted on the heterogeneity of material and spiritual substances, with the consequence that he could not regard all monads as percipient: some of them rather were endowed only with moving force (the more realistic character of his philosophy is shown by his temporary attempt completely to replace the *vis percipiendi* of the Leibnizian monads by *vis motrix*). His other major deviation from Leibniz was on the question of pre-established harmony, which he held to apply not to the whole universe but only to the relation between soul and body and to consist in a correspondence of inner states in the percipient and in the nonpercipient monads.

Bilfinger's major publications were: *Dissertatio de harmonia praestabilita* (1721); *De triplici rerum cognitione* (1722); *De axiomatibus philosophicis* (1722); *De harmonia animae et corporis humani maxime praestabilita* (1723); *De origine et permissione mali* (1724); and his most important work, *Dilucidationes philosophicae de Deo, anima humana, mundo et generalibus rerum affectionibus* (1725 and later editions). (M. O. G.)

BILHARZIASIS: *see* Schistosomiasis.

BILINGUALISM. The learning of one language is a universal trait of human behaviour; the mastery of two or more languages—bilingualism or multilingualism—is a special skill. Bilingualism and multilingualism are relative terms since individuals vary greatly in types and degrees of language proficiency.

The Bilingual Individual.—What makes a person bilingual? It is usually regular contact with people who speak another language. Such contact may come from intermarriage, immigration, trade, colonization, religious conversion, military conquest, travel or residence in a foreign or bilingual community. A person may also become bilingual through foreign language study; in many countries the mastery of a second language is an indispensable part of education.

Bilinguals differ in the skill with which they use their languages and in the environments in which they use them, in the age and order in which they learn them and in their ability to switch from one language to another and keep both languages apart. Between the language of the home and the language of the school there is often a difference which may force a bilingual, for the rest of his life, to pray in one language and count in another. Bilinguals generally experience periods in which one language becomes more prominent than the other. When this process continues in one direction it may eliminate one of the languages—even the mother tongue.

The Bilingual Community.—When a community which speaks one language lives in contact with a community which speaks another, a proportion of one or both communities becomes bilingual. The linguistic frontiers between the communities may correspond with geographical or political borders or may exist within the same national boundary, as is the case in such officially bilingual countries as Belgium where Flemish (a Germanic language) is spoken in the north, an area which corresponds to that occupied by the Germanic invaders—the Franks in the 4th century A.D. and the Germani in the 1st century; whereas Walloon French (a Romance language of Latin origin) is used south of a line which marked the limits of the Roman occupation.

There are also historical explanations for the distribution of French and English in Canada, of Czech and Slovak in Czechoslovakia, of Swiss German, French, Italian and Romansh in Switzerland, of Afrikaans and English in the Union of South Africa, and of Serbian, Croatian and Slovenian in Yugoslavia, all of which countries are officially bilingual.

Because a country is officially bilingual does not necessarily mean its entire population is. Bilingualism in certain unilingual countries may be more widespread, although perhaps less permanent. In the United States more than 20,000,000 persons reported in 1940 that the language of their childhood was not English. These were mostly immigrants or descendants of immigrants who, on arrival in the new country, joined others of the same language and formed isolated communities. In many cases the demands of mass communication in an industrial society put an end to their isolation, forcing them into bilingualism. If their children receive their schooling in the language of the surrounding majority, the whole community eventually becomes bilingual and the immigrant language, no longer needed in communication, is neglected by succeeding generations and may eventually die out. In such cases bilingualism functions historically as a transition from one general language to another.

The history of many countries shows a number of these bilingual transitions. France had the Gallo-Roman period (Celtic and Latin) at the rise of the Roman empire, and the Frankish period (Germanic and Latin) at its downfall. England too, after the Viking and Norman conquests, experienced periods of bilingualism. After 1066 it was in the interest of the conquered Anglo-Saxons to learn the French of their Norman masters who, when cut off from France after about 1250, started taking an interest in the language of the English-speaking majority. By about 1300 many children of Norman ancestry had English as their first language, and a large section of the nobility had become bilingual. These bilinguals often mixed their English speech with French words, such as *court, saint, music* and *beauty*, which now form a large and essential part of the English vocabulary.

Effects on Language.—Nearly every sentence of English shows traces of the languages which the English people have had to learn in the past—French, Norse and Latin. In fact, any prolonged period of bilingualism leaves some trace on the vocabulary, grammar or phonemes of one or both languages.

Vocabulary is the most readily transferred, especially the names of objects for which there is no exact equivalent in the borrowing language. When they appear, the borrowed words are not necessarily placed in the same part of speech from which they came; nouns may turn out as verbs, and verbs as nouns. Thus the old French verb *demorer*, "to delay," appears as an English noun, *demurrer*; and the English participles *dancing, parking* and *smoking* appear as nouns in French. Borrowed words must be made to fit the grammar of the language borrowing them. English nouns must appear as either masculine or feminine if used in French. The English word *gang* was put in the masculine in France—but in French Canada it appeared as feminine. Verbs must be placed into a certain conjugation in French; since most new verbs go into the first conjugation (*-er*), English *stop* became the French verb *stopper*. Borrowed words must also be made to fit into the sound patterns of the language. So the English word *store* appears differently in some of the immigrant languages of the United States: *storo* (Italian), *estor* (Spanish), *sztór* (Hungarian), *stoori* (Finnish), *štóras* (Lithuanian), *sztor* (Polish), *štor* (Serbian), *stur* (Syrian).

Bilingual contact may change the meaning of a native word. Acadian French has extended the meaning of *introduire* ("to insert," "to admit") to include that of the English *introduce* (someone to somebody), in French *présenter*.

Certain grammatical features may also be attributed to the bilingual influence of neighbouring languages. Suomi Finnish and Estonian were almost identical in the 13th century. In modern times their differing passive forms are due to the fact that Estonian was influenced by German and Suomi by Swedish.

Finally bilinguals may transfer sounds and phonemic patterns from one language to another. The replacement of [f] by [h] in Spanish came from the speech of the Iberians and of bilingual Basques, who became prominent when their country was a centre of Spanish culture and resistance during that period when most of Spain was under Moorish occupation. The fronting of Latin [u] to French [y] as when Latin *murus* becomes French *mur*, has been attributed to the pronunciation habits of the bilingual Gauls. Such features of languages long extinct may thus survive in the modern languages.

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BILL. The term "bill" has three distinct meanings: (1) a written, originally sealed, document; (2) a long-handled cutting weapon (*see* HALBERT); and (3) the beak of a bird (*q.v.*).

In the sense of a document the word is used in various connections in law and commerce.

In legislation a bill is a draft of a proposed statute which is introduced in the legislature and which if passed and signed by the executive becomes an act (*see* LEGISLATION; STATUTE LAW).

A bill in chancery or bill in equity is a written statement of the plaintiff's case and a prayer for relief upon which a suit in equity is based. In Great Britain it was abolished by the Judicature acts of 1873 and 1875 and its place was taken by a writ and statement of claim. In the United States it was abolished in federal practice with the merger of the forms of action under the Federal Rules of Civil Procedure (1938) and disappeared even earlier in most of the states. Where the distinction between law and equity remains, however, the term is still in use. (*See* PRACTICE AND PROCEDURE.)

A bill of indictment is a written accusation against a prisoner, charging him with an offence, and presented to the grand jury (*see* INDICTMENT; CRIMINAL LAW: *Criminal Procedure;* JURY).

A bill of exceptions is a statement in writing of objections to the rulings of a judge who, at a civil trial, has mistaken the law, either in directing the jury, or in refusing or admitting evidence or otherwise. In England the bill of exceptions was abolished by the Judicature act of 1875, and a "motion for a new trial" substituted. In the United States rule 46 of the Federal Rules of Civil Procedure makes exceptions unnecessary by making it sufficient for a party to object to the judge's ruling by stating the ground of his objection at the time the ruling is made. In some of the practice acts of the states the filing of a bill of exceptions is still a requirement for appeal, though there is a marked trend toward liberalizing the requirement.

A bill of health is a document given to the master of a ship by the consul or other proper authority of the port from which he clears, describing the sanitary state of the place. A bill of health may be either "clean," "suspected" or "touched," or "foul." A "clean" bill imports that at the time the ship sails no disease of an infectious or contagious kind is known to exist; a "suspected" or "touched" bill that no such disease has yet appeared but that there is reason to fear it; a "foul" bill that such a disease actually exists at the time of the ship's departure. Bills of health are necessary where the destination of the ship is a country whose laws require the production of such a bill before the ship is allowed into port and where, in default of such production, the ship is subjected to quarantine.

A bill of particulars is a supplementary statement in writing requested by a party to an action when pleadings filed by the opposing party are so lacking in details that they fail to inform him of the nature of the case he must meet. In U.S. federal practice the bill of particulars was abolished by a 1948 amendment to the Federal Rules of Civil Procedure, which substituted a motion for a more definite statement. In the states bills of particulars are still used, even in some of the more recent codes of civil procedure. The bill of particulars is retained in the Federal Rules of Criminal Procedure, but they are rarely granted.

See also ATTAINDER; BILL OF EXCHANGE; BILL OF LADING; BILL OF RIGHTS; BILL OF SALE; COMMERCIAL PAPER. (J. D. Ls.)

BILLAUD-VARENNE, JEAN NICOLAS (1756–1819), French revolutionary politician notorious for his extreme republican views and a leading figure during the Reign of Terror, was born at La Rochelle on April 23, 1756, the son of a barrister. He studied at the Collège d'Harcourt in Paris and then at Poitiers, qualifying as a lawyer in 1778. Returning to La Rochelle, he staged a comedy that he had written, but without success. After teaching at the Oratorian college at Juilly, he was called to the Paris bar. In 1786 he married Angélique Doye, the illegitimate daughter of a farmer-general. It was at this period that he became acquainted with Georges Danton and wrote several works anonymously, notably *Le Despotisme des ministres de France . . .*, 3 vol. (1789), which was seized by the police.

Billaud-Varenne was from 1790 one of the most ardent of the "patriot" orators at the Jacobin club (*see* FRANCE: *History;* FRENCH REVOLUTION). After the flight of Louis XVI he called for the establishment of a republican government, putting his views forward in two pamphlets, *L'Acéphocratie* and *Éléments du républicanisme*. Secretary to the Jacobin club and then vice-president, he was elected to the commune of Aug. 10, 1792, and became assistant to the public prosecutor. As deputy for Paris in the convention, he denounced the generals N. Luckner and A. R. Dillon and later, during the trial of Louis XVI, added new charges against the king, voting for death "within 24 hours." On June 2, 1793, he proposed the decree of accusation against the Girondins. On June 9, at the Jacobin club, he demanded the punishment of defeated military leaders, the detention of wives of *émigrés*, the formation of a revolutionary army and the levying of a forced loan on the rich. In August he went as representative *"en mission"* to the northern *départements* and caused numerous political suspects to be arrested at Dunkerque and at Calais. A member of the war committee, he was secretary of the Paris assembly, then its president (Sept. 5), and called for the trial of the ministers E. Clavière and C. F. Lebrun and of the queen, Marie Antoinette. On Sept. 6, together with his friend J. Collot d'Herbois, he became a member of the Committee of Public Safety. In Feb. 1794, he went to Saint-Malo to supervise an expedition against Jersey.

Billaud-Varenne helped bring about the fall of Danton, of the Hébertistes and of Robespierre. He had originally supported Robespierre, but on 8–9 Thermidor (July 26–27, 1794) he delivered a vehement attack on him. Subsequently he was himself attacked by the Thermidorians and prosecuted as a terrorist. Despite his courageous defense, he was found guilty and deported to French Guiana. After the *coup d'état* of 18 Brumaire (Nov. 9, 1799) he refused the pardon offered by Napoleon Bonaparte and remained at Cayenne, developing his small estate. He made his way to New York in 1816, but later sought refuge in Haiti, dying near Port-au-Prince on June 13, 1819. The *Mémoires* that he wrote in his youth appeared in the periodical *La Révolution française* in 1888. Further *Mémoires* written in Cayenne were published by A. Bégis (1893). (Ma. Bo.)

BILL BROKER, a broker who deals in bills of exchange. Bill brokers specialize in bill discounting, and their operations are very varied in character. They may deal for themselves as principals or for others as agents. When they sell bills of exchange on commission, they are purely brokers; this function has become almost obsolete. When they buy bills of exchange to sell again at a profit they become, in effect, bill merchants. *See* BILL OF EXCHANGE; DISCOUNT; DISCOUNT HOUSE; MONEY MARKET.

BILLIARDS, an indoor game of skill, played with various numbers of balls and a long stick, called a cue, on a rectangular

table that may or may not have pockets.

In the modern form of this game, the playing surface is covered with a tight-fitting green cloth and surrounded by rubber-cushioned rails.

The various games of billiards include pocket billiards, more commonly called pool, played with 15 coloured number balls and a white cue ball on a table with 6 pockets; snooker, played with 21 balls and a cue ball on a table with 6 small pockets; carom, or cannon, also known as French billiards, played with 3 balls on a table with no pockets; and English billiards played with 3 balls on a table with 6 pockets. In addition there are numerous varieties of each game, particularly of French billiards and pool.

This article is divided into the following sections and subdivisions:

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I. ORIGINS

Various fanciful accounts have been given of the origins of billiards. Some of these, indeed, trace it back to classical times, quoting as evidence some such witness as the Scythian philosopher Anacharsis, who mentions a game analogous to billiards that he watched while traveling in Greece. Other dubious, if not bizarre, resemblances allegedly exist in games played by the Greeks and Romans. In this connection, Jacques Bonhomme, writing in 1885, remarked with irony that had billiards been a Roman diversion Horace would assuredly have devoted an ode to it and Nero would have been diverted from his famed incendiary exploit by so agreeable a pastime.

Many countries, among them England, China, France, Italy and Spain, have been credited with inventing the game; but, in fact, nothing is known about the origin of billiards. It may only be inferred that it developed from a variety of games in which propelling a ball was a main feature.

Billiards has been related to such games as *shovilla bourde* or shuffleboard, popular in the time of Henry VIII. Later known as paille-maille or pell-mell, this was an early ball-and-mallet game played on the ground with hoops and is believed to be the origin of croquet.

The confusion in the nomenclature of games in general during the different stages of their development is another obstacle to accurate research. Etymology lends little aid, as the derivation of the word billiards from the French *billard*, or *billart* (O.F.), meaning a curved stick (cue), not to mention the diminutive *bille* (stick), is uncertain. "For myself," writes Maurice Vignaux in *Le Billard* (1895), "*bille*, meaning a ball, is the key, and billard comes from it. And *bille*, whence comes this? From *pila* (Latin) says one authority; and *pila* is derived from. . . ." After this he confesses to being lost in an etymological fog.

Research is on surer ground in the 16th and 17th centuries, however, for allusions to the game are then plentiful and there are old prints, both English and French, to provide corroborative evidence. Poets and dramatists such as Edmund Spenser in *Mother Hubberds Tale* (1591); George Chapman (1598), who makes a character say, "Go, Aspasia, send for some ladies who could play with you at chess, at billiards and at other games"; Shakespeare (1623), with his anachronistic "Let us to billiards . . ." from *Antony and Cleopatra;* Ben Jonson (1637); and, later, Samuel Johnson in his *Dictionary* (1755) all cite the game.

John Evelyn (1620–1706) had the habit of noting the billiard tables in country mansions he visited. Historical allusions such as the complaint of Mary, queen of Scots, in 1576, during her captivity, that her billiard table had been taken away, also occur. An interesting reference is to be found in Francis Quarles's *Emblems* (1635), in which one of the engravings depicts two angels playing a table game with balls, hoops and maces (the earlier form of the cue), the table having pockets.

In some of the old prints a number of obstacles are seen on the tables, such as hoops, ivory pegs or "kings," forts, batteries, etc., the player's ball being required either to circumvent such objects without knocking them over or to pass through them, as in the case of hoops. Objects such as forts gave a military flavour to the game, and one such contest bore the name of the "fortification game." A French print shows the duchess of Burgundy playing billiards with a mace in 1694. The first description of billiards in English is to be found in Charles Cotton's *Compleat Gamester* (1674).

Originally only two balls were used in French billiards, and it was thus imported into England. Holes, suggested probably by the iron hoop formerly used, were cut in the bed of the table, first in the centre, then at the corners and sides, into which the balls were driven. About 1775, the third ball, called a "carom," was introduced by the French. This third ball was soon brought over to England. The various terms applied to this phase of the game all mean one thing—striking both balls with a cue ball.

Billiards first became distinctly fashionable in the latter half of the 17th century during the reign of Louis XIV, who was advised by his physician to play the game every day after dinner. The king played with the duke de Villerdi and Monsieur de Chamillard. Although both were far better players than the king, they were too loyal to win often.

Billiards, shorn of its early crudities and more or less in its modern form, dates back to about 1800. In the first English book devoted to billiards, written by E. White in 1807, the same features are discernible as obtain today.

II. DEVELOPMENT OF IMPLEMENTS

1. Cue.—The cue was superseding the mace by the late 1700s, and about 1760 cues with perfectly flat ends or points came into vogue. Twenty-five years later, a cue cut obliquely at the small end or slightly rounded at one side was produced to enable the player to hit a ball below the centre. Still another change was adopted toward the end of the century when the point of the cue was beveled all around, thus making a still broader surface. The leather cue tip invented by Mingaud did not follow until 1806 when the advantage of using chalk was discovered. The billiard cue finally became, in its most popular form, a tapered wood butt made of an assortment of various-density woods, joined onto a carefully tapered maple shaft. This improvement made it possible to develop cues in various weights and balances. The end of the maple shaft that strikes the ball was fitted with various reinforcements such as fibre, buckhorn, ivory or plastic to which was cemented the leather cue tip, greatly improving durability and uniformity. Aluminum-alloy cues were introduced in the 20th century.

2. Chalk.—Players at one time roughened the cue tip by rubbing it against a whitewashed ceiling. Later, prepared chalk came into use. With a chalked cue tip the player is able to strike the cue ball off centre, imparting "side," as it is called in Great Britain, or "English," as it is called in the U.S. Before the introduction of

chalk it had been possible to strike the ball only at or near its centre.

3. Balls.—The most widely used billiard balls until the late 19th century were of elephant-tusk ivory. In 1868, John Hyatt, in his search for a better billiard ball, discovered that a mixture of nitrocellulose, camphor and a small amount of alcohol when properly prepared becomes thermoplastic, *i.e.*, soft when heated, and can be molded in a hydraulic press. After cooling at ordinary atmospheric pressure it becomes hard and strong. This discovery heralded the beginning not only of the composition billiard ball but of the plastic industry. In the 1920s a new type of plastic billiard ball was produced from cast phenolic resin which proved to be much more durable, offered a greater brilliance of colours and gradually replaced the ivory ball. Ivory was credited by the outstanding players with being more sensitive, but composition balls were found to be unaffected by weather and did not become imperfect and untrue as did those made from ivory.

4. Cloth.—Early in the history of billiards, billiard cloth was developed into a finely woven green woolen cloth with a lustrous nap. Because of its appearance, billiard cloth has also been referred to as a felt instead of a woven fabric.

5. Rubber Cushions.—John Thurston founded a billiard equipment firm in 1799 and, in 1835, he introduced an india rubber cushion to replace the old stuffed cushion built up with layers of list (strips of cloth) or felt. This rubber cushion was a great improvement, but cold weather affected its resilience. In 1842, however, the process of vulcanization was discovered, and in 1845 Thurston obtained letters patent for applying the process to billiard cushions.

6. Slate Beds.—A year after his introduction of the rubber cushion Thurston, in collaboration with Edwin (called Jonathan) Kentfield, introduced the slate bed (beds had formerly been made of wood). The slate sections were secured with brass dowels to form a perfectly flat surface. Accurate running of the balls was thereby greatly facilitated. Thurston also effected improvements in cues, balls, lighting and other equipment.

III. BILLIARD TERMS

Although some terms used in printed accounts of and books of instructions for billiards and expressions used by players are in common usage, there is considerable variation among certain terms as used in Great Britain and in the United States.

The following are terms having specific meaning when used in reference to billiards.

All-Round Cannon.—*See* Carom below.

Bank Shot.—A bank shot results when a player banks the cue ball or, in pocket billiards, drives an object ball against a cushion and then into a pocket.

Carom (*U.S.*) *or Cannon* (*British*).—A score or a count, the result of the cue ball bounding from one object ball to another. A carom may be made by the cue ball glancing off one object ball directly into the second (or third) object, or by glancing off first object ball into a cushion and then into the second (or third) object. A cannon in which two, three or more cushions are struck in between contact with the first and the second object balls is called an all-round cannon.

Centre Spot.—A spot in the exact centre of the table on which a cue ball or an object ball may be spotted in games requiring the use of that spot.

Cushion.—The felt-covered resilient ridge which borders the inside of the rails on carom and pocket billiard tables. Also, a cushion can be an "object" in billiard games such as cushion caroms and three-cushion, which require cushion contact for legal scores.

Dead Ball.—One that stops or rolls "dead" upon contact with an object. A cue ball, for example, which stops upon contacting an object ball is called a dead ball.

English (*U.S.*) *or Side* (*British*).—Stroking influence a player is able to put on a cue ball to control the action of that ball either after or before it hits an object ball. Sometimes referred to as spin. English "left" is applied by striking the cue on the left side; "right" on the right side. Experts warn against the use of excessive English.

Frozen (*U.S.*) *or Touching* (*British*).—A term used to describe balls that are touching each other on the table. When object balls are frozen they remain in play as they are. When the cue ball is frozen to an object ball, player proceeds according to the rules of the game being played. A ball may also be frozen to a cushion; that is, resting against the cushion.

Full-Ball.—Aim taken through the cue ball centre at the centre of the object ball.

Half-Ball stroke.—A basic stroke for aiming, aim being taken through the centre of the cue ball at the edge of the object ball.

Hazard.—A basic scoring stroke, called winning or losing depending on whether the object or cue ball is pocketed.

Inning (*U.S.*) *or Break* (*British*).—A turn at the table. The duration of a player's stay at the table from the time he legally makes the first shot of a turn until he ends his turn, either by missing, fouling, scoring the maximum number of balls allowed or terminating the game.

Long Loser.—A losing hazard off a ball centrally situated into a top pocket.

Long On-Off (*U.S.*) *or Long In-Off* (*British*).—A loser off a ball situated between the pyramid spot and the top cushion.

Massé.—Extreme application of English downward on a cue ball, applied by elevating the cue. Half massé is applied by elevating cue to about a 45° angle. Full massé is applied by elevating the cue to an angle up to 90°. Massé is used to drive the cue ball around or through one object ball to strike another, or to apply extreme follow or draw when position of balls prevents the ordinary application of English.

Miscue.—Faulty stroke; faulty contact of the tip of the cue against the cue ball. A stroke in which the cue tip slips from the cue ball, because of a defective tip, improper chalking or, in many instances, excessive English.

Miss.—Playing the cue ball without contacting another ball.

Rack (*U.S.*) *or Triangle* (*British*).—The wooden triangle used to pyramid balls on the foot spot for the opening shot in pocket billiard games. Also, the grouping of balls on the foot spot in pyramid formation after the wooden triangle has been removed. For example, the player, on the opening shot, drives the cue ball into the rack (racked balls).

Run-Through.—Making the cue ball follow through the path of the object ball, either for a cannon or a losing hazard.

Safety.—A defensive measure used by a player when confronted with a difficult shot. He sacrifices an opportunity to score, as well as his turn at the table, in an attempt to leave a difficult shot for his opponent.

Scratch (*U.S.*) *or Coup* (*British*).—Running the cue ball into a pocket.

Screw.—Making the cue ball recoil at less than the natural (half-ball) angle off an object ball, by low striking; *i.e.*, at about one-quarter of its height.

Side.—*See* English.

Stun and Stab.—Causing the cue ball to remain stationary or nearby (after contact with the object ball) by hitting the cue ball dead centre, if the object ball is close, or below the centre to give it reverse rotation until it reaches the object ball, if the object ball is some distance away. These two strokes, very similar, are almost the mainstay of break making in modern snooker.

IV. VARIOUS GAMES OF BILLIARDS

The game of billiards, while using the same basic equipment of the table, the cue and the balls, has developed into several important variations.

A. English Billiards

1. Table.—English billiards is played on an eight-legged table of oak or mahogany, 12 ft. by 6 ft. 1⅛ in. in the area marked by the outside of the cloth part of the rail and measuring 2 ft. 9½ in. to 2 ft. 10½ in. from the floor to the top of the wooden rail which surrounds the playing surface. The slate bed is covered with billiard cloth which has a strong nap running from the balk end (bottom) of the table to the spot end (top). The table has six net pockets, one at each corner and one at the centre of each of the long sides. The slate bed is cut away at each pocket to permit the balls to enter. Rubber cushions, also covered by the cloth and formed to project not more than 2 in. and not less than 1⅛ in. from the rail over the playing surface, make up a continuous boundary around the table. The edge of the projecting cushion surface slopes inward toward the base so that the balls come into contact with a thin strip of rubber only. The overhang of the cushion on the modern standard table is two inches. Consequently, the actual playing surface measures 11 ft. 8 in. by 5 ft. 9½ in.

The pocket openings must conform to the official templates by which tables are tested. The corner pockets measure 3½ in. across the actual spot where the fall of the slate begins, but manufacturers, when providing a standard table, cut the rubber to conform with the templates and not specifically to measurement.

2. Balls.—Billiard balls must be of equal weight (the average weight is about five ounces) and size (diameter of $2\frac{1}{16}$ to $2\frac{3}{32}$ in.). Two are white, one of them being distinguished by one or two black spots, at opposite points on its circumference. The third ball is red. The marked white ball is called "spot," the other "plain." One player plays with spot and the other with plain, and the ball

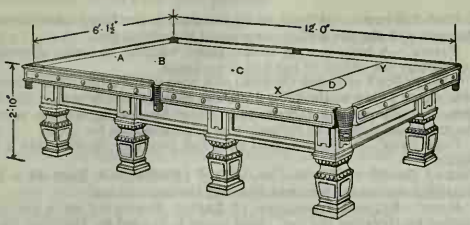


FIG. 1.—STANDARD SIZE ENGLISH BILLIARD TABLE, WITH MEASUREMENTS SHOWN

The length and breadth of the English billiard table are as shown: the height may vary between 2 ft. 9½ in. and 2 ft. 10½ in. A shows the billiard spot, on the centre line, 12¾ in. from the top cushion; C, the centre spot, in the centre of the table; and B the pyramid spot, midway between the face of the top cushion and C; XY is the balk line, and D the D

being played with—that is, struck with the cue—is called the cue ball. The average length of the cue is 4 ft. 10 in., and it must not measure less than 3 ft. Favourite weights are from 16 to 18 oz.

3. Markings.—A line drawn 29 in. from the face of the bottom cushion and parallel to it is called the balk line. The area between it and the bottom cushion is termed the balk. A semicircle, 11½ in. in radius, with its centre at the middle of the balk line, is marked in the balk; this is called the D. The cue ball, retrieved from a pocket when the player has scored a losing hazard, must then be played from within or on the lines of the D (called "playing from hand") and must be sent out of, not into, balk.

Four spots (marked by silk wafers) are placed as follows: the billiard spot, 12¾ in. from the face of the top cushion and equidistant from the two long cushions; the centre spot, halfway between the centre pockets; the pyramid spot, halfway between the centre spot and the face of the top cushion; and the spot on the middle of the balk line. Thus all four spots are on an imaginary central longitudinal line. There is also a similar spot at each end of the D line; these are used only in snooker. To play up the table is to play with the cue pointing toward the billiard spot; to play down the table is to play with the cue pointing toward balk.

4. Scoring.—The player's ball is called the cue ball; the other two balls, the opponent's ball and the red, are called object balls. There are three ways of scoring: (1) the losing hazard or loser, a stroke in which the striker's ball is pocketed after contact with another ball; (2) the winning hazard or "pot," a stroke in which a ball other than the striker's ball is pocketed after contact with another ball; and (3) the cannon, a stroke in which the striker's ball contacts the two other balls successively or simultaneously. Two points are scored for a losing hazard off white, three for one off red. Three points are scored for a winning hazard if red is potted; two if white. Two points are scored for a cannon. If the red ball is potted twice in succession, it is spotted on the centre spot; if once, on the billiard spot.

The object of the game is to score more points than one's opponent. The skill involved consists of leaving one scoring stroke after another. A player continues at the table for as long as he succeeds in scoring.

A succession of scoring strokes is called a break. Losing hazards are limited to 25 in succession, or 15 in professional and amateur championships. Consecutive cannons are limited to 35, after which the player must make either a losing or a winning hazard, a direct cannon in conjunction with a hazard or an indirect cannon (one in which the striker's ball, after contact with the first object ball, strikes a cushion or cushions before making contact with the second object ball).

B. Carom or French Billiards

The game of carom billiards is played on a pocketless table that is twice as long as it is wide. Balls and cues are the same as those used in English billiards.

For the layout of the table, which has no pockets, *see* fig. 2.

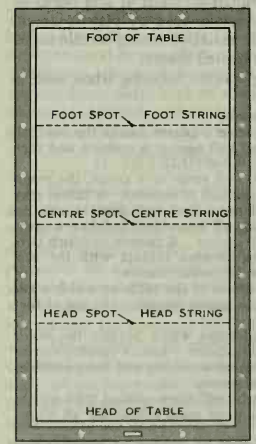
1. Three-Cushion Billiards.—All carom games, including three-cushion, are begun by lagging to determine rotation of play. If more than two players are involved, rotation of play may be determined by drawing lots. When the game is played by two players (or sides) each player (or side) selects a cue ball (spot or plain) which is placed on the table within the head string. The red ball, meanwhile, has been spotted on the foot spot. The players, one lagging to the left of the red ball and the other to the right, stroke the white balls to the foot cushion and return. The player whose ball comes to rest nearest the headrail wins the lag. The winner has his choice of cue balls and also has the right to shoot first or assign the break shot to his opponent.

A count is made in three-cushion billiards (1) when the cue ball strikes an object ball and then strikes three or more cushions before striking the second object ball; (2) when the cue ball strikes three or more cushions before contacting the two object balls; (3) when the cue ball strikes a cushion, then the first object ball, then two or more cushions and then the second object ball; (4) when the cue ball strikes two or more cushions, then the first object ball, then one or more cushions and finally the second object ball.

The number of cushions struck does not mean three different ones; a count may be executed on one cushion with the required number of contacts by the cue ball. Each three-cushion carom counts one point.

2. Straight-Rail Billiards.—In straight rail, the player must drive his cue ball against the two object balls to score a carom for one point. He may contact both object balls at the same time or alternately. Cushion contact is not required, although a count is legal if one or more cushions are contacted. When object balls are crotched (standing in the corner of the table no more than 4½ in. out from either rail), three counts are allowed. The player then must drive an object ball out of the crotch. Failure to do so is a miss and ends the inning.

3. 14.2 Balk-Line Game.—To mark the table properly for 14-in. balk line, lines are drawn on a 5-by-10-ft. table from each of the first diamond sights on the end and side rails to the corresponding diamond sight on the opposite end or side rail. The large centre space on the table is not a balk space. The object balls are in balk whenever both have stopped within any one of the balk spaces. The referee then calls "in," and when one or both object balls are driven out of balk space the referee calls "out." A ball on the line is in balk. It is on the line only when its centre or point of contact with the table touches this line. When two object balls are on the same line the striker has the option of determining in which balk they are to be called, and must govern his play accordingly. But two shots are allowed when two object balls are within the same balk space; hence the name 14.2 balk line. At least one of the object balls must be driven out of balk on one of these shots. Points are scored for caroms as in straight-rail billiards.



BY COURTESY OF BILLIARD CONGRESS OF AMERICA

FIG. 2.—PLAN OF THE CAROM TABLE

4. 18.2 Balk-Line Game.—The game of 18.2 balk line is played on a 5-by-10-ft. table with the balk lines drawn 18 in. from the edges of the cushions. In addition there are eight anchor spaces, each seven inches square, to which the same rules apply as to the larger balks. Two each are located on the headrail and on the footrail and two each on the side rails with the 18-in. balk lines across the ends of the table as centres.

The general rules of 18.2 balk line are similar to those of the 14.2 balk-line game.

C. Pocket Games

Pocket games are played on billiard tables that are twice as long as they are wide and have six pockets, or openings—one in each corner of the table and one in the centre of each side rail. Most of these tables also contain ball returns to bring the balls from the individual pockets back to a rack at the end of the table, and sometimes are known as subway or gully tables.

1. Snooker.—In snooker, 22 balls, 2⅛ in. in diameter, are used: 1 white ball (the cue ball), 15 red balls and 6 numbered "colours," which are (with their values): black, 7 points; pink, 6; blue, 5; brown, 4; green, 3; yellow, 2. The scheme of play is as follows: a player must first pot a red ball (one point), then try to pot any colour he may choose, scoring the value of the potted colour. Then, alternately potting reds and colours, he reaches the stage at which only the six colours remain, as each red, when potted, remains in the pocket, while the colours, when potted (as long as any reds remain on the table), are placed on their respective spots. Finally, in potting the six colours the player must follow this order: yellow, green, brown, blue, pink and black. When this last is pocketed the game ends. This pocketing of the 21 object balls constitutes a frame. A match consists of a selected number of frames.

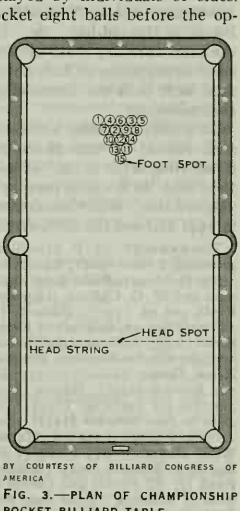
Snooker is related to the games of pyramids and pool, out of which it developed. The word snooker refers to a position in which a player cannot hit the ball which the rules require him to play at, because of obstruction by another ball or balls. He is therefore said to be snookered, and loses his turn. If he is snookered after a foul by his opponent, he may nominate to play at another ball. This is termed a free (nominated) ball.

2. Pocket Billiards or Pool.—The game of pocket billiards, commonly called pool and by far the most popular of all the billiard games, has a large number of players, particularly amateurs, in the United States. A white cue ball and 15 coloured number balls are used, with the balls from 1 to 8 in solid colours and from 9 to 15 striped. The fundamental object of pocket billiards is to pocket the object balls.

Basic pocket billiards can be played by individuals or sides. One individual or side seeks to pocket eight balls before the opponents do. On all strokes following the opening shot, the player must call the ball or balls he intends to pocket, although he is not compelled to call the pocket.

Rotation, a popular game with the average amateur player, requires that the 15 object balls be pocketed in numerical order. The individual or side first scoring 61 points wins the game.

There are a number of other games of pocket billiards. Among those recognized with formal rules by the Billiard Congress of America are 15-ball pocket billiards, eight ball, line-up, bottle pocket billiards, cowboy, cribbage, forty-one, golf, Mr. and Mrs., one and nine balls, baseball, and poker pocket billiards. The Billiards Association and Control council of Great Britain has established rules for English billiards, snooker, volunteer snooker, pyramids, pool and Russian pool.



BY COURTESY OF BILLIARD CONGRESS OF AMERICA

FIG. 3.—PLAN OF CHAMPIONSHIP POCKET BILLIARD TABLE

3. Continuous Pocket Billiards.—This is the championship game requiring the highest degree of skill. Players lag for break, and the winner may decide whether he or his opponent shall begin to play. For the first shot, all 15 object balls are racked in a triangle, the apex of which is on the foot spot of the table. The starting player on the opening stroke must drive two or more object balls to a cushion or cause an object ball to drop into a pocket.

This is a call-shot game and the player must designate the ball he intends to pocket and the pocket in which he intends to score. If the player misses the shot called, it is an error and ends his inning. In the 14.1 pocket game, a player may pocket 14 balls successively. The 15th ball remains on the table as a break ball. The referee then racks the 14 pocketed balls, leaving the space at the foot spot vacant in the triangle. The player then continues, making the ball outside the triangle the break ball. The procedure is to pocket the break ball in a designated pocket and carom the cue ball from the break ball into the triangle of racked balls. The player can continue pocketing the 14 balls, having them reracked and breaking until he misses, scratches or scores 150 points.

4. "Bumpers."—After World War II, the game of billiards developed into a game widely played in the home. During the early 1950s a variation of the game known as "bumpers," or bumper pool, was introduced. In this game, cushioned pegs or bumpers were added to the playing surface, necessitating an emphasis on bank shots in order to dodge these obstructions. Following the wide acceptance and the reintroduction of this age-old game, it became an increasingly popular family game played in the home, mostly on small tables measuring 4 by 8 ft., 3½ by 7 ft. and 3 by 6 ft. Tables for the home were made both with bumpers and in the standard pocket-billiard style.

V. CHAMPIONSHIP PLAY AND PLAYERS

The various games of billiards have been dominated for long periods of time by relatively few players. Since many billiard games were played primarily within certain geographical or national areas, international competition has not been as common as in many other sports. Record keeping in international competition dates back only to the late 19th century.

A. England and Europe

The important games in England and European countries have been English billiards, snooker and French billiards.

1. English Billiards.—Jonathan Kentfield was the first outstanding player (highest break, 196). In 1849, however, John Roberts, Sr., father of the great John Roberts, challenged Kentfield who, doubting his chances at his advanced age, refused to settle the issue by a match, and so Roberts became champion. He, in his turn, defeated all rivals until, in 1870, in the first official championship, he was beaten by a younger player, W. Cook. John Roberts, Jr., dominated the game in every respect for the rest of the 19th century. He brought to the game a pot-and-cannon sequence around the billiard spot as an antidote to the spot stroke (potting the red ball into the top pockets) which threatened to make billiards a one-stroke game.

A new era of great players began about 1900; namely, C. Dawson, H. W. Stevenson, M. Inman, T. Reece, C. Falkiner, Willie Smith, C. Harverson and E. Diggle. Willie Smith in 1928 compiled what is considered the finest "all-round" break (meaning without concentrated top-of-the-table play and without sequences of close, or nursery cannons; that is, cannons played with the three balls bunched together against a cushion and taken gradually along it), 2,743.

Red-ball play (in-offs) gradually became the dominating form after the turn of the century and in 1911 George Gray, an Australian, using this stroke extensively, again threatened the equilibrium of the game. Gray, who came to England for the 1910–11 season, made twenty-three 1,000 breaks by consecutive losing hazards off the red ball.

The period 1925–35 constituted the third golden era of professional play. Its dominating figure was the Australian Walter Lindrum. To his credit stands the record break (apart from one-stroke repetition breaks) 4,137, and many other records. The other outstanding players of this time were Joe Davis, Tom Newman and Clark McConachy. This period was notable for the reign of the nursery cannon.

Expert execution of certain strokes has, throughout billiards history, menaced the popularity of the game as a public attraction. Mastery at such play as the spot stroke (with the red ball spotted

on the billiard spot), the losing hazard and the nursery cannon, by its growing effect of monotony, became a real threat to public interest.

The rule making it compulsory to transfer the red ball to the centre spot, after being potted twice from the billiard spot, rendered the spot stroke impossible. The push stroke, in which the cue ball was shoved rather than struck with the cue, was prohibited and made a foul in 1898.

To counteract excess red-ball play, the Billiards association in 1926 limited consecutive losing hazards to 25 (later, 15 for championship play), while in 1932 the baleful effect of the nursery cannon was further countered by a rule which made it obligatory for a player to cross the balk line after every 150 points. In 1935 the rule was altered so that a player had to send the cue ball across the line during the last 20 points of each 200 points in a break. The balk-line proposals, welcomed at first by the professionals, were afterward strongly criticized, but, as nothing better could be suggested, the rule remained.

Amateur billiards after the early days of the amateur championships (1888–1900) improved remarkably, and in 1953, another Australian, Robert Marshall set a new amateur break record of 702.

2. Governing Bodies.—The first body formed to govern the game was the Billiards association (1885). Prior to this the professionals had been a law unto themselves. But, as the large amateur element in the game was still unrepresented, matters were far from satisfactory. Eventually, in 1908, the Billiards Control club was founded by an influential body of amateurs. Dual control, however, inevitably led to friction, rivalry and confusion. The two bodies amalgamated in 1919 and the Billiards Association and Control council became the sole governing body for the sport.

The Billiards Association and Control council promotes the interests of all concerned in the game, frames conditions and rules, and publishes the *Billiard Player*, which first appeared in 1920.

Billiards is extensively played by amateurs throughout Great Britain and the commonwealth; and, though snooker has the greater professional following, the older game has countless adherents.

3. Snooker.—About 1930 the billiard professional Joe Davis began to study snooker seriously, as he foresaw its potentialities as public entertainment. By studying the technique of the game, enriching it by development of positional play and increasing the control of potting, he was instrumental in bringing it new popularity. In doing this his billiard knowledge helped enormously, since he brought cue-ball control into the game by incorporating billiards craft, building the profitable red-and-black sequence (the most remunerative scoring force in snooker and basis of 100-point breaks) on the famous top-of-the-table sequence in billiards. In 1955 he achieved the "perfect" score of 147, so clearing the table. By 1960 Davis had compiled more than 650 "century" breaks at snooker.

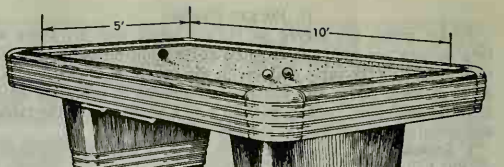
Other professional snooker players included Horace Lindrum, Fred Davis, Walter Donaldson, Albert Brown, Alec Brown, John Pulman, Jack Rea, John Barrie, S. Smith, K. Kennerley and R. Williams.

Amateur snooker advanced greatly after the 1930s and several amateurs play a type of game which differs only in degree and not in kind from professional standards.

B. North and South America

Two basic types of billiards are played extensively in North and South America: carom billiards and pocket billiards, or pool. They can be easily distinguished by the tables on which they are played; pool tables have pockets at each corner and in the centre of the long rails (sides) and carom tables have no pockets. The rectangular tables for both forms must be twice as long as they are wide; 4-by-8-ft., 4½-by-9-ft. and 5-by-10-ft. sizes are authorized.

Tom Foley, an authority on billiards, dated the real start of the game in the United States from the year 1859. The first national match was played at Detroit, Mich., on April 12 of that year between John Secreiter of Detroit and Michael Phelan of New York city. The game was for 2,000 points caroms, with 4 balls, the 4th ball being light red, on a 6-by-12-ft., 6-pocket table. Pushing and crotching were allowed. Phelan won this first championship event. Beginning in 1869 the championship was played for at 4-ball caroms on a 5½-by-11-ft. pocket table for 1,200 points. Pushing and crotching were barred; single caroms counted 3 and double caroms 6. In 1876 the rules were changed to what was called straight-rail play, three balls on a 5-by-10-ft. carom table. William Sexton was champion in 1876–78 and following him was Jacob Schaefer, Sr., known as the "Wizard," who was champion in the years 1879–82. In 1883 the 5-by-10-ft. table was in use with an 8-in. balk line to prevent nursing. Schaefer won in 1883–84. In 1885 the balk line was widened from 8 to 14 in. and Schaefer won again in the years 1886–90.



BY COURTESY OF THE BRUNSWICK-BALKE-COLLENDER CO.

FIG. 4.—CHAMPIONSHIP CAROM BILLIARD TABLE WITH DIMENSIONS
The playing surface of championship tables in the U.S. is 5 ft. wide by 10 ft. long. Other tables are 4½ ft. by 9 ft. and 4 ft. by 8 ft.

As the long reign of Jake Schaefer, Sr., drew to a close, Willie Hoppe won the 18.1 balk-line world title from Maurice Vignaux of France in 1906. Hoppe dominated in world carom title play from that time until his retirement from championship competition in 1952.

Charles C. Peterson was known as the missionary of billiards, in addition to being the world's fancy-shot champion and for years holder of the red-ball title. Peterson did more, perhaps, to sell the game than any other billiard figure in the U.S. He made personal appearances at U.S. universities and became closely associated with both the Intercollegiate and Boys Clubs of America championships.

In pocket billiards, Alfredo DeOro and Thomas Hueston held sway around the turn of the 20th century, with Ralph Greenleaf dominating in the 1920s. In the following two decades, world titles were held, for the most part, by Erwin Rudolph, Andrew Ponzi and James Caras. Willie Mosconi won the first of his many world titles in 1941 and was the titleholder in the 1950s.

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BILLINGHAM, an urban district (1923) in the Sedgefield parliamentary division of Durham, Eng., on the river Tees about 4 mi. N.W. of Middlesborough by road. Pop. (1961) 32,130. Billingham, still a hamlet after World War I, was founded in the 9th century; St. Cuthbert's church has a 10th-century tower. The building of the Port Clarence railway, begun in 1833, was the first step in the growth of Billingham. By 1837 an iron foundry and a glass works had been established at Haverton Hill

(part of the present urban district). The production of salt followed and by the early 1960s more than 70% of the adult population was working for Imperial Chemical Industries Ltd. During World War I the North Tees power station, a small garden village, and a shipyard at Haverton Hill with a model village for the workers were built. A bypass over the railway for the Stockton-Sunderland road was constructed during World War II.

BILLINGS, JOHN SHAW (1839–1913), U.S. surgeon and librarian, who achieved excellence in no fewer than six different fields—military and public hygiene, hospital construction and sanitary engineering, vital and medical statistics, medical bibliography and history, medical education, and the practice of medicine—was born on April 12, 1839, in Switzerland county, Ind. He graduated from Miami university, Oxford, O., in 1857 and from the Medical College of Ohio, Cincinnati, in 1860. During the Civil War he served as a surgeon in the field and in hospitals until 1864, when he entered the surgeon general's office in Washington, D.C. In this position he had charge of the army medical museum and library, and he developed the latter into one of the largest medical libraries in the world, for which he prepared an unusually valuable index catalogue.

Billings was one of the organizers of the Carnegie Institution of Washington and played an important part in the reorganization of the U.S. marine hospital service in 1870. In 1896, upon the consolidation of the Astor and Lennox libraries and the Tilden trust into the New York Public library, he became its first director. He died in New York city on March 11, 1913.

See F. H. Garrison, *John Shaw Billings* (1915).

BILLINGS, JOSH (pseudonym of HENRY WHEELER SHAW) (1818–1885), U.S. "cracker barrel" philosopher-humorist who reached an extensive audience during several decades following the Civil War through his newspaper pieces, books and comic platform lectures. His unique contributions to American humour were his rustic aphorisms ("The biggest phool in this world haint bin born yet; thare iz plenty ov time yet.") and his droll delineations of animal life. He was born at Lanesboro, Mass., April 21, 1818, was expelled from Hamilton college, Clinton, N.Y., in his second year and drifted about in the west and midwest for some years before settling in Poughkeepsie, N.Y., in 1858 as an auctioneer and land dealer. He began writing comparatively late in life, with slight success until he attempted the misspelled humour then in vogue. An "Essa on the Muel" made him suddenly famous, and after joining Street and Smith's *New York Weekly* in 1867 as an "exclusive" contributor he grew into a national idol. His books, apart from a 10-year series of burlesque almanacs (1870–79), were hasty agglomerations of his newspaper writings; the most comprehensive was *Everybody's Friend* (1874). For a time he contributed to the *Century Magazine* as "Uncle Esek," but his best work was done for Street and Smith. He died in Monterey, Calif., Oct. 14, 1885.

Shaw wrote almost no narratives and resembled only externally such contemporaries as Artemus Ward and Petroleum V. Nasby. His humour was intended as timeless, not topical.

See Joseph J. Jones, "Josh Billings: Some Yankee Notions on Humor," University of Texas, *Studies in English*, pp. 148–161 (1943); Jennette R. Tandy, *Crackerbox Philosophers in American Humor and Satire* (1925). (J. J. Js.)

BILLINGS, a city in south central Montana, U.S., on the Yellowstone river, 3,119 ft. above sea level; the seat of Yellowstone county. It is an important junction for air, rail and highway travel. Named for Frederick Billings, it was established in 1882 by the Northern Pacific railway upon its arrival in the Yellowstone valley.

Billings is the metropolis of the "midland empire," a productive region of Montana and Wyoming, with expanses of range land and broad irrigated river valleys. Sugar beets, wheat, wool and livestock are leading products of the area and there are large crude oil refineries in the vicinity. Other manufactures of importance include meat packing and flour milling. Billings' manufacturing plants employ more than one-tenth of the state's manufacturing employees and its wholesale houses distribute to a large area. Its livestock commission sales and facilities are among the largest in the west. The Midland Empire fair is held there each year.

The Eastern Montana College of Education (founded in 1927), Rocky Mountain college (one branch of which was founded in 1883) and the first orthopedic hospital established in the northwest are situated there.

Billings is a gateway to the Beartooth division of the Custer national forest, one of the picturesque regions in the northwest, in which is Grasshopper glacier with millions of grasshoppers embedded in its ice. There are many vacation resorts in and near the forest including numerous dude ranches.

The population (1960) was 52,851. (For comparative population figures *see* table in MONTANA: *Population.*) The Billings standard metropolitan statistical area (Yellowstone county) had a population of 79,016 in 1960. (M. G. BU.)

BILLINGSGATE, the most ancient city market of London, Eng., takes its name from Belin's gate, where royal tolls were collected on various goods as early as A.D. 980. It has been primarily a fish market since the 16th century. Statutorily established in 1699, the existing market on the north bank of the Thames was completed in 1876 and is now the clearinghouse for the British fishing industry. Between 400 and 650 tons of every variety of fish are dealt with between 5 and 10 A.M. daily. Most of the fish is carried by land, and by the early 1960s there was little renewal of the water-borne supplies that ceased before World War II. The word "Billingsgate" was proverbially the coarse vituperation of scolding fish women. (H. G. B.)

BILLITON (BELITUNG), an island of the Republic of Indonesia lying between Bangka and Borneo. The Gaspar strait separates it from Bangka and the Karimata strait from Borneo. With Bangka it forms a division of South Sumatra province. Roughly square in shape, Billiton is 55 mi. long and 43 mi. wide, and its area is 1,866 sq.mi. Included with it are 135 small adjacent islands with an area of 95 sq.mi., which are separated by narrow and mostly unnavigable channels. In physical structure and products it resembles Bangka (*q.v.*). Its coasts are sandy and marshy. In the centre a height of 1,673 ft. is reached (Mt. Tanjem) but most of the land lies less than 130 ft. above sea level. Groups of hills of granite or sedimentary formation rise from the flat or slightly undulating country; in the central parts there are treeless plains covered with alang-alang grass. The geological formation is Devonian and granitic, with laterites. The average annual rainfall is 114.5 in., with an average of 192 rainy days; the average temperature is 77°. Billiton has extensive tin deposits and forms the southern limit of the occurrence of this metal. Most of the tin ore is taken from alluvial deposits but there is some lode mining.

The estimated population of Billiton in 1956 was 92,444, including many foreign Asians, largely Chinese. The aborigines (Muslims with some pagan beliefs) are akin to those of Bangka, resembling the Bataks of Sumatra; on the coast there are *Orang laut*, or sea gypsies. The coast is a difficult one, beset with rocks and coral banks, but one river, the Cheruchup, is 1,300 to 1,600 ft. wide at its mouth (barred by a sandbank), and is tidal for seven miles and navigable as far as Cheruchup village. The best harbour is that of Tandjungpandan (pop. [1958] 42,765), the capital of Billiton, on the west coast. Billiton was formerly under the sultan of Palembang, Sumatra, by whom it was ceded to the British in 1812. The British recognized the Dutch claim in 1824. Tin was discovered on the island in 1851. At first it was exploited by a private Dutch company, later with participation of the government in the profits. The ore was formerly sent to the Straits Settlements for smelting, but after 1936 it went to a new tin smelter in Holland. The Indonesian government has taken over the enterprise, but the actual mining is done largely by Chinese. (J. O. M. B.)

BILLITONITE: *see* TEKTITE.

BILL OF EXCHANGE, a form of negotiable instrument, defined by s. 3 of the English Bills of Exchange act, 1882, as an unconditional order in writing "addressed by one person to another, signed by the person giving it, requiring the person to whom it is addressed to pay on demand or at a fixed or deter-

minable future time a sum certain in money to or to the order of a specified person, or to bearer." Sec. 126 of the U.S. Negotiable Instruments law is identical, except that there a bill may only be made payable "to order or to bearer." The bill was in general use in English foreign commerce by the end of the 16th century. Since then it has also been widely used in domestic or so-called inland transactions. *See* CHECK; COMMERCIAL PAPER; INTERNATIONAL PAYMENTS. (R. T. S.)

BILL OF LADING, a document executed by a carrier, such as a railroad or shipping line, acknowledging receipt of goods and embodying the agreement to transport the goods to a stated destination. Bills of lading are closely related to warehouse receipts, which contain an agreement for storage rather than carriage. Both may be "negotiable" when they provide that the goods are to be delivered not to a fixed individual but (typically) to the "order" of a stated person; this person may endorse the document and deliver it to another, who will then be entitled to receive the goods. The rights of purchasers of such negotiable documents of title have been strongly protected by legislation. Such a negotiable document of title, which calls for the delivery of goods, must be distinguished from negotiable commercial paper (such as notes and bills of exchange) which calls for the payment of money. *See* AFFREIGHTMENT; COMMERCIAL PAPER; SALE OF GOODS.

(J. O. Ho.)

BILL OF RIGHTS, ENGLISH, is the name by which the "Act declaring the Rights and Liberties of the Subject and Setleing the Succession of the Crowne," 1689 (1 Will. and Mar., Sess. 2, c. 2), is commonly known. It incorporated the provisions of the Declaration of Right, acceptance of which had been the condition upon which the throne held to have been vacated by James II was offered to the prince and princess of Orange, afterward William III and Mary II. The act began by reciting the unconstitutional proceedings of James II and its main stipulations were intended to prevent their repetition by future monarchs. They are as follows:

(1) That the pretended Power of Suspending of Laws or the Execution of Laws by Regall Authoritie without Consent of Parlyament is illegall; (2) That the pretended Power of Dispensing with Laws or the Execution of Laws by Regall Authoritie as it hath beene assumed and exercised of late is illegall; (3) That the Commission for erecting the late Court of Commissioners for Ecclesiasticall Causes and all other Commissions and Courts of like nature are Illegall and Pernicious; (4) That levying Money for or to the Use of the Crowne by pretence of Prerogative without Grant of Parlyament for longer time or in other manner than the same is or shall be granted is Illegall; (5) That it is the Right of the Subjects to petition the King and all Commitments and Prosecutions for such Petitioning are Illegal; (6) That the raising or keeping a standing Army within the Kingdom in time of Peace unlesse it be with Consent of Parlyament is against Law; (7) That the Subjects which are Protestants may have Arms for their Defence suitable to their Conditions and as allowed by Law; (8) That Election of Members of Parlyament ought to be free; (9) That the Freedome of Speech and Debates or Proceedings in Parlyament ought not to be impeached or questioned in any Court or Place out of Parlyament; (10) That excessive Baile ought not to be required nor excessive Fines imposed nor cruell and unusuall Punishments inflicted; (11) That Jurors ought to be duely impanelled and returned and Jurors which passe upon Men in Trialls for High Treason ought to be Freeholders; (12) That all Grants and Promises of Fines and Forfeitures of particular persons before Conviction are illegall and void; (13) And that for Redresse of all Grievances and for the amending strengthening and preserving of the Lawes Parlyaments ought to be held frequently.

The act settled the succession upon the heirs of Mary, the heirs of Princess Anne (Mary's sister), and then upon the heirs of William, provided that they were Protestants. It prescribed the new oaths of allegiance and supremacy, and limited the practice of dispensation by *non obstante, i.e.,* by royal licence, to those statutes which explicitly allowed it.

The Bill of Rights, together with the Toleration act, 1689, the Triennial act, 1694 (later modified by the Septennial act, 1716), and the Act of Settlement, 1701, constituted the renovated foundation upon which government rested after the revolution of 1688. It sought to introduce no new principle into English government, but purported to declare the existing law, repairing some of the omissions and removing some of the obscurities which were thought to have been exploited by James II. Though possibly less important for deciding the future character of monarchy in the 18th century than the other parts of the revolution settlement, and certainly less so than the conditions which now made annual parliaments essential, the Bill of Rights has, nevertheless, considerable significance. In addition to clarifying the existing law, particularly, perhaps, in respect of the suspending and dispensing powers of the crown, it clearly placed the monarchy upon a parliamentary and conditional basis; and though leaving the monarch the chief executive officer of government, still endowed with considerable power, it provided the foundation for that freedom from arbitrary government of which most 18th-century Englishmen were so proud and many foreigners were so envious. In theory, and before long in practice, it served to remove from the monarchy both the aura of divine right and something of the actuality of an obscure but extensive prerogative. It was not, however, intended to make monarchical government impossible, but only conditional. The positive role of monarchy was taken for granted rather than forgotten, but the question of the proper relation between king, ministers and parliament, so often agitated during the 17th century, was left undefined and unsolved by the Bill of Rights, to be answered as need arose in terms of the changing forces and interests of politicians and politics. In practice, the limitations imposed upon the monarchy eventually necessitated considerable changes in its functions. At the time, however, the ambiguities of the constitution and the uncertain distribution of political power provided no insuperable obstacles to the working of "mixed" regal and parliamentary government in a period when the conventions of constitutional behaviour were more monarchical and the demands upon government for swift and continuous legislative action were less persistent than they subsequently became.

(Ro. R.)

BILL OF RIGHTS, UNITED STATES, a term applied to the first ten amendments to the U.S. constitution, which were adopted in 1791. The term is also applied, by extension, to a larger composite of about 40 mutually reinforcing guarantees of individual rights and of limitations on federal and state governments found in the body of the constitution of 1787 and in various later amendments, as well as in the first ten amendments. The Bill of Rights derives from Magna Carta, the English Bill of Rights, the colonial struggle against king and parliament and a gradually broadening concept of equality among the American people. Virginia's 1776 Declaration of Rights, drafted chiefly by George Mason, was a notable forerunner. Besides being axioms of government, these guarantees have binding legal force. Acts of congress in conflict with them may be voided by the United States supreme court when the question of their constitutionality arises in appropriate litigation.

The constitution in its main body forbids suspension of the writ of habeas corpus except in cases of rebellion or invasion (i, 9), prohibits state or federal bills of attainder and ex post facto laws (i, 9, 10), requires that all crimes against the United States be tried by jury in the state where committed (iii, 2), limits the definition, trial and punishment of treason (iii, 3), prohibits titles of nobility (i, 9) and religious tests for officeholding (vi), guarantees a republican form of government in every state (iv, 4) and assures each citizen the privileges and immunities of the citizens of the several states (iv, 2). Popular dissatisfaction with these limited guarantees, expressed in the state conventions called to ratify the constitution, led to demands and promises which the first congress of the United States satisfied by submitting to the states 12 amendments drafted by James Madison. Ten were ratified. Individual states being subject to their own bills of rights, these amendments were limited to restraining the federal government. The senate refused to submit Madison's house-approved amendment protecting religious liberty, freedom of the press and trial by jury against violation by the states.

Under the first amendment, congress can make no law respecting an establishment of religion or prohibiting its free exercise, or abridging freedom of speech or press or the right to assemble and petition for redress of grievances. Hostility to standing armies found expression in a guarantee of the people's right to bear arms and in limitation of the quartering of soldiers in private houses.

The fourth amendment secures the people against unreasonable searches and seizures and forbids the issuance of warrants except upon probable cause, directed against specific persons and places. The fifth requires grand jury indictment in prosecutions for major crimes and prohibits double jeopardy for a single offense. It provides that no person shall be compelled to testify against himself, forbids the taking of life, liberty or property without due process of law or the taking of private property for public use without just compensation.

By the sixth amendment, an accused person is to have a speedy public trial by jury, to be informed of the nature of the accusation, to be confronted with the witnesses against him and to have the assistance of counsel. Excessive bail or fines and cruel or unusual punishment are forbidden. The ninth amendment protects unenumerated residual rights of the people, and by the tenth, powers not delegated to the United States are reserved to the states or the people.

After the Civil War, slavery was abolished by the 13th amendment (1865). The 14th (1868) declares that all persons born or naturalized in the United States and subject to its jurisdiction are citizens thereof. It forbids the states to abridge the privileges or immunities of citizens of the United States, or to deprive any person of life, liberty or property without due process of law, or to deny to any person the equal protection of the laws. Other amendments provide that voting rights cannot be denied or abridged because of race (15th, 1870), sex (19th, 1920) or failure to pay any poll tax or other tax (24th, 1964). In 1954 racial segregation in public schools was held to violate the increasingly important equal protection guarantee. The due process clause of the 14th amendment is construed to prohibit the states from violating certain rights—notably those of the first amendment—which also are protected against federal violation by the Bill of Rights. This effectuates the major portion of Madison's unaccepted 1789 proposal. There has been varying minority support in the supreme court for the contention that the 14th amendment, by its wording and legislative history, makes the federal Bill of Rights generally applicable to the states.

See also CIVIL LIBERTIES; UNITED STATES (OF AMERICA): *Administration and Social Conditions.* (I. BT.)

BILL OF SALE, a written document transferring the ownership of goods. The function of a bill of sale corresponds roughly to that of a deed for the conveyance of land, but the bill of sale is of less importance for the transfer of property in the form of goods since this may be readily accomplished by physical delivery without further formality. In addition, the parties to a sales transaction may transfer property rights by a sales agreement without delivery of the goods and, under some circumstances, without the agreement being in writing (*see* SALE OF GOODS). In England the term has come to be applied to mortgages as well as to sales, and the expression "bill of sale" generally signifies a document evidencing a sale or mortgage of personal chattels unaccompanied by an actual transfer of possession. In the United States, however, the instrument most widely used for the assignment of personal property to secure a debt has been the chattel mortgage (*q.v.*) rather than the bill of sale.

In England and in some states of the United States, legislation has been enacted which denies effect to bills of sale against third persons, such as creditors, unless the bill of sale has been registered in a public office. The first English law on the subject, only slightly modified by subsequent legislation, was the Bills of Sale act of 1854, which provided that bills of sale would be void against execution creditors (those acting on a judgment against the debtor) unless registered. In a few states of the United States there is similar legislation, but in most states the effect of a seller's remaining in possession after a sale is left to case law. In some jurisdictions the transaction is held void against the seller's creditors, and in many the buyer has the burden of establishing that the sale is what it purports to be and not a sham designed to mislead or to defraud creditors. If the parties to the transaction do not contemplate a permanent transfer of ownership but, instead, merely an interest to secure the repayment of a debt, chattel mortgage statutes will generally render the "sale" ineffective against the debtor's creditors unless the transaction has been recorded in the prescribed manner in a public office. *See* also DEBTOR AND CREDITOR LAW; INSTALLMENT CREDIT.

(J. O. Ho.)

BILLOPP, CHRISTOPHER (1638–1726), British ship captain, traditionally supposed to have won Staten Island for the state of New York. The story is that in granting New Jersey to Lord Berkeley and Sir George Carteret, the duke of York did not make clear whether Staten Island was to be included in New York or New Jersey. He therefore ruled that all islands in New York harbour which could be circumnavigated in a day should continue to belong to him. Billopp succeeded in sailing around Staten Island in the appointed time, and as a reward the duke gave him 1,163 ac. of land at the foot of the island, the territory which became Tottenville. On that land, Billopp erected what was later to be known as the Conference house. He spent the next years as a minor officer of the duke's army and of the state of New York, but he was eventually discharged from both positions for political misconduct. Shortly thereafter he is thought to have left for England, from which he never returned.

His grandson, Christopher Billopp (1737–1827), was the owner of the Billopp or Conference house during the Revolutionary War. There, in Sept. 1776, Lord Howe, Benjamin Franklin and Edward Rutledge met to try to establish peace between the colonies and England. The second Christopher Billopp sided with the Tories as a member of the continental congress and served in the British army during the Revolution. After the American victory, he went with a number of other loyalists to Canada, where he remained for the rest of his life.

BILLROTH, (ALBERT CHRISTIAN) THEODOR (1829–1894), Viennese surgeon who is generally regarded as the founder of modern abdominal surgery, was born on April 26, 1829, at Bergen, on the island of Rügen, his family being of Swedish origin. He studied at the universities of Greifswald, Göttingen and Berlin, Ger., and received his degree from the last in 1852. From 1853 to 1860 he was assistant in B. R. K. Langenbeck's surgical clinic in Berlin, and in 1860 received the double appointment of regular professor of surgery and director of the surgical clinic in the University of Zürich, Switz. He remained there until 1867, when he joined the faculty of the University of Vienna.

In 1872 he made his first resection of the esophagus, and in 1881 the first resection of the pylorus for cancer, which was successful. In 1873 he made the first complete excision of the larynx, and is said to have been the first to perform the "inter-ilio-abdominal" amputation (1891). He did a large number of intestinal resections and enterorrhaphies (1878–83). All these operations upon the gastrointestinal tract did much to elucidate the pathology of those regions.

Billroth had a strong artistic bent and was a life-long friend of Johannes Brahms. His publications include *Die allgemeine chirurgische Pathologie und Therapie* (1863) and *Wer ist' musikalisch?* A posthumous edition of his *Briefe* was first published in 1896. He died in Abbazia, Yugos., on Feb. 6, 1894.

BILLUNG, the leading ruling dynasty in Saxony in the 10th and 11th centuries, founded by Hermann Billung, who in 936 received from the German king Otto I a march on the lower Elbe river to be held against the pagan Wends. From the year 961 Hermann used the title duke of Saxony, which on his death (973) passed to his son and thereafter to his descendants. Although the family extended its conquests toward the Oder river, thus preparing these territories for Christianization, their lands comprised only the northeastern part of the former stem duchy of Saxony. Within the boundaries of the duchy the Billungs under Bernard II (d. 1059) and Ordulf (d. 1072) had to defend their territories against the encroachments of Adalbert, archbishop of Bremen, while externally the family came to embody the Saxon national resentment to the Salian kings, Henry III and particularly Henry IV, who wished to re-establish royal authority in Saxony. In Aug. 1106, with the death of Magnus Billung, the family died out; its alodial lands were divided between the Ascanians and the Welfs while the Saxon count, Lothair of Supplinburg (the future emperor Lothair III) received the duchy of Saxony from King Henry V.

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BILMA, a Saharan oasis, is 60 mi. by 10 mi. in extent. The name Bilma belongs strictly to the south part near the chief settlement, Bilma or Garu, which is 800 mi. S. of the town of Tripoli and about 350 mi. N. of the northwest corner of Lake Chad. The water of a number of lakes on evaporation yields large quantities of fine salt, the object of an extensive trade with western Africa. North of Bilma is the town of Dirki, said to date from the 11th century. Near Bilma is a small oasis, kept green by spring water, but to the south marked desert conditions prevail. The inhabitants are Tibbu and Kanuri.

By the Anglo-French declaration of 1899 Bilma was included in the French sphere of influence in west Africa. Turkey claimed the oasis and garrisoned Bilma in 1902. In 1906, however, a French force occupied the town without opposition. In 1907 the district was created a circle of the French territory of the Niger, which became the Republic of Niger in 1958.

See also SAHARA. (J. D.)

BILNEY, THOMAS (1495?–1531), leader of the group of Cambridge men who were the vanguard of the English Reformation, was born probably at East Bilney near Norwich in Norfolk. He was educated at Trinity hall, Cambridge, and became a fellow of his college. Converted by reading the Latin New Testament of Erasmus (1516), he became leader of a group of younger dons who walked on Heretic's hill (as it came to be called) and talked of the new learning in the White Horse and who were known for their frequent communion and devotion to the needy, particularly those in hospitals and prisons. Bilney was ordained priest on Sept. 24, 1519. At the end of 1525 the group was in trouble for bold preaching against the invocation of saints, and after an informal hearing before Cardinal Wolsey in 1526, Bilney faced formal trial at Westminster in Dec. 1527. He abjured and did penance but returned to Cambridge from prison, a year later, a broken spirit. He found relief only by defying authority once again and was burned as a relapsed heretic in the Lollard's pit, Norwich, on Aug. 19, 1531. Among those present was his friend Matthew Parker, later archbishop of Canterbury. Historically interesting is his appeal to the new title of Royal Supremacy which caused embarrassment to the spiritual authorities at his death. Conservative in many opinions, he seems to have moved from Erasmian humanism to the views later championed by his converts, the martyrs Robert Barnes, John Lambert and Hugh Latimer. Innocent and austere, Latimer's "Saint Bilney" concealed stubborn strength in slender body.

See John Foxe, *Acts and Monuments,* 4th ed., vol. iv, pp. 619–656 (1877); C. H. Cooper, *Athenae Cantabrigienses,* vol. i (1858). (E. G. RU.)

BILOXI, a small tribe of Siouan Indians (*q.v.*), who formerly lived in lower Louisiana and Mississippi. In the early 1960s a reported 125 Biloxi and Choctaw lived intermingled in central Louisiana. Their existence was first recorded by Pierre le Moyne d'Iberville in 1699, at which time they were settled on Biloxi bay, Mississippi. In 1702 they moved east to Mobile bay but in 1763, when the English took over that territory from the French, the Mobile tribes transferred to Spanish territory in Louisiana, and it is likely that the Biloxi went with them. In the next years they were mentioned by writers as being found in Mississippi, Louisiana and Texas. The Biloxi lived in tents and made tools and implements of wood and bone. Their society was matrilineal.

The Biloxi were never a large tribe and by the early part of the 20th century they had become nearly extinct. In 1886 a study of their language proved that they were Siouan Indians rather than Muskogians as ethnologists had previously thought.

BILOXI, a city of Harrison county, Miss., U.S., on a narrow peninsula extending into the Gulf of Mexico about midway between Mobile, Ala., and New Orleans, La. (For comparative population figures *see* table in MISSISSIPPI: *Population.*)

In 1699 Pierre le Moyne, Sieur d'Iberville (1661–1706) planted the French flag across the bay from the present city of Biloxi. The settlement there, at Ft. Maurepas, was the first capital of the French territory. In three different periods Biloxi served as the capital of the French territory (1699–1702, 1719–20, 1720–22). The site took its name, meaning "the first people," from the local tribe, the Biloxi, of Sioux Indians. In the War of 1812 the British fleet anchored off Ship Island, preparatory to its attack on New Orleans, and during the American Civil War Ft. Massachusetts (now abandoned), an important base of federal operations, was built on the island by Union forces. One of the most interesting historic sites within the city of Biloxi is Beauvoir, Jefferson Davis' home. For many years it was a Confederate soldiers' home but is now operated as a Confederate shrine and administered by the Sons of the Confederacy.

Biloxi was incorporated as a village in 1872 and as a city in 1896.

Biloxi is a popular year-round resort. Its streets and parkways are characterized by gigantic old live oaks, dripping with Spanish moss, longleaf pines, magnolias, oleanders, camphor trees and palms. More than 900 boats and 10,000 persons are employed in fishing, packing and shipping shrimp, oysters, crabs and other fish products. The blessing of the shrimp fleet each June, a ritual observed since the 17th century, is a festive occasion for the whole area. Other industries include boatbuilding, marine repair, machine shops and the manufacture of storage batteries.

Keesler air force base and a large U.S. veterans administration centre, with a soldiers' home and hospital, are in the city. (J. T. D.)

BILSTON, a municipal and parliamentary borough of Staffordshire, Eng., 3 mi. S.E. of Wolverhampton. Pop. (1961) 33,067. The coal and ironstone mines in the vicinity have been worked since 1315. The principal trades are in metal products of all kinds, especially in founding, for which foreign ores and south Wales coke are used. Shoes, glassware, enameling (since 1760) and earth-moving equipment are a few of the many manufactures. A museum, library and art gallery were opened in 1937 and a modern health clinic in 1940. Although the town appears in Domesday book, it was not incorporated until 1933.

BIMETALLISM, a term denoting a monetary standard or system based upon the use of two metals rather than one (monometallism). Traditionally these metals have been gold and silver, although the term could include the use of any two metals. Theoretically, bimetallism may take several forms: a coin standard that makes both gold and silver coins legal tender; a bullion standard that uses bars or ingots but not coins; or an exchange standard that ties one nation's monetary system to that of another for the purpose of settling international obligations. Only the first form has been used in actual practice. The typical bimetallic system of the 19th century included several main features: it defined the monetary unit of a nation (dollar, pound, franc, etc.) by law in terms of fixed quantities of gold and silver; it provided a free and unlimited market for the two metals; it imposed no restrictions on the use and coinage of either metal; and it made all other money in circulation redeemable in either gold or silver.

Defining a monetary unit in terms of both gold and silver automatically establishes a rate of exchange between the two metals. For example, when the United States in 1792 defined the dollar as a unit containing 24.75 grains of fine (pure) gold or 371.25 grains of fine silver, the exchange ratio was set at 15 to 1. In 1834, the gold content of the dollar was reduced to 23.2 gr. while the silver dollar remained unchanged. This altered the ratio between the two metals to approximately 16 to 1 (more exactly, 16.002 to 1). A slight adjustment was again made in 1837 which reduced the ratio to 15.988 to 1. This exchange ratio was then maintained in the United States until bimetallism was officially abandoned in 1900. Under the laws of 1834 and 1837, silver practically disappeared from circulation for many years.

The bimetallic monetary system was extensively used by most western nations during the latter part of the 18th and most of the 19th centuries. The United States and France operated under this standard for almost a century, whereas Great Britain changed to the gold coin standard as early as 1816. The great discoveries

of gold in California (1848) and Australia (1851) brought about the displacement of silver by gold in many nations and the continuance of gold as the principal currency metal in the United States. Most countries officially or unofficially abandoned bimetallism during the 1870s and 1880s. British opposition to it, together with the numerous difficulties encountered in its administration, accounted in part for its ultimate downfall.

One of the major problems associated with the use of bimetallism on an international basis was that each nation acted independently in setting its own rate of exchange between the two metals. These rates often differed so widely that local and international problems resulted. For instance, it was possible in the period 1803–08 to exchange silver and gold on a 15½ to 1 basis in France, 16.06 to 1 in Germany, 15.8 to 1 in Portugal, 16 to 1 in Spain and 15 to 1 in the United States.

Operation of Gresham's Law.—These differences in exchange rates made it possible for enterprising individuals to take advantage of price differentials by buying and selling the metals in different markets. Since the officially established mint ratio in the United States favoured silver, only that metal was taken to the mint; gold, on the other hand, was sold either in the free market or was exported to foreign countries where the exchange ratio was more favourable. This demonstrates what is often referred to as Gresham's law (*q.v.*) which, in its simplest terms, states that poor money tends to drive good money out of circulation. A more sophisticated definition explains Gresham's law as stating that metal which is overvalued at the mint tends to drive out of circulation metal which is undervalued at the mint. During most of the period from 1792 to 1834 the United States maintained an exchange ratio between gold and silver of 15 to 1, whereas the exchange ratio in European countries varied from 15½ to 1 to 16.06 to 1. It thus became profitable for owners of gold to sell it in the European market and take their silver to the United States mint. During this same period practically no gold was acquired by the United States mint, though its purchases of silver during the years were very large. This trend was reversed after passage of the acts of 1834 and 1837, when the U.S. ratio was changed to about 16 to 1 while the average for most European countries remained at about 15½ to 1. For many years thereafter, only gold was taken to the U.S. mint; silver was sold in the free market or in the foreign markets.

Latin Monetary Union.—Difficulties in administering the bimetallic system on a national level led to the suggestion that it be tried on an international scale. The first concerted effort to accomplish this objective was taken in 1865 when the Latin Monetary union was formed by France, Belgium, Italy and Switzerland. These countries entered into an agreement to create an international bimetallic monetary system. A mint ratio of 15½ to 1 between the two metals was established and provision was made for the coinage of both gold and silver. The union even provided for use of the same standard units and issuance of coins which were to be uniform in weight, size and fineness. It was expected that these coins would be uniformly accepted in each participating country.

Unfortunately, however, Italy soon began issuing large quantities of irredeemable paper money which drove specie out of that country and increased the supply of coins in other countries. Later, after Greece was admitted to the union, its monetary manipulations also proved to be a detriment rather than a benefit. The Franco-German War (1870–71) brought a speedy end to this monetary experiment and no successful attempt was made after that time to revive international bimetallism.

Developments Following 1870.—The future of the bimetallic standard apparently was sealed at an international monetary conference held in Paris in 1867, when most of the delegates voted in favour of adopting the gold standard. This vote was particularly interesting in light of the fact that Great Britain was then the only country using gold as the basis of its monetary system. Within a period of five or six years, Sweden, Norway, Denmark and Germany all adopted the gold standard. Moreover, the United States in 1873 dropped the silver dollar from the list of coins to be struck at the mint. This step relegated silver to a position of secondary importance and for all practical purposes took the United States off the bimetallic standard. The Bland-Allison act (1878) and the Sherman Silver Purchase act (1890) required the U.S. treasury to purchase specified amounts of silver each month. The bimetallic legislation was not repealed until 1900, when the Gold Standard act was passed. This measure legally placed the United States on a single or monometallic gold standard system.

William Jennings Bryan (*q.v.*) the Democratic candidate for president in 1896, campaigned vigorously for restoration of the bimetallic standard. It was his intention to re-establish bimetallism at the old ratio of 16 to 1. His loss of the election virtually ended active campaigning for this standard, though Bryan also worked for it in the election of 1900. The issue was again resurrected during the depression of the 1930s. One of the provisions of the Thomas amendment to the Agricultural Adjustment act of 1933 gave the president authority to re-establish bimetallism at whatever ratio he might select, but this power was never exercised. The president chose instead to appease the silver interests by offering to buy silver at prices considerably above existing market levels.

The most comprehensive of all silver-purchase legislation in the U.S. was the Silver Purchase act approved on June 19, 1934. This act authorized the secretary of the treasury to continue the purchase of silver until its total monetary value (at $1.29 per ounce) would equal one-fourth of the combined value of the nation's gold and silver stocks; *i.e.*, until the total monetary stocks of the treasury would reach the ratio of 3 parts gold to 1 part silver. It should be pointed out that while this act provided a government market for silver it did not re-establish bimetallism. Actually, it relegated silver to a position of secondary importance. The monetary standard of the U.S. is more properly characterized as a managed gold bullion standard with limited convertibility.

Arguments Favouring Bimetallism.—Supporters of bimetallism offer three main arguments in favour of this monetary standard. It is claimed that such a standard will provide: (1) greater monetary reserves; (2) greater stability in the general level of prices for all participating countries; and (3) greater ease in determination and stabilization of exchange rates among countries using gold, silver or bimetallic standards.

The first of these arguments was advanced by Alexander Hamilton, as his principal reason for supporting the use of this standard. He reasoned that the newly established government of the United States did not have enough gold or silver independently to support a monetary system, so the reserves of both metals should be combined. Unfortunately, he failed to foresee that because of the disparities in exchange rates for gold and silver and the operation of Gresham's law, the United States would soon be faced with the problem of having only silver turned in to the mint while gold moved to the foreign markets.

The second argument assumes that any nation which uses the two metals will have a larger monetary base to begin with and that accordingly any future additions to or withdrawals from this base will have proportionately less effect on total reserves than would be the case if only one metal were used. Moreover, the argument runs, if total reserves can be maintained at a relatively constant level, prices in general will also remain relatively stable. The assumption here is that price changes are a result of changes in monetary reserves and the total volume of money in circulation. While this conclusion is subject to question, under certain (but somewhat limited) circumstances it could have merit.

The third argument has meaning only in those instances where different countries throughout the world are actually using gold, silver or bimetallic standards. In such instances, bimetallism does offer a convenient mechanism for establishing pars of exchange among the various currencies. Such standards, however, are rarely found.

Arguments Against Bimetallism.—The main arguments advanced against the use of a bimetallic standard are: (1) that it is practically impossible for a single nation to use such a standard without having international cooperation; (2) that such a system is wasteful; and (3) that it does not provide greater stability of

prices than does a monometallic or even a properly regulated fiat system.

The operation of Gresham's law has demonstrated that it is not feasible for any one nation to use a bimetallic standard independently of what others might be doing. Nor does it appear likely that agreement can be reached to establish bimetallism on an international scale. Accordingly, this standard commands very little support throughout the world.

Any standard which calls for the mining, handling and coinage of two metals rather than one incurs added costs. Such added expenditures might be justified if the resulting standard provided greater income and price stability than could be obtained by use of a different standard. But opponents of bimetallism contend that stability of the price level and the economy as a whole can be achieved only by carefully regulating and controlling all segments of the economy and that it actually makes little difference which type of monetary standard is used. They point out that even a fiat monetary standard may be used effectively as long as the monetary authorities exercise prudence in regulating the volume of money and credit used in the economy.

A proposal, sometimes confounded with bimetallism, is that for a standard composed of both gold and silver, which is better described as the joint standard or as symmetallism.

See also GOLD STANDARD; MONEY.

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BINARY NUMBERS. Binary numbers, such as those used in digital computing machines, are numbers expressed digitally in the usual radical system using 2 as a base. Only two different digital values are required, 0 and 1. (Using the base 10 for decimal numbers requires ten different digital values from 0 through 9.) Just as the decimal number $237.4375 = (2 \times 10^2) + (3 \times 10) + 7 + (4 \times 10^{-1}) + (3 \times 10^{-2}) + (7 \times 10^{-3}) + (5 \times 10^{-4})$, the ordered digits of a binary number are to be multiplied by appropriate powers of two and added to give the value of the number represented. The fractional part of the number is separated from the whole part by the binary point or radical point. The binary form of the number above is 111 01101.0111.

To convert a whole decimal number to its binary form, repeated division by two is used; initially the number itself is divided by two and in each later step the quotient obtained from the preceding step is divided until a quotient of 0 remains. The remainders, which are all 0 or 1, are the digits of the binary form of the integer reading to the left from the binary point. Proper fractions are converted to binary form by an analogous process involving doubling the fractional part of each number obtained; the succession of digits to the right of the binary point is given by the largest integral part of the product, which is always 0 or 1. Thus the sequence of quotients and remainders for 237 is (118, 1) (59, 0), (29, 1), (14, 1), (7, 0), (3, 1), (1, 1), (0, 1), as obtained in the following steps:

(1) $2\overline{)237}$ quotient 118, remainder 1

(2) $2\overline{)118}$ quotient 59, remainder 0

(3) $2\overline{)59}$ quotient 29, remainder 1

(4) $2\overline{)29}$ quotient 14, remainder 1

(5) $2\overline{)14}$ quotient 7, remainder 0

(6) $2\overline{)7}$ quotient 3, remainder 1

(7) $2\overline{)3}$ quotient 1, remainder 1

(8) $2\overline{)1}$ quotient 0, remainder 1

The remainders, in the order of their occurrence, give the binary expansion reversed, that is, reading from right to left away from the binary point, or 111 01101. In writing binary numbers, a space is left after every fifth unit to the left or right of the binary point.

The overflows and fractional parts for .4375 as given in the example above are (0.8750), (1.7500), (1.5000), (1.0000). (Note that the whole parts are dropped before doubling in each step.) The binary expansion of the fraction is the set of whole parts in their order of occurrence, reading from left to right from the binary point, or .0111. Conversion in the other direction using decimal arithmetic is easiest with a decimal table of powers of 2.

To convert a binary number to a decimal number, start with the first digit at the far left in the binary number and proceed one place at a time to the right, multiplying each figure by 2 and adding either 1 or 0 to the product as indicated in the next place to the right before multiplying by 2 again. For example, the whole part of the binary number given above is converted to a decimal number in the following steps:

(1) (3) (5) (7)
1 1 1 0 1 1 0 1
(2) (4) (6)

(1) $1 \times 2 = 2$, $2 + 1 = 3$

(2) $3 \times 2 = 6$, $6 + 1 = 7$

(3) $7 \times 2 = 14$, $14 + 0 = 14$

(4) $14 \times 2 = 28$, $28 + 1 = 29$

(5) $29 \times 2 = 58$, $58 + 1 = 59$

(6) $59 \times 2 = 118$, $118 + 0 = 118$

(7) $118 \times 2 = 236$, $236 + 1 = 237$

Binary numbers may be handled arithmetically by methods analogous to those used in handling decimal numbers. The addition and multiplication tables necessary are spectacularly simple, however: $0 + 0 = 0$, $0 + 1 = 1$, $1 + 1 = 10$; $0 \times 0 = 0$, $0 \times 1 = 0$, $1 \times 1 = 1$. Nonrestoring division is also possible because of the paucity of digital values; this amounts essentially to expanding the quotient in a binary fashion using digits 1 and -1 and converting easily to a standard digital form.

The simple nature of the addition and multiplication tables for binary numbers and the ease and reliability with which a digit that may have only one of two values may be represented electrically or electronically has led to widespread use of binary arithmetic in automatic computing machines. Many electronic digital machines using decimal numbers represent these numbers in a code whose groups are sets of four binary digits.

Negative numbers are frequently represented by complements. A common method is to replace each digit in the binary expression for the absolute value of a negative number by its complement (that is, replace 1 by 0 and 0 by 1) to express the negative number. This leads to ambiguity unless it is agreed that the number will have a fixed number of digits with the leading digit having value 0 for positive and 1 for negative numbers; zero is still ambiguously represented by a number all 1's or all 0's. Thus in ten binary digits the decimal number 237 becomes 00111 01101 and the decimal number -237 becomes 11000 10010. Most arithmetical operations are convenient in this system, but provision for "carry" from the most significant place to the least (cyclic or end-around carry) must be provided. If the computing device used subtracts but does not add, the representation of zero by a number whose digits are all 1's does not occur naturally. Most electronic machines either add or subtract, but do not do both. The complementation usually found on a desk calculator also has an analogue in binary numbers.

Binary digits also occur in Boolean algebra, and this algebra

is formally used in the development of computer circuits. This is the algebra of propositions, where a proposition is either true (has truth value 1) or false (has truth value 0). Two propositions can be connected with a conjunction to form a compound proposition, the conjunctions used in computers being "and" and "or." The truth value of the resulting proposition depends on the truth values of the components and the conjunction used; using the standard symbols $\wedge$ for "and" and $\vee$ for "or" the tables in terms of truth values are: $0 \wedge 0 = 0$, $0 \wedge 1 = 0$, $1 \wedge 1 = 0$; $0 \vee 0 = 0$, $0 \vee 1 = 1$, $1 \vee 1. = 1$.

Any binary operation can be generated by the Boolean operations mentioned above; in particular the arithmetic operations on binary digits can be generated. Electronic equipment for carrying out the binary operations is simple and reliable, and this is the basis for much design of electronic computing circuitry.

Much binary arithmetic antedates the current uses; an old scheme of multiplication attributed to Russian peasants is equivalent to expansion of the multiplier to its binary form. (The multiplicand is repeatedly doubled and the multiplier halved; if the remainder in the division is 1 the value of the multiplicand term before doubling is added into a sum which is the developing product.)

See COMPUTING MACHINES, ELECTRONIC.

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BINARY SYSTEM, in astronomy, a system composed of two stars revolving around each other under the influence of their mutual gravitational attraction. In some cases (visual binaries) a telescope will show the two components separated. In others (spectroscopic binaries) the duality is detected by observing the changing motion in the line of sight of one or both components. *See* STAR.

BINCHOIS, GILLES (EGIDIUS; GILLES DE BINCHE) (*c.* 1400–1460), Flemish composer of secular *chansons* and church music, was born at Mons in Hainaut, *c.* 1400. In 1424 he was in the service of William de la Pole, earl of Suffolk, in Paris, and must have been in contact with English musicians. He went with Suffolk to Hainaut in 1425, and joined the chapel of Philip of Burgundy in 1430. The text of Johannes Okeghem's *Déploration* on his death affirms that he was a soldier in his youth, calls him *"le père de joyeuseté"* and suggests that he wrote some of the verses he set, since both *"Rhétorique"* and *"Musique"* are represented as mourning his loss. He died in Sept. or early Oct. 1460, near Mons. In the manuscript of Martin le Franc's poem *Le Champion des dames* (1440) Guillaume Dufay is depicted next to a small organ, symbolizing church music while Binchois holds a harp, symbolizing secular music. However, Le Franc's comment that both took John Dunstable as their model applies equally to the sacred and secular music of Binchois. In both he cultivated the gently subtle rhythm, the suavely graceful melody and the smooth treatment of dissonance characteristic of his English contemporaries. Some of his church music is related to English liturgical use, and his techniques in these works have English affiliations. While his sacred music has historical importance at a time of interchange between English and French traditions, his secular *chansons* are among the finest examples of their genre, notable for their elegance of line and grave sweetness of expression.

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BINDWEED. Any trailing or climbing (rarely erect) herbaceous vine of the genus *Convolvulus*, an assemblage of about 180 species, nearly world-wide in distribution, closely related to the morning-glory, and many of them persistent and pernicious weeds. A few are cultivated for ornament, especially *C. mauritanicus*, a blue-flowered perennial used for hanging baskets in the greenhouse or as an outdoor ground cover in California; *C. tricolor*, the dwarf bindweed, an erect annual from southern Europe, and *C. cneorum*, a pink-flowered, handsome species also from southern Europe, cultivated more in England than in the United States. The only species of any economic importance is *C. scammonia* from the eastern Mediterranean region, the fresh rootstocks of which furnish the violent cathartic scammony.

RUTHERFORD PLATT

HEDGE BINDWEED (CONVOLVULUS SEPIUM)

European field bindweed (*C. arvensis*) is one of the most invasive and persistent weeds. It is widely naturalized in the United States. It is a deep-rooted perennial, whose prostrate vine is difficult to control by tillage or hoeing, and can be killed only by applications of weed-killing chemicals such as 2, 4-D. Less difficult is the ubiquitous hedge bindweed (*C. sepium*), originally European but widely naturalized throughout North America. Its shallow roots are easily killed by tillage or hoeing. An interesting freak is the double-flowered Japanese bindweed (*C. japonicus*), often called California rose, introduced for ornament, but usually weedy in lawns. (N. TR.)

BINET, ALFRED (1857–1911), French psychologist, famous for his experiments on the psychology of reasoning and intelligence, was born at Nice, France, on July 8, 1857. At Paris he studied law, medicine and biology, and, after collaborating with C. Féré and H. E. Beaunis at the Sorbonne, he succeeded the latter as director of the new psychological laboratory. French psychology was still largely dominated by the views of the English empirical school, especially by the theory of mental association as systematized by James and John Stuart Mill and the later biological and physiological interpretations developed by Herbert Spencer and other evolutionists. Binet began by accepting these general principles, but sought to establish them (if necessary with due modifications) on a sound experimental basis. Unlike the German experimentalists, he saw little value in laboratory researches on elementary processes of sensation or reaction and endeavoured to adapt experimental techniques to the "higher mental processes," and above all to study their manifestations in everyday life. The "brass instruments of the German band" he soon discarded, and displayed great ingenuity in devising instructive experiments with the simplest materials—paper, pencil, illustrative pictures and portable objects, such as could be used in the school or the workshop. His early work, *La Psychologie du raisonnement* (1886), already reveals a growing dissatisfaction with the purely mechanical theories of the associationist school, and it was followed by entirely original work on "imageless thought." Binet was equally alive to the effect of emotional and other nonrational influences on thought processes, and published a number of important investigations of suggestibility, hypnotism, mental fatigue and semipathological "alterations of personality." In 1895 *L'Année psychologique* began its career as the main organ of Binet's school; and most of his work (often undertaken in collaboration with other specialists, including Féré, V. Henri, N. Vaschide and T. Simon) appeared year after year in this periodical.

About the same time, in conjunction with Belot and Vaney, he opened a laboratory at Paris for child study and experimental teaching. He had been much impressed by Francis Galton's endeavour to establish individual psychology on a scientific basis by means of standardized tests, and adapted the method in a series of experimental studies of eminent writers, artists, mathematicians and chess players, often supplementing the more formal tests with observations on body type, head measurements, handwriting, etc. In this new field his most notable work was his *Étude expérimentale de l'intelligence* (1905), which was planned as an investigation of the mental characteristics of his two daughters and developed into a systematic study of two contrasted types of personality. Here his skillful use of selected pictures, inkblots and

the like paved the way for what later became known as "projection tests" and tests of "thematic apperception." His well-known scales (1905–11) for the measurement of intelligence and educational attainments of school children were developed at the request of the Paris education authority, but were largely inspired by his interest in the mental differences between individuals, subnormal as well as normal. He was still engaged on a revision of his scheme when he died in Paris on Oct. 18, 1911. *See* PSYCHOLOGICAL TESTS AND MEASUREMENTS.

See R. Martin, *Alfred Binet* (1925). (CY. B.)

BINGEN, a town of Germany which after partition of the nation following World War II was in the *Land* (state) of the Rhineland-Palatinate, Federal Republic of Germany. It is situated at the confluence of the Rhine and the Nahe, 26 km. (16 mi.) W. of Mainz. Pop. (1961) 20,210. Klopp castle, dominating the town, and the Nahe bridge are on Roman sites. The parish church of St. Martin was built in 406 (rebuilt 1403 in Gothic style after a fire). The local history museum has instruments of a Roman doctor. Nearby are the rocky ledges and swift currents of the Rhine whirlpool, the Binger loch. Bingen is on the main line from Cologne to Mainz and Frankfurt; other lines run to Kreuznach and Simmern. There are brandy distilleries and trade in wine and spirits. Bingen is an important tourist centre. The Roman Bingium became a free town of the empire, and was made a part of the electorate of Mainz by Emperor Otto II. In 1105 the emperor Henry IV was held in Klopp castle; in 1301 the town and castle were besieged by King Albert I. In World War II Bingen was captured by the Allies (March 1945). (J. A. S.-K.)

BINGHAM, GEORGE CALEB (1811–1879), U.S. painter, whose work represents the best-known American genre painting of the mid-19th century, was born on March 20, 1811, in Augusta county, Va., and later settled in Missouri. His best genre paintings were produced from 1840 to 1857. The large, tightly composed pictures, crowded with details of local colour, developed in two themes: river life, as shown in "Jolly Flatboatmen"; and political life, as shown in "County Election." His later paintings were either polemical or sentimental. He died on July 7, 1879.

See A. W. Christ-Janer, *George Caleb Bingham of Missouri* (1940). (A. W. C.-J.)

BINGHAM, HIRAM (1875–1956), U.S. politician, historian, explorer and discoverer of the lost city of the Incas, was born in Honolulu, Hawaii, on Nov. 19, 1875, the descendant of missionaries to Hawaii and Polynesia. Following his education at Yale and Harvard (Ph.D. in history, 1905) he joined the faculty of Yale university in the field of Latin-American history. A devotee of field trips, he retraced in 1906–07 Simón Bolívar's route across Venezuela and Colombia and two years later explored the old Spanish trade route from Buenos Aires to Lima. In 1911, while on a trip to southern Peru, Bingham made one of the most sensational discoveries of modern times when he found Machu Picchu, the legendary Inca citadel, located high on an impregnable mountain peak near Cuzco (*q.v.*) and unknown for four centuries. Bingham described his explorations in a series of books, beginning with *Journal of an Expedition Across Venezuela and Colombia* (1909) and ending with *Lost City of the Incas* (1948).

The latter years of his life were devoted to politics; he was elected governor of Connecticut in 1924 and served one partial and one full term in the U.S. senate. He died in Washington on June 6, 1956.

BINGHAMTON, a city of New York, U.S., on the Susquehanna river, at the mouth of the Chenango, 125 mi. S.W. of Albany, near the Pennsylvania border; seat of Broome county. Pop. (1960) city, 75,941; standard metropolitan statistical area 283,600. The metropolitan area includes Johnson City (*q.v.*) and Endicott, which with Binghamton are known as the Triple Cities. (For comparative population figures *see* table in NEW YORK: *Population.*)

The site of Binghamton was in Indian territory until 1779, when a decisive victory was won by Gen. James Clinton and Gen. John Sullivan at Newtown (now Elmira). An Iroquois village known as Ochenang was situated there, and the white settlement, established in 1787, was first called Chenango Point. The greater part of the city stands on land originally included in the Bingham patent, a large tract on both sides of the Susquehanna, owned by William Bingham (1751–1804), a merchant of Philadelphia, Pa.

A village was laid out in 1800. It was incorporated in 1834 and received a city charter in 1867.

Easy access to large markets, sea and lake ports, and coal, steel and raw materials favoured industrial development. By 1837 the Chenango canal provided a waterway to the Erie canal at Utica. In 1851 the Erie railroad linked Binghamton to Buffalo and Jersey City. Binghamton's leading manufactures include cameras and film, footwear, dairy and bakery products, clothing, furniture, forgings and stampings, hardware, valves, industrial machines, aircraft parts, small boats and cosmetics.

The sale of dairy products (largely milk for the New York metropolitan market) is the leading source of agricultural income, followed by livestock, poultry and poultry products. The largest crop acreage is devoted to hay. The Broome County Farm bureau (1911) is the oldest in the country.

Institutions of higher education in the Triple Cities region include Broome Technical Community college (founded 1947), at Binghamton, and Harpur college (founded as the Triple Cities College of Syracuse university in 1946) since 1950 a unit of the State University of New York, at Endicott. (R. C. HE.)

BINGO, a lottery game played in many variants and under several different names. As a game of chance, bingo is said to claim more devotees than any other gambling game in the United States in spite of its being banned in many states. The more recent name given this game before the current one was keno, developed by traveling carnivals in the 1880s from a game for children called lotto (also spelled loto), which in Great Britain is popularly known as house. The origin of lotto is thought to be the Italian game *tumbule*, the word "lotto" meaning "lot" in Italian. In the United States the names keno, bingo, beano, lucky, radio, fortune, po-keno, screeno and many others are applied to games which are essentially the same as lotto. Latin Americans play a similar game called *bolito*.

Whatever the name or the variant, each player pays to receive a card bearing rows of numbers, no two cards being identical. Numbers are then drawn by lot, in one fashion or another. The first player on whose card five of these numbers appear in a row—vertically, horizontally or diagonally—is the winner.

The original lotto card was divided into five horizontal rows of nine squares each. There were five numbered squares on each row, the other squares being blank. The first vertical row contained numbers from 1 to 10, the second row numbers from 11 to 20 and so on. Small numbered disks were drawn at random from an enclosed bowl, and a player having a corresponding number covered it on his card, until some player, having all five numbers on a horizontal row covered, cried "lotto" and won the stakes of the other players, or the prize if one was offered.

The keno card contained only 25 squares in a 5-by-5 grid, with a number from 1 to 90 in each square, there being no blank spaces. Players were seated at long counters and bought one or more cards each. The operator of the game drew numbered balls from a "keno goose" which permitted only one ball to escape at a time. There were no duplicate numbers in the goose, and each number called was marked off on a master board so that a winning player's card might be verified.

Bingo is almost identical with keno except that only 75 numbers are used and the central square on the bingo card is a free number. It is generally customary for entry fees to be collected before a game or series of games. The house retains this fee and awards prizes of cash or merchandise to the winners. Bingo attained its greatest popularity in the 1930s, when depressed business conditions turned people from higher-priced gambling games.

The variant known as screeno and by other names was designed to be played in motion-picture theatres. With screeno began the custom of designating one night in the week to be "bank night" at the theatre; patrons received free screeno cards with their tickets of admission to the theatre. Prizes amounted in cash or in value to hundreds of dollars. (F. HN.)

BINIOU: *see* BAGPIPE.

BINNEY, THOMAS (1798–1874), English Congregational minister, hymn writer and a leader of the liturgical movement in his denomination, was born of Presbyterian parents at Newcastle upon Tyne. He entered the theological college at Wymondley, Hertfordshire (afterward New college, Hampstead), and after a one-year pastorate at the New Meeting, Bedford, he moved (1824) to the St. James's Street Independent chapel, Newport, Isle of Wight. He received a unanimous call to become minister of the Weigh House chapel, London (1829), where he drew such large congregations that a new chapel was built. Binney's speech on laying the foundation stone (1833) provoked controversy with the Church of England; but although soundly convinced of its errors (he published *Twenty-Four Reasons for Dissenting From the Church of England* in 1835), he actively sought reunion, and while visiting Australia (1857) he corresponded with the bishop of Adelaide about the occasional interchange of ministers. He wrote much devotional verse, published *The Service of Song in the House of the Lord* (1848), and brought his chapel services closer to those of the established church by introducing the chanting of psalms taken from the Authorized Version of the Bible. Binney was chairman of the Congregational union in 1848. He resigned his pastorate in 1869 and died in London on Feb. 24, 1874.

BINOCULAR INSTRUMENT. An optical device that permits simultaneous vision with both eyes. Such instruments are usually designed to make use of the stereoscopic phenomenon of binocular vision. There are two general classes of such instruments, namely, (1) those for viewing objects in three-dimensional space; and (2) those for viewing pairs of flat prints, transparencies or projected images for the purpose of creating a visual perception in three dimensions.

In either type of instrument, it is essential for stereoscopic vision that each eye receives an image that originates from a viewpoint laterally displaced from that seen by the other eye. These dissimilar images are mentally fused into a single three-dimensional image. Man's lifelong experience with such binocular images results in perception of objects in three-dimensional space. A complete understanding of the creation and interpretation of binocular images involves a knowledge of physiology and psychology as well as physics. Nevertheless, the fundamentals of stereoscopy can be made clear by geometrical methods.

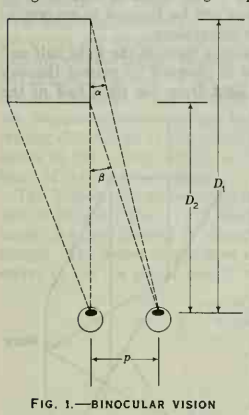

FIG. 1.—BINOCULAR VISION

The right and left eyes see different views of the cube, the parallax angles for the right-hand corners being respectively α and β

For example, objects at distances D_1 and D_2 viewed by eyes with an interpupillary separation p (fig. 1) have different parallax angles α and β for the two eyes. If the objects are sufficiently far away in comparison with p, these angles will be simply $\alpha = p/D_1$ and $\beta = p/D_2$ in radians, one radian being equal to 206,265 sec. of arc. The minimum detectable difference in binocular parallax angles is generally assumed to be 30 sec., but there is some evidence that it may be as low as 4 sec. for trained observers. This minimum angle difference determines the minimum perceptible difference in distance D. Since the parallax angle for objects at infinity is zero, the limit of stereoscopic vision is the distance D_1 at which $\alpha = \frac{30}{206{,}265} = \frac{p}{D_1}$. For a standard interpupillary distance of $p = 65$ mm. this limit, often called the radius of stereoscopic vision, is found to be 450 m. The purpose of binocular telescopes is to increase this quantity. This may be accomplished by two methods, used singly or together.

In the first place, a magnification m increases the parallax angles of all points in the images by a factor m, making objects appear closer by a factor $1/m$. Hence, smaller differences in parallax angles can be perceived. Secondly, the centres of the objectives may be farther apart than the pupils of the eyes by a factor n, which increases parallax angles by the same factor. The combined effect of magnification and lens separation is to increase the radius of stereoscopic vision to mn times that for the unaided eyes. This also enhances stereoscopic discrimination at distances below the limit.

Opera glasses and inexpensive field glasses consist of two telescopes of the Galilean type. These have a converging objective lens, usually achromatic, and a diverging eyepiece lens. Since the objectives are the same distance apart as the eyes, the radius of stereoscopic vision is increased solely by a factor equal to the magnification m. As usually constructed, Galilean telescopes suffer from several optical defects and have a characteristically small field of view at the larger magnifications. Hence their usefulness is generally restricted to magnifications of only $2\frac{1}{2}$ to 4.

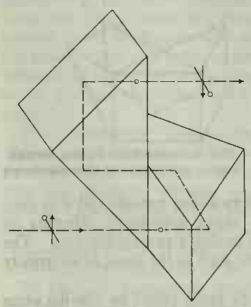

FIG. 2.—PORRO PRISMS

Light is totally reflected inside two 45°–90° prisms at right angles to each other. This inverts and reverses the image

Telescopes with converging lenses as eyepieces and objectives potentially give sharper images and a larger field of view than those of the Galilean type, but their images are inverted and reversed. The reinversion is usually accomplished by a series of four total reflections inside glass prisms. The most common system of prisms, the Porro (fig. 2), consists of a pair of 45°–90° prisms with the light entering the hypotenuse face of each in turn and being totally reflected at the two smaller faces. One such prism inverts the image, the other, being at right angles, causes a reversion of the image. Light emerges parallel to its original direction but is displaced laterally. The lateral displacement permits a greater separation of objectives than of the eyepieces, thus increasing the stereoscopic effect (fig. 3). The folded optical path in the prisms permits the use of objectives of longer focal length, and therefore greater magnification, without unduly increasing the length of the telescope.

Magnifications of 6, 7 or 8 are common in hand-held binoculars. With powers greater than 8, it is advisable to use a tripod to hold the binoculars steady. In the common designation of binoculars as 6×30, 7×50 or 8×30, for example, the first number is the magnification and the second number is the diameter of the objective in millimetres. The quotient of the second number divided by the first is the diameter of the exit pupil, which is the ring through which the light passes into the eye of the observer. It may be seen as a circular patch of light just behind the eyepiece when the binoculars are held at arm's length and pointed at the sky. If the exit pupil is as large or larger than the eye pupil, one obtains ideally (neglecting light losses in the instrument) as bright a retinal image as without the binocular. This is called normal brightness. Conversely, if the exit pupil is smaller than the eye pupil, the image brightness is diminished by a factor equal to the ratio of the squares of the diameters of the exit pupil and the eye pupil. For example, the exit pupil of a 6×30 binocu-

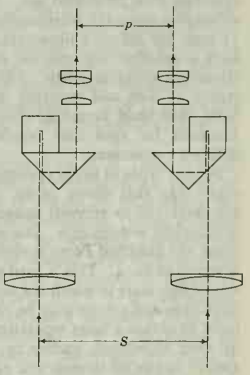

FIG. 3.—PRISM BINOCULARS

Light from the object enters the two objectives whose centres are a distance S apart. The Porro prisms erect the images which are seen through the two eyepieces at a separation p equal to that of the observer's pupils

lar has a diameter of 5 mm. and the pupil of the normal human eye varies in diameter from 2 mm. in bright daylight to 7 mm. at night. In daylight, then, a 6×30 binocular gives an image of normal brightness but at night the brightness is 25/49 or about half the ideal. A 7×50 binocular, on the other hand, having an exit pupil of 7+ mm. diameter, gives images of normal brightness at night as well as by day and is often called a night glass. While it is superior to the 6×30 when used at night, the brightness of its image is no greater in the daytime. Moreover, being heavier, it is less comfortable to hold over extended periods and it is considerably more expensive. The above statements referring to image brightness apply to objects having a perceptible area. The brightness of objects seen as points, such as the stars, often greatly exceeds normal brightness.

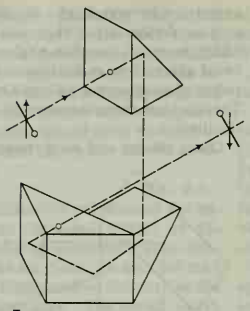

FIG. 4.—MODIFIED PORRO PRISMS
Used in periscopes and stereobinoculars

The quality of a binocular may be easily tested by viewing some distant structure with clear-cut vertical and horizontal detail. First the best focus possible in the centre of the field should be obtained. Vertical and horizontal lines should focus sharply and simultaneously. If the image is of high quality, the range of adjustment for sharp focus will be small.

Next, the telescopes should be turned to bring the centrally focused object toward the edge of the field of view. The image should remain sharp. It may, however, show some colour along boundaries between light and dark objects, but this should not be so large as to seriously reduce the definition. There may be some distortion of straight lines near the edge of the field, but this should be small.

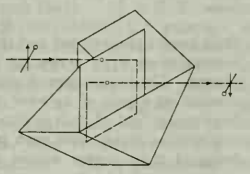

FIG. 5.—PORRO PRISMS OF THE SECOND TYPE
A compact combination of rectifying prisms

The two telescopes of a binocular should have exactly parallel axes and should have exactly the same magnification. Large deviations make the binocular useless and smaller deviations lead to eyestrain with prolonged use. The eyepiece separation should be adjustable since the interpupillary distance may vary from 55 to 72 mm. for different observers. Binoculars for sports use often have a crossbar between the eyepieces to permit focusing both telescopes simultaneously. This is convenient but may allow entrance of dust and moisture into the telescopes. On the other hand, individual focusing, while slower, is more adaptable to adjustment for eyes that require different corrections.

Several types of prism systems, other than that shown in fig. 2, are employed to reinvert images in binocular instruments. One of these, the modified Porro system, is shown in fig. 4. This is used in stereobinoculars in which the two telescopes and prisms may be rotated to obtain a large separation between objectives, leading to a greatly enhanced stereoscopic effect. With the telescope tubes vertical the instrument becomes a binocular periscope for viewing over a projecting parapet. Tank sights employ a similar prism effect but with a fixed separation between objectives.

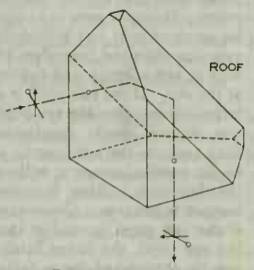

FIG. 6.—AMICI PRISM
A 90° roof is ground on the hypotenuse of a 45°–90° prism to correct inversion and reversion in a single prism. The 90° deviation is useful in telescopes for observing objects overhead

Porro prisms of the second type (fig. 5) are sometimes used in telescopes of high magnification.

The Amici prism (fig. 6) is often used in military binoculars. It is a 45°–90° prism with a 90° roof on the hypotenuse face. The angle on the roof must be accurately 90° within a tolerance of ±2″, to avoid a double image, and it must have a sharply ground ridge. This prism is very difficult to manufacture because of the stringent requirements. When used in a telescope without other prisms, the light is deviated through 90°, making the instrument useful for tracking planes flying overhead.

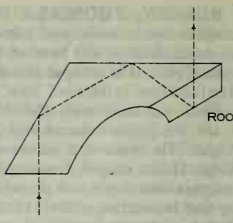

FIG. 7.—LEMAN OR SPRENGER PRISM
Often used to rectify images in various types of gun sights

The roof angle principle is also applied in prisms of other form, of which the Sprenger prism (fig. 7) is one example. This prism is often used in gun sights of various kinds. Other varieties of roof angle prisms are the Daubresse (fig. 8) and the Koenig or Brashear-Hastings prism (fig. 9).

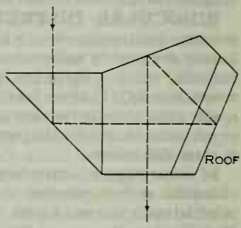

FIG. 8.—DAUBRESSE PRISM
Used in some prism binoculars

Binocular Microscopes.— Many modern microscopes have a binocular optical system. Frequently, in the higher power instruments, the prism arrangement (fig. 10) merely permits the use of both eyes simultaneously but without binocular parallax and therefore without stereoscopic effect. Its purpose is to make extended viewing more comfortable than with monocular instruments. The eyepiece separation is usually adjustable and one eyepiece can be focused to accommodate eyes with different refractive corrections.

In some instruments the light passing through the right half and the left half of a single objective is directed by prisms through the respective eyepieces. If the light from the right half of the objective passes through the right-hand eyepiece simply, *i.e.*, without reinversion of the images, the view is pseudoscopic: depressions appear as elevations and vice versa. For correct stereoscopy one must either effect a crossover of the beams of light to opposite eyepieces or reinvert the images.

Low-power binocular microscopes, used for dissection, study of insects, etc., usually have two separate, matched objectives with Porro prisms in front of each of the two eyepieces. These provide true stereoscopic vision as well as the comfort of binocular viewing. Pairs of objectives may be mounted on a rotating nosepiece to permit rapid change in magnification. The eyepiece separation may be adjusted by rotating the Porro prisms about the axis of the beams from the objectives.

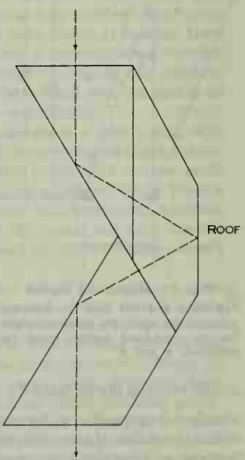

FIG. 9.—ABBE, KOENIG OR BRASHEAR-HASTINGS PRISM
Produces an erect image without displacement or deviation of the beam

Stereoscopes. — Stereoscopes are binocular instruments for viewing pairs of drawings or photographs made from laterally

displaced centres of perspective for the purpose of obtaining a three-dimensional view of objects or scenes. Since it is very difficult to make drawings of anything but simple objects with the required accuracy, photography is generally employed. Stereophotographs may be taken by successive exposures from laterally displaced positions of the camera if the object is a still-life or an architectural subject. For other objects a stereocamera or a pair of cameras that record the two views simultaneously is required.

In the stereoscope of Wheatstone (fig. 11) the two drawings or prints are mounted opposite each other and viewed by means of two mirrors. The mirrors are inclined so that each eye sees one of the mirror images directly ahead of and superimposed on the other. Since mirror images reverse rights and lefts, the view is pseudoscopic unless the drawings are printed reversed or are interchanged.

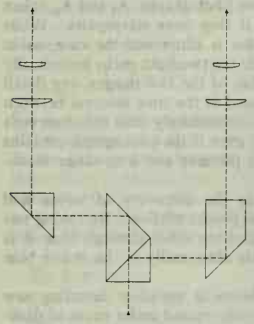

FIG. 10.—BINOCULAR MICROSCOPE PRISMS AND EYEPIECES

These permit more comfortable vision than is possible monocularly, but vision is not stereoscopic

It can be proved by purely geometrical considerations that to obtain orthostereoscopy, *i.e.*, fidelity of depth-to-width ratio and apparent distance, the interval between centres of the lenses in the stereocamera must equal the interpupillary separation of the observer's eyes; furthermore, the apparent magnification must be unity.

Apparent magnification is the ratio of the angles subtended by the images in the stereoscope to the angles subtended by the corresponding objects at the camera location. For unit magnification photographic contact prints must be viewed from a distance equal to the lens-to-film distance in the camera. Since most cameras have focal lengths considerably smaller than the normal reading distance, one must use, in front of the eyes, lenses having a focal length approximately equal to that of the camera lenses. If the prints are enlarged by a factor m before insertion into the stereoscope, the proper viewing distance becomes m times as large as for contact prints. Thus, for example, if pictures taken with camera lenses of 5 cm. focal length are enlarged five diameters, one obtains orthostereoscopy by viewing them from the normal reading distance of 25 cm., provided that the distance between the lenses of the taking camera was equal to the interpupillary distance of the observer's eyes.

The Wheatstone stereoscope has been generally supplanted by that of Brewster (fig. 12) in which lenses and prisms, or off-centre lenses, are used instead of mirrors to superimpose the two stereoimages. The lenses should have a focal length that enables the observer to see the prints clearly without undue eye strain from a distance equal to the lens-to-film distance in the camera, when contact prints are used. Since the equivalent prismatic powers of decentred lenses are proportional to the lateral shift of their optical centres, observers with different interpupillary separations will obtain different prism powers with a fixed separation of the lenses. This may create some difficulty in fusing the two images unless the lens separation is adjustable.

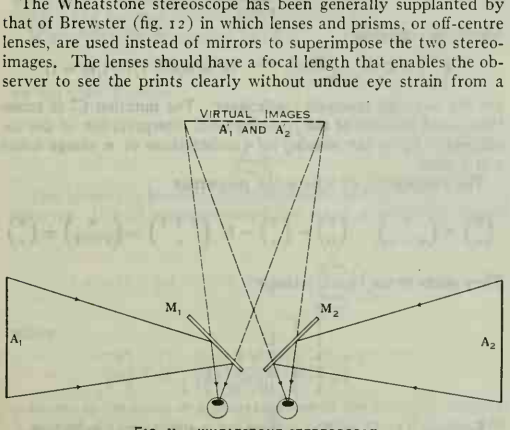

FIG. 11.—WHEATSTONE STEREOSCOPE

The inclined mirrors M_1 and M_2 enable the observer to fuse the images of two stereoscopic drawings or photographs A_1 and A_2

The Helmholtz stereoscope (fig. 13) is a refinement of Brewster's in which it is possible to vary the distance between the viewing lenses by means of a micrometer screw and to choose between one of two focal lengths by removing or retaining one of the lens components in each eyepiece.

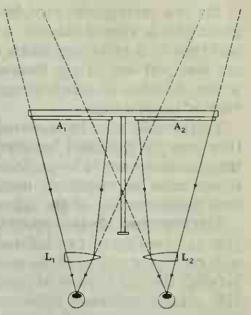

FIG. 12.—BREWSTER STEREOSCOPE

The two off-centre lenses L_1 and L_2 enable the observer to fuse the two magnified images of the views A_1 and A_2 stereoscopically

To produce stereoscopic images that may be seen by several people at the same time, one method is to project one of the images through a red filter and the other through a complementary bluish-green filter with the images nearly overlapping. Each person in the audience is provided with a viewing device consisting simply of a red filter over one eye and a bluish-green filter over the other. Through the red filter one eye sees only the blue-green image while the other eye sees only the red image. If the images are properly constructed stereopairs, the observer sees them fused into a three-dimensional image in monochrome. Alternatively, the two stereoviews may be printed on a card with inks of the appropriate colours. Such stereograms are called anaglyphs.

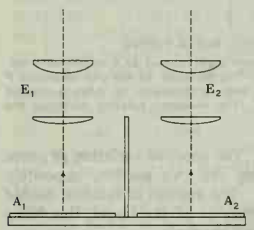

FIG. 13.—HELMHOLTZ STEREOSCOPE

Two compound magnifiers E_1 and E_2, with adjustments for focusing and interpupillary separation, enable the observer to fuse the two images stereoscopically. The focal lengths of the magnifiers may be selected to make the view orthostereoscopic

An analogous process employs projection of the stereopairs through polarizing filters oriented so that in one image the light vibrates at right angles to the vibrations in the other. By means of polarizing viewing filters properly oriented in front of each eye, the observer sees one of the images with one eye and the other image with the other eye. This principle has been applied to the projection of motion pictures in three dimensions and in colour, the latter being impossible with anaglyphs. The projection screen must have a metallic coating so that the reflected light retains its original polarization.

Another stereoscopic process, invented by E. H. Land in 1940, employs a stereopair of vectographs. Vectographs are prints or transparencies in which variations in degree of polarization replace the usual variations in degrees of absorption. Using a photochemical process invented by Land, an ordinary photographic negative is printed onto a sheet of special polarizing material to obtain a positive in which there are gradations in degree of polarization from 100% in the shadows to 0% in the highlights. When such an image is examined through a polarizing filter that is turned so its direction of polarization is at right angles to the direction of maximum polarization in the image, the image is seen with maximum contrast. As the polarizer is rotated from this position, the image decreases in contrast and fades out completely when the polarization directions of the viewer and image are parallel.

To obtain a stereoscopic effect, two vectographs, made respectively from each half of a stereonegative, are superposed with a slight lateral shift and with the planes of maximum polarization

in the two vectographs at right angles to each other. The vectograph pair is viewed through a polarizing device of the spectacle lens type with polarizing filters oriented in the frame so that each eye sees just one of the images. Incidentally, if one makes the wrong choice as to which image is to be seen with which eye, the view is pseudoscopic.

Vectographs may be mounted on metallized sheets of paper or they may be mounted between glass as transparencies. If the transparencies are to be projected as lantern slides, the projection screen must be metalized, usually with aluminum paint, to prevent depolarization of the diffusely reflected light.

Stereoscopic Measurements.—The stereoscopic range finder (fig. 14) consists of two horizontal, oppositely directed telescopes with rectifying prisms of the modified Porro type. A large distance between the end mirrors M_1 and M_2 and a high magnification provide greatly enhanced stereoscopic perception. In front of the eyepieces are reticles, R_1 and R_2, consisting of stereoscopic transparencies that are seen as a three-dimensional array of three rows of vertical marks, one row running from left to right and the other two rows crossing obliquely at the centre. This field of marks is seen superposed on the stereoscopic image of external objects observed through the telescopes. By means of a prism combination P of variable deviation inside one of the telescopes, the target is made to coincide with the intersection of the three rows of marks

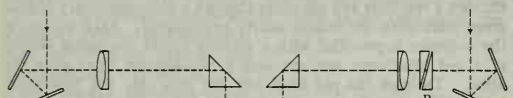

FIG. 14.—STEREOSCOPIC RANGE FINDER

A stereoscopic view of distant objects is seen superimposed on a stereoscopic pattern of marks on the reticles R_1 and R_2. The deviation by the pair of prisms P is adjusted by rotation of the prisms in opposite directions to make a selected object coincide with the central mark. The necessary rotation indicates the distance of the object

at the centre of the field of view. The required variation in prism deviation is obtained by rotating the two narrow, oppositely directed prisms in opposite senses. The amount of rotation needed for coincidence depends on the distance of the target, this being indicated directly on the prism-rotation scale.

Stereoscopy is also employed in determining the elevation of objects photographed from an airplane flying over them. The photographic exposures are made at regular intervals from an airplane in uniform, horizontal flight. Any two successive photographs are then viewed by a suitably designed stereoscopic unit in which differences in elevation are perceived. To measure these, the operator uses a stereocomparator which consists essentially of two parallel, short-focus telescopes with special reticles in front of their eyepieces. Each reticle contains a centrally located spot,

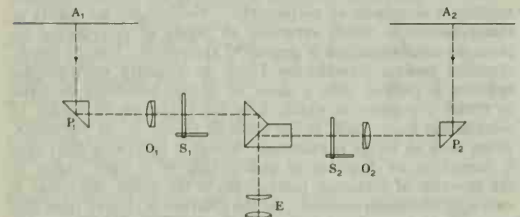

FIG. 15.—PULFRICH'S BLINK MICROSCOPE

The two photographs at A_1 and A_2 are seen either simultaneously or alternately by operating the shutters S_1 and S_2. Even slight differences in the two photographs are easily detected by fluctuations in their position or intensity

and one or both of the spots may be moved laterally by means of a micrometer screw. The binocularly fused image of the spots is thus made to move forward or backward and may be set to coincide with the stereoimage of objects at different elevations. The micrometer is usually calibrated to read elevations directly. Greater precision is obtained by the use of glass diapositives instead of paper prints.

Horizontal as well as vertical distances are measured to construct a topographical map.

The so-called blink microscope (fig. 15) is an instrument that is useful in detecting changes in objects such as stars or terrain held by the enemy in warfare. Two photographs, A_1 and A_2, taken at different times, are viewed as if they were stereopairs. While binocular vision may be used, this is often not the case, as in fig. 15. If the shutters S_1 and S_2 in the two light paths periodically obscure first one and then the other of the two images, any detail in the photographs that had changed in the time interval between exposures is seen to flicker. This immediately calls the observer's attention to that particular object even if the photograph contains much detail, as in wide-field star pictures and long-range reconnaissance photographs.

Thus astronomers are aided in the discovery of novae and variable stars or stars with a large proper motion. By taking one photograph through a red filter and the other through blue, it is possible to locate stars that radiate abnormally in the red or blue regions of the spectrum.

In military applications, the device is useful in detecting new trenches, gun emplacements, etc., constructed under cover of darkness.

See also LENS; MICROSCOPE; OPTICS; TELESCOPE.

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(J. VK.)

BINOMIAL THEOREM. By the term binomial theorem is meant the expansion of the nth power of the sum $a + b$; more generally by the term multinomial theorem is meant the expansion of the nth power of the sum of the k numbers $a_1, a_2, \ldots, a_k$.

Positive Integral Exponents.—Let n be a positive integer. Then the binomial theorem may be stated as

$$(a+b)^n = \sum_{r=0}^{n} \binom{n}{r} a^{n-r} b^r \qquad (1)$$

where the coefficients

$$\binom{n}{r} = C_r^n = \frac{n!}{r!\,(n-r)!} \qquad (n! = n(n-1)\cdots 1, 0! = 1)$$

are the so-called binomial coefficients. The notation C_r^n is sometimes used because of the combinatorial interpretation of the coefficients: C_r^n is the number of combinations of n things taken r at a time.

The coefficients $\binom{n}{r}$ have the properties

$$\binom{n}{r} = \binom{n}{n-r}, \quad \binom{n}{0} = \binom{n}{n} = 1, \quad \binom{n+1}{r} = \binom{n}{r-1} + \binom{n}{r}$$

They occur in the Pascal triangle:

```
1
1  1
1  2  1
1  3  3  1
1  4  6  4  1
1  5  10 10 5  1
. . . . . .
```

Formula (1) is readily proved by mathematical induction.

If $k \geq 2$ and n is a positive integer, then the multinomial theorem may be stated as

$$(a_1 + \cdots + a_k)^n = \sum \frac{n!}{r_1!\, r_2! \cdots r_k!}\; a_1^{r_1} a_2^{r_2} \cdots a_k^{r_k} \qquad (2)$$

where the summation is over all nonnegative integers $r_1, r_2, \ldots,$ r_k such that $r_1 + r_2 + \ldots + r_k = n$.

The numbers a, b in (1) and $a_1, a_2, \ldots, a_k$ in (2) may be thought of as arbitrary real or complex numbers. (More generally they may be numbers in any commutative ring.)

Arbitrary Exponents.—If α and x are arbitrary complex numbers, we have the expansion

$$(1 + x)^\alpha = \sum_{r=0}^{\infty} \binom{\alpha}{r} x^r \qquad (3)$$

where now we define

$$\binom{\alpha}{r} = \frac{\alpha(\alpha - 1) \cdots (\alpha - r + 1)}{r!}, \quad \binom{\alpha}{0} = 1$$

For $\alpha = n$, a positive integer, the expansion in the right member of (3) reduces to a finite sum and the result coincides with (1). In the general case, however, the expansion is infinite. Also it is necessary to explain what is meant by the left member. For any complex number $w \neq 0$, we can find a unique complex number $z = x + yi$, x and y real, such that $-\pi < y \leq \pi$ and $w = e^z$; z is called the principal value of the logarithm of w and we write $z = \log w$.

We now define

$$(1 + x)^\alpha = e^{\alpha \log (1 + x)} \qquad (x \neq -1)$$

We may now state the following fundamental result. If α is a nonnegative integer, the sum in the right member of (3) is finite. If α is not a nonnegative integer, the series converges absolutely for $|x| < 1$ and diverges for $|x| > 1$; for $|x| = 1$, we have, when $R(\alpha)$ signifies the real part of α,

(a) if $R(\alpha) > 0$, the series converges absolutely;
(b) if $R(\alpha) \leq -1$, the series diverges;
(c) if $-1 < R(\alpha) \leq 0$, the series diverges at $x = -1$ and converges conditionally at every other point on the unit circle.

When the series converges the sum is equal to the principal value of $(1 + x)^\alpha$; in particular the sum is 0 when $x = -1$.

Analogs of the Binomial Theorem.—N. H. Abel in 1826 gave the following extension of (1):

$$(x + \alpha)^n = \sum_{r=0}^{n} \binom{n}{r} \alpha(\alpha - r\beta)^{r-1} (x + r\beta)^{n-r}$$

where n is a nonnegative positive integer while x, α, β are arbitrary. The formula reduces to (1) where $\beta = 0$.

If we define the descending factorial

$$x^{(n)} = x(x - 1) \cdots (x - n + 1), \quad x^{(0)} = 1$$

we have the formula

$$(x + y)^{(n)} = \sum_{r=0}^{n} \binom{n}{r} x^r y^{(n-r)}$$

This identity is known as Vandermonde's analog of the binomial theorem. It is of course assumed that n is a nonnegative integer.

The expansion

$$(1 + x)(1 + qx) \cdots (1 + q^{n-1}x) = \sum_{r=0}^{n} \begin{bmatrix} n \\ r \end{bmatrix} q^{\frac{1}{2}r(r-1)} x^r,$$

where

$$\begin{bmatrix} n \\ r \end{bmatrix} = \frac{(1 - q^n)(1 - q^{n-1}) \cdots (1 - q^{n-r+1})}{(1 - q)(1 - q^2) \cdots (1 - q^r)}$$

is known as the basic or q-generalization of the binomial formula; it reduces to (1) when $q = 1$. The coefficients $\begin{bmatrix} n \\ r \end{bmatrix}$ are polynomials in q with integral coefficients and have properties analogous to those of the binomial coefficients $\binom{n}{r}$. It may be of interest to mention also the formulas

$$\prod_{r=0}^{n-1} (1 - q^r x)^{-1} = \sum_{r=0}^{\infty} \begin{bmatrix} n + r - 1 \\ r \end{bmatrix} x^r$$

$$\prod_{r=0}^{\infty} (1 + q^r x) = \sum_{r=0}^{\infty} \frac{q^{\frac{1}{2}r(r-1)} x^r}{(1 - q)(1 - q^2) \cdots (1 - q^r)}$$

$$\prod_{r=0}^{\infty} (1 - q^r x)^{-1} = \sum_{r=0}^{\infty} \frac{x^r}{(1 - q)(1 - q^2) \cdots (1 - q^r)}$$

Historical Note.—The general formula (arbitrary n) was first given by Newton in letters to H. Oldenburg dated June 13, 1676, and Oct. 24, 1676. Newton apparently gave no proof. Special cases of the binomial theorem occurred long before Newton. The Indians and Arabs used the expansions of $(a + b)^2$ and $(a + b)^3$ for root extractions. Vieta knew the expansion of $(a + b)^4$. Blaise Pascal was familiar with the "arithmetical triangle" described above; however this triangular array is found in 1303 in a Chinese tract by Chu Shih-Chieh.

The first proof of the binomial theorem for positive integral n was given by Jakob Bernoulli in his posthumous book *Ars conjectandi*, published in 1713. The first rigorous proof of the general formula (3) was given by Abel.

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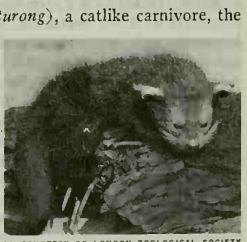
(LE. C.)

BINTURONG (*Arctictis binturong*), a catlike carnivore, the single species of a genus of the civet family (Viverridae), ranging from northeast India, northern Burma and Indo-China south through the Malay peninsula and the islands of Sumatra, Java, Borneo and Palawan. It has long, shaggy body hair, tufted ears and a long, bushy, prehensile tail. The colour is generally black with a sprinkling of whitish hairs. Head and body together measure about 30 in. in length; the tail adds 24 to 27 in. more. The binturong inhabits dense forests and is principally nocturnal and arboreal in habits. It feeds upon eggs, small animals, and fruits.



BY COURTESY OF LONDON ZOOLOGICAL SOCIETY
BINTURONG (ARCTICTIS BINTURONG)

(J. N. L.)

BINYON, (ROBERT) LAURENCE (1869–1943), English poet, dramatist and writer on art whose rare feeling for beauty was expressed in a language and style of great purity, owing much to his classical training. Born at Lancaster, Aug. 10, 1869, the son of a clergyman of Quaker stock, he was educated at St. Paul's school, London, where he met the poet Mohammed Ghose and thus made his first contact with the east. He was already writing poetry, and at Trinity college, Oxford, won the Newdigate prize for *Persephone* (1890). He combined his lifelong interests—in in books and in painting—when in 1893 he began work at the British museum, London, where later he was for many years in charge of oriental prints and drawings. He continued to write poetry and to contribute to periodicals.

His first book on oriental art, *Painting in the Far East* (1908), a pioneer work and still a classic, proved the genius for the interpretation of painting in words which was to make his lectures memorable experiences. Later books on art included *The Flight of the Dragon* (1911) and *The Spirit of Man in Asian Art* (1935), as well as writings on English watercolours, particularly those of Blake and his followers.

World War I came as a devastating experience and his poem "For the Fallen" (first published in the *Times*, Sept. 21, 1914)

won immediate recognition as the expression of the feelings of a generation. His poetic powers reached maturity before the break with traditional diction marked by the war, though he was much interested in experiments with classical diction and sprung rhythm. His best works were produced after the war, however: *The Sirens* (1924), *The Idols* (1928) and *The Burning of the Leaves and Other Poems* (1944). *Collected Poems* appeared in 1931. He was also concerned with the revival of verse drama, his works in this form including *Attila* (1907); *Arthur* (1923); and *The Young King* (1934). His translation of Dante's *Divine Comedy* into *terza rima*, the work of many years, was finished just before his death, at Reading, March 10, 1943. (N. Gy.)

BÍO-BÍO, an inland agricultural province of southern Chile approximately bisected by latitude 37° 30′ S. Created in 1875 from Arauco province, Bío-Bío has an area of 4,343 sq.mi. Pop. (1960) 167,286. Los Ángeles (pop. [1959 est.] 31,812) is the provincial capital and commercial centre.. It lies about 300 mi. S. of Santiago, and 60 mi. S.E. of Concepción. It was founded in 1739 and elevated to city rank in 1852. Los Ángeles was repeatedly attacked and several times destroyed in the long struggle with the Araucanians. Its industries process milk, wine, wheat and sugar beets; cattle and sheep are shipped north. The products arise chiefly from the farms of the longitudinal valley although dairy and meat livestock are raised at higher altitude in the cordilleran part of the province. The state railway and dry-season roads link the city to Santiago, Concepción and Puerto Montt. Hydroelectric power for the province, as well as for the industrial hub of Concepción, is produced at El Abanico, on the Laja river.

The province is in a zone subject to earthquakes and from time to time Los Ángeles and other towns have suffered severely. (J. T.)

BIOCHEMISTRY, the branch of science that deals with the chemistry of living organisms, has enabled man to live better and longer through its applications to nutrition, medicine, genetics, agriculture and other fundamental facets of life.

The terms biochemistry, biological chemistry and physiological chemistry are often used interchangeably. As a field of specialization, this is a young science; however, although the term biochemistry has been in use only since about 1900, the origins of the science can be traced far back in the early history of organized knowledge. Biochemistry lies in the border area between the biological and the physical sciences, between physiology and chemistry. Its early history is a part of the early history of these subjects.

History.—The natural development of scientific knowledge has proceeded from the simple to the more intricate. The complexities of living matter are such that a genuine body of biochemical theory in the modern scientific sense could not be developed until the study of simpler inanimate systems had provided a sound theoretical basis for chemistry itself and until the science of biology had progressed from the earlier completely descriptive phase to the study of function. Man's interest in living nature has always been spurred by the practical necessities of obtaining an adequate supply of food and by the desire for good health. The alchemists searched not only for a method of making gold from baser metals but also for an elixir of life, sensing vaguely that knowledge of the chemical transformations of matter might lead to power to cure disease. The iatrochemists of the 16th century taught that the main purpose of chemical studies was to make medicines and thus aid the physician.

Before chemistry could contribute adequately to medicine and agriculture, however, it had to free itself from immediate practical demands in order to become a pure science. This happened in the period from about 1650 to 1780, starting with the work of Robert Boyle and culminating in that of Antoine Laurent Lavoisier, the father of modern chemistry. Boyle questioned the basis of the chemical theory of his day and taught that the proper object of chemistry was to determine the composition of substances. His contemporary, John Mayow, observed the fundamental analogy between the respiration of an animal and the burning or oxidation of organic matter in air. Then, when Lavoisier carried out his fundamental studies on chemical oxidation, grasping the true nature of the process, he also showed, quantitatively, the similarity between chemical oxidation and the respiratory process. Photosynthesis was another biological phenomenon that occupied the attention of the chemists of the late 18th century. The demonstration, through the combined work of Joseph Priestley, Jan Ingenhousz and Jean Senebier, that photosynthesis was essentially the reverse of respiration was a milestone in the development of biochemical thought.

In spite of these early fundamental discoveries, rapid progress in biochemistry had to wait upon the development of structural organic chemistry, one of the great achievements of 19th-century science. A living organism contains many thousands of different chemical compounds. The elucidation of the chemical transformations undergone by these compounds within the living cell is the central problem of biochemistry. Clearly the determination of the molecular structure of the organic substances present in living cells had to precede the study of the cellular mechanisms whereby these substances are synthesized and degraded.

There are few sharp boundaries in science, and the boundaries between organic and physical chemistry on the one hand and biochemistry on the other have always shown much overlap. Biochemistry has borrowed the methods and theories of organic and physical chemistry and applied them to physiological problems. Progress in this path was at first impeded by a stubborn misconception in scientific thinking—the error of supposing that the transformations undergone by matter in the living organism are not subject to the chemical and physical laws which apply to inanimate substances, and that consequently these "vital" phenomena cannot be described in ordinary chemical or physical terms. Such an attitude was taken by the vitalists, who maintained that natural products formed by living organisms could never be synthesized by ordinary chemical means. The first laboratory synthesis of an organic compound, urea, by Friedrich Wöhler in 1828 was a blow to the vitalists but not a decisive one. They retreated to new lines of defense, arguing that urea was only an excretory substance—a product of breakdown and not of synthesis. The success of the organic chemists in synthesizing many natural products forced further retreats of the vitalists. It is axiomatic in modern biochemistry that the chemical laws which apply to inanimate materials are equally valid within the living cell.

At the same time that progress was being impeded by a misplaced kind of reverence for living phenomena, the practical needs of man operated to spur the progress of the new science. Medicine and agriculture had long looked on chemistry as a potential ally in man's struggle with nature. The 19th and 20th centuries witnessed the fruition of this hope. As organic and physical chemistry erected an imposing and beautiful body of theory in the 19th century, the needs of the physician, the pharmacist and the agriculturalist provided an ever-present stimulus for the application of the new discoveries of chemistry to various urgent practical problems.

Liebig and Pasteur.—Two outstanding figures, the German Justus von Liebig (1803–73) and the Frenchman Louis Pasteur (1822–95), were particularly responsible for dramatizing the successful application of chemistry to the study of biology. Liebig studied chemistry in Paris and carried back to Germany the inspiration gained by contact with the former students and colleagues of Lavoisier. He established at Giessen a great teaching and research laboratory, one of the first of its kind, which drew students from all over Europe.

Besides putting the study of organic chemistry on a firm basis, Liebig engaged in extensive literary activity, attracting the attention of all scientists to organic chemistry and popularizing it for the layman as well. His classic works, *Die organische Chemie in ihrer Anwendung auf Agrikulturchemie und Physiologie* (1840) and *Die Tierchemie, oder die organische Chemie in ihrer Anwendung auf Physiologie und Pathologie* (1842), were prepared as a report on the state of knowledge in organic chemistry at the request of the British Association for the Advancement of Science and had a profound influence on contemporary thought. Liebig described the great chemical cycles in nature. He pointed out that animals would disappear from the face of the earth if it were

not for the photosynthesizing plants, since animals require for their nutrition the complex organic compound that can be synthesized by the plants alone. Even carnivores are dependent eventually on herbivorous forms. The animal builds a portion of its food into its own body and oxidizes a portion to carbon dioxide and water and other simple products. The animal excretions and the animal body after death are also converted by a process of decay to simple products that can be reutilized only by plants.

In contrast with animals, green plants require for their growth only carbon dioxide, water, mineral salts, a source of nitrogen, such as ammonia, and sunlight. The minerals must be obtained from the soil, and the fertility of the soil depends on its ability to furnish the plants with these essential nutrients. But the soil is depleted of these materials by the removal of successive crops. Hence the need for fertilizers. Liebig pointed out that chemical analysis of plants could serve as a guide to the substances that should be present in fertilizers. Agricultural chemistry as an applied science was thus born.

In his analysis of fermentation, putrefaction and infectious disease, Liebig was less fortunate. He admitted the similarity of these phenomena, but refused to admit that living organisms might function as the causative agents. It remained for another great chemist, Pasteur, to found the science of bacteriology. Pasteur proved that various yeasts and bacteria were responsible for causing fermentation and disease. He also demonstrated the usefulness of chemical methods in studying these tiny organisms. Pasteur put the study of the processes of fermentation and putrefaction on a sound scientific basis.

Bernard.—Not all the men who grasped the power of chemical tools in solving biological problems were trained initially as chemists. The great French physiologist Claude Bernard (1813–78) was trained as a physician. Among his many achievements were the discovery of glycogen or animal starch and the demonstration of the role of the liver as a storage depot for carbohydrates. Physiologists trained in the traditions of Claude Bernard could not help recognizing the importance of the chemical approach. It became common for research laboratories devoted to physiological studies to acquire an adjoining chemical laboratory. The chemists themselves, however, were often too busy with their own interesting problems to spend much effort on the problems of most pressing interest to the biologists. A need for a new type of specialist arose. The pressure came particularly from medicine, and physiological chemistry developed, in part, as a kind of applied chemistry, with a principal objective of providing the clinician with aids for the diagnosis and treatment of disease.

Growth of Special Training, Journals and Societies.—The first institute for physiological chemistry was established at the University of Strasbourg in 1872 under the direction of Ernst Felix Hoppe-Seyler. In the United States, the Sheffield Scientific school at Yale university began giving graduate training in physiological chemistry in 1880. After about 1900 the provision of special advanced training in biochemistry at universities became general in many countries. Departments of biochemistry frequently developed as offshoots of departments of physiology. Thus Sir Frederick Gowland Hopkins took charge of the chemistry laboratory in the department of physiology at Cambridge university in 1899, and was appointed to the newly established chair of biochemistry at that institution in 1914.

The increase in the number of trained scientists devoting their time to biochemical studies is evidenced by the founding of scientific journals and periodicals. In the absence of any journals devoted exclusively to biochemical subjects, scientific papers in this field were published in various journals of chemistry, physiology, medicine and related disciplines. In 1871 R. Maly began issuing the *Jahres-Bericht über die Fortschritte der Tier-Chemie,* which appeared in yearly volumes until 1919. With the assistance of biochemists in other countries, Maly abstracted from various scientific journals published all over the world all those papers that had primarily a biochemical content. The first scientific journal devoted exclusively to the subject of biochemistry was the *Zeitschrift für physiologische Chemie,* founded by Hoppe-Seyler in 1877. The U.S. *Journal of Biological Chemistry* was founded in 1905, and the British *Biochemical Journal* in 1906. In the same year another German journal, *Biochemische Zeitschrift,* also was founded. The French *Bulletin de la Société de Chimie Biologique* first appeared in 1914 and the *Journal of Biochemistry* (Japan) in 1922. With temporary interruptions during World Wars I and II, there has been a steady increase in number of new journals containing biochemical papers and in the volume of material published by the older journals as well.

Paralleling the growth of journals was the growth of scientific societies. The American Society of Biological Chemists was founded in 1906 by a group of members of the Physiological society, spurred, perhaps, by the formation in 1905 of a biochemical section of the American Chemical society. The British Biochemical society, founded in 1911, was also an offshoot of the Physiological society. These two biochemical societies own and control the *Journal of Biological Chemistry* and the *Biochemical Journal* (London), respectively.

Scope.—The field of biochemistry has become so large that many subspecialities are recognized. Some are practised largely as applied sciences; *e.g.,* clinical chemistry and nutrition. Taken as a whole, however, modern biochemistry has outgrown the status of an applied science and has acquired a place among the pure or theoretical sciences. There has been a tendency since about 1950 to call biochemistry "molecular biology," since biochemistry is concerned with all types of living organisms and its ultimate goal is to achieve a complete description of life at the molecular level. The term molecular biology can also be used conveniently to denote the combined areas covered by biophysics (*q.v.*) and biochemistry. The distinction between these two latter areas is not at all clear-cut, since it is based on the methodology employed rather than on the areas investigated and the problems for which answers are sought.

A description of life at the molecular level must include a description of all the complexly interrelated chemical changes that occur within the cell; *i.e.,* the processes known as intermediary metabolism (*see* METABOLISM). The processes of growth, reproduction and heredity (*qq.v.*) are also subjects of the biochemist's curiosity; these processes are intimately related to intermediary metabolism, and cannot be understood independently of it. The properties and capacities exhibited by a complex multicellular organism can be reduced to the properties of the individual cells of that organism, and the behaviour of each individual cell can be understood in terms of its chemical structure and the chemical changes occurring within that cell. When all the chemical changes within a cell are completely described and understood, man will have achieved as complete an understanding of life as can be achieved by the intellect alone. Living processes are sufficiently complex, however, to guarantee the biochemist enough unsolved problems to last into the unforseeable future.

Chemical Composition of Living Matter.—Living organisms of diverse types differ markedly in their chemical makeup. In a single individual, moreover, various tissues and secretions, such as blood, muscle, liver, bone and milk, show enormous differences in composition, reflecting their diverse functions. Nevertheless, the living cell itself, apart from secretions, interstitial material and supporting structures, shows a pattern of similarity in chemical constitution from species to species and from one tissue to another in the same species.

Every living cell contains, in addition to water and salts or minerals, a large number of organic compounds (*see* CHEMISTRY: *Organic Chemistry*). The organic substances of living cells are composed of carbon combined with varying amounts of hydrogen and usually also of oxygen. Nitrogen, phosphorus and sulfur are likewise common constituents. In general, the bulk of the organic matter of a cell may be classified as (1) sugar, or carbohydrate, (2) fat, or lipid and (3) protein. Nucleic acids and various porphyrin derivatives are also important constituents. Each of these classes or groups contains a great diversity of individual compounds. Many substances that cannot be classified in any of the above categories also occur, though usually not in large amounts.

The knowledge already accumulated about the chemical composition of living matter is not by any means complete. In the case of substances of low molecular weight, however, the general methods for determining chemical structure had largely been worked out by the early 1960s. The organic chemists achieved marked success in solving many problems of identification of unknown materials that were first detected only by their physiological effects. The determination of the structure of the hormones thyroxine and adrenaline and of the various vitamins may be cited as examples. The development of the chemistry of the steroids, including that of the sex hormones and of the adrenal hormone cortisone, likewise stands as a monument to the skill of the organic chemist. Great gaps still existed by the late 1960s, however, particularly in information about the details of the structural composition of the larger molecules such as proteins and nucleic acids.

Proteins and Nucleic Acids.—In the case of polymers of high molecular weight, the determination of structural detail is extraordinarily complex. Proteins, for example, are composed of long chains of amino acids linked by peptide bonds; *i.e.*, bonds formed between the carboxyl group of one amino acid and the amino group of the next. A protein molecule may contain several thousand amino acid residues. The relative amount of each of the amino acids present in a molecule of protein can be determined by special methods of analysis. It is necessary to know also the order in which the amino acids occur in the peptide chains, and this is a more difficult problem. Even though there are only about 24 different amino acids, it is clear that there is an enormous number of different sequences in which a thousand such units could be arranged in linear order. The amino acid sequence and the complete chemical structure of the protein hormone insulin was determined by Frederick Sanger and his associates in the 1950s. By 1963 the sequence of amino acids in the protein enzyme ribonuclease had also been determined. These are relatively small proteins, insulin having a molecular weight of only 5,700 and ribonuclease, 12,700.

In principle, the analytic methods successfully applied in determining the structure of insulin and ribonuclease can also be used to determine the structure of large proteins; but for those with molecular weights in the range of 10^5 to 10^6 this will be a very formidable task. The structure of proteins involves other problems than the determination of amino acid sequences. The protein in its natural state in the cell is often a very unstable substance. Its properties can sometimes be changed by very mild procedures. In this case it is thought that the folding or arrangement of the peptide chain is somehow altered.

A number of powerful physical techniques have been applied with marked success to the study of the structure of protein molecules. One of the most successful of these has been X-ray analysis. Applied to fibres and crystals, this method has given much information about the way peptide chains are coiled and folded in the protein molecule. The oxygen-carrying blood pigment, hemoglobin, and the related muscle pigment, myoglobin, have been subjected to intensive analysis by X-ray diffraction, and by 1960, J. C. Kendrew and M. F. Perutz had constructed detailed atomic models of the structure of these complex proteins on the basis of the X-ray data. Their conclusions have been corroborated and extended by chemical studies, with the result that the structure of hemoglobin and myoglobin have been completely described. (*See* also X-RAYS: *Single-Crystal Structure Research.*)

Other physical methods that have been highly useful for studying protein structure include the use of electrophoresis (*q.v.*) techniques, to measure migration in an electric field; of the ultracentrifuge to measure migration in a gravitational field (*see* CENTRIFUGE: *The Analytical Ultracentrifuge*); and of optical rotation measurements, which give information about the nature and extent of helical coiling of the peptide chain within a protein molecule.

The great importance attached to proteins by the biochemist is partly attributable to the demonstrated functional role of these substances in the cell. The chemical reactions that occur in the living cell are catalyzed by substances called enzymes, and these key substances all appear to be proteins. In fact, a large proportion of the protoplasmic protein must have some enzymatic function.

The nucleic acids (*q.v.*) constitute another group of cellular constituents of high molecular weight. They are composed of chains consisting of alternating units of carbohydrate and phosphate with each carbohydrate residue linked to a nitrogenous base, which may be a purine or a pyrimidine. The nucleic acids exist in the cell in combination with protein, as nucleoprotein. The chromatin of the nucleus consists of nucleoprotein and the genes (the carriers of hereditary characteristics) are composed of deoxyribonucleic acid. The difficulties encountered in determining the chemical structure of nucleic acids are similar in some respects to those encountered in determining protein structure. In both instances, an enormous variety of different molecules are possible because of the high molecular weight.

Different types of living organisms may contain identical materials of low molecular weight, but the proteins and probably the nucleic acids are characteristic of a species. It is here that the chemical basis for the more obvious anatomical differences between divergent forms of life is found.

Nutrition.—Biochemists have long been interested in the chemical composition of the food of animals. The practical value of knowing what must be present in the diet to ensure good health is self-evident. The fact that knowledge of essential dietary constituents may help in an understanding of the nature of life processes, however, requires emphasis.

All animals require organic material in their diet, in addition to water and minerals. This organic matter must be sufficient in quantity to satisfy the caloric or energy requirements of the animals. Within certain limits, carbohydrate, fat and protein may be used interchangeably for this purpose. In addition, however, animals have nutritional requirements for specific organic compounds. Certain essential fatty acids, about ten different amino acids (the so-called essential amino acids) and a heterogeneous group of compounds called vitamins (*q.v.*) are required by many higher animals. The nutritional requirements of various species are similar but not necessarily identical. Thus man and the guinea pig require vitamin C or ascorbic acid, whereas the rat does not.

In all cases, the need for a specific substance in the diet indicates that the organism requires this particular substance for proper cellular function and that the tissues of the animal are unable to synthesize the substance from any other available material. In the absence of a particular vitamin or amino acid, the cells cannot carry out certain necessary chemical reactions. Such chemical deficiencies underlie the functional and anatomical changes that are so often characteristic of vitamin deficiency. The chemical functions of some of the vitamins in the cell are known. Thiamine (vitamin B_1), riboflavin (vitamin B_2), niacin, pyridoxine (vitamin B_6) and cobalamine (vitamin B_{12}) all function as components of specific enzyme systems. Vitamin A aldehyde forms a part of visual purple, the retinal pigment responsible for vision in dim light. Hence, vitamin A deficiencies lead to night blindness. Thus, the demonstration of a nutritional requirement can actually serve as a tool to help elucidate the chemical mechanisms operating in the cell.

The photosynthesizing plants differ from animals in requiring no preformed organic material. Instead they make all their cellular material from simple substances, carbon dioxide, water, salts and a source of nitrogen such as ammonia or nitrate. The energy for this process is furnished by sunlight. The process of photosynthesis (*q.v.*) itself is primarily concerned with manufacture of carbohydrate, from which fat can be made by animals that eat plant carbohydrates. Protein can also be formed from carbohydrate precursors provided ammonia is furnished.

In spite of the large apparent differences in nutritional requirements of plants and animals, the patterns of chemical change within the cell are the same. The plant itself manufactures all the materials it needs, but these materials are essentially similar to those which the animal cell uses and are often handled in the same way once they are formed. Plants could not furnish animals with their nutritional requirements if the cellular constituents in the two forms were not basically similar. (*See* also NUTRITION.)

Digestion.—The organic food of animals and men consists in part of large molecules. In the digestive tracts of higher animals these molecules are hydrolyzed or broken down to their component building blocks. Proteins are converted to mixtures of amino acids, and polysaccharides are converted to monosaccharides. In general, all living forms use the same small molecules, but many of the large complex molecules are different in each species. An animal, therefore, cannot use the protein of a plant or of another animal directly, but must first break it down to amino acids and then recombine the amino acids into its own characteristic proteins. The hydrolysis of food material is necessary also to convert solid material into soluble substances suitable for absorption. The liquefaction of stomach contents aroused the early interest of observers, long before the birth of modern chemistry, and the hydrolytic enzymes secreted into the digestive tract were among the first enzymes to be studied in detail. Pepsin and trypsin, the proteolytic enzymes of the gastric and pancreatic juice, respectively, continue to be intensively investigated.

Absorption and Secretion.—The products of enzymatic action on the food of an animal are absorbed through the walls of the intestines and distributed to the body by the blood and lymph. In organisms without digestive tracts, substances must also be absorbed in some way from the environment. When a substance passes across a cell membrane in either direction (*i.e.*, from the outside to the inside, or from the inside to the outside) the problem of the mechanism of this reaction arises. Examples of this problem include the mechanisms whereby the kidney forms urine; the plant roots take up minerals from the soil; and a bacterium takes up some materials from a medium in which it is growing, excludes others or even secretes or excretes certain substances from the cell into the medium. In some instances simple diffusion appears to be sufficient to explain the transfer of a substance across a cell membrane. In other cases, however (*e.g.*, in the case of the transfer of glucose from the lumen of the intestine to the blood), transfer occurs against a concentration gradient. That is, the glucose may move from a place of lower concentration to a place of higher concentration. Simple diffusion cannot explain such a process. Some evidence was provided to indicate that glucose is phosphorylated at some site where it is taken up and dephosphorylated at another site where it is released. Whether or not such an explanation is correct, it appears clear that the problem of mechanism here is a chemical one.

In the case of the secretion of hydrochloric acid into gastric juice, it was shown that active secretion is dependent on an adequate oxygen supply (*i.e.*, on the respiratory metabolism of the tissue), and the same holds for absorption of salts by plant roots. The energy released during the tissue oxidation must be harnessed in some way to provide the energy necessary for the absorption or secretion. This harnessing is achieved by a special chemical coupling system. The elucidation of the nature of such coupling systems is an objective of the biochemist.

Blood.—One of the animal tissues that has always excited special curiosity is blood (*q.v.*). Blood has been investigated intensively from the early days of biochemistry, and its chemical composition is known with greater accuracy and in more detail than that of any other tissue in the body. The physician takes blood samples to determine such things as the sugar content, the urea content or the inorganic ion composition of the blood, since these show characteristic changes in disease.

The blood pigment hemoglobin has been intensively studied. Hemoglobin is confined within the blood corpuscles and carries oxygen from the lungs to the tissues. It combines with oxygen in the lungs, where the oxygen concentration is high, and releases this oxygen in the tissues where the oxygen concentration is low. The site of combination with oxygen is an iron atom complexed with a porphyrin ring that is bound to a protein, globin. The hemoglobins of higher animals are related but not identical. In invertebrates other pigments may take the place and function of hemoglobin. The comparative study of these compounds constitutes a fascinating chapter in biochemical investigation.

The proteins of blood plasma also have been extensively investigated. Methods have been developed for the large-scale fractionation and purification of these substances. The gamma globulin fraction of the plasma proteins contains the antibodies of the blood and is of practical value as an immunizing agent. An animal develops resistance to disease largely by antibody production. The antibodies are proteins that have the ability to combine with an antigen; *i.e.*, an agent that induces their formation. When this agent is a component of a pathogenic bacterium, the antibody can protect an organism from infection by that bacterium. The chemical study of antigens and antibodies and their interrelationship is known as immunochemistry.

Intermediary Metabolism.—Whether a cell is moving or not, whether it is growing or wasting, it is the site of a constant, complex and orderly set of chemical changes. One may visualize these changes in the following way. The structure of the living cell is essentially unstable. It is constantly breaking down. There is therefore a constant need for repair. The cell makes the chemical building blocks necessary for this repair from its nutrients, and rebuilds its own substance. Such synthetic processes as well as work done on the external environment require energy. The energy must be obtained by the breakdown of other food molecules. In aerobic organisms, energy is obtained by the oxidation of the food; in anaerobic organisms, other chemical changes yield the energy. In photosynthetic organisms, the cell manufactures its own food with the energy of sunlight. Nevertheless, the patterns of breakdown and repair are similar in all living forms.

This process of chemical change, called metabolism, is associated with a release of heat. Precise measurements have been made of the heat released by both higher and lower organisms, and these measurements have been compared with the net chemical changes that occur simultaneously. The heat released is the same as that obtained if the same chemical change is brought about outside the living organism. This confirms the fact that the laws of thermodynamics apply to living systems just as they apply to the inanimate world. However, the pattern of chemical change in a living cell is distinctive and different from anything encountered in nonliving systems. This difference does not mean that any chemical laws are invalidated. It resides rather in the extraordinary complexity of the interrelations of cellular reactions.

The body has been likened to a machine that is driven by the combustion of some fuel provided from the outside. The fuel is likened to the food an animal eats. Such an analogy has only a superficial validity. To improve it, one must try to imagine a machine in which it is necessary that some of the structural components be broken down and repaired automatically during operation, this breakdown and repair being intermeshed with the combustion of the fuel in such a way that it often becomes meaningless to inquire whether a particular component of the process represents one or the other, combustion of the fuel or breakdown and repair of mechanical parts.

Methods of Study.—Many different methods have been used to study intermediary metabolism. Early studies were concerned with the analysis of food and excretions. The net chemical change occurring in the body could thereby be ascertained, but this gave no information about the detail of the over-all process. More was learned from studies of the effect of metabolic diseases (*see* METABOLISM, DISEASES OF), such as diabetes, on excretory products. In another type of approach, chemical substances foreign to an animal were administered and the special excretory products were identified. Valuable hints were thereby obtained concerning the chemical transformations occurring in the body under more normal circumstances.

At a later stage, isolated tissues and organs were examined, as were slices and extracts prepared from various tissues. The chemical processes occurring in the body do not terminate with the death of the organism. Minced liver and muscle continue to consume oxygen and to convert foodstuffs to carbon dioxide and various other end products. Examination of the chemical changes occurring in such preparations has given much information about metabolic processes. (*See* TISSUE CULTURE.)

Empirical procedures were developed for obtaining parts of a reaction system separated from other parts. Poisons or inhibitors may be added to stop certain reactions and cause substances nor-

mally present at very low concentrations to accumulate in such quantity that they can be isolated and identified.

For the final determination of a detail of a particular reaction mechanism, it may be necessary to separate the enzyme causing the reaction from all other enzymes. Such procedures necessarily involve a complete destruction of the organization of a living cell, and they have been likened to the procedure of smashing a watch with a hammer in order to find out how it works. This analogy implies some doubt of the validity of these procedures, and it is indeed necessary to devise other means to determine whether the information obtained by studying the enzymes in a tissue extract gives useful information about the metabolism of the intact organism. Determinations of nutritional requirements and of excretory products are often helpful in this connection, but they have only limited applicability.

Among the most useful tools for studying the metabolism of the intact organism are radioactive and stable isotopes of the elements most commonly found in living matter. These became generally available after World War II. Radioactive carbon (C^{14}), heavy nitrogen (N^{15}), radioactive phosphorus (P^{32}) and heavy hydrogen (deuterium) have been applied with particular success to the study of biochemical problems. The usefulness of these substances rests on the fact that the heavy or radioactive isotopes react chemically just as do the normal elements, but can be distinguished from the normal elements by sensitive physical analytical methods. A substance such as glucose may be "labeled" or "tagged" with C^{14} by incorporation of the C^{14} into some particular position in the molecule. The glucose may then be fed to an animal, and, at various time intervals, the distribution of the C^{14} in various body constituents is determined. The fate of a particular atom in the glucose molecule can thereby be determined. The information thus gained can be compared with the results that would be predicted from facts learned by studies of extracts, or, when insufficient facts are available, tracer results may serve as a valuable guide for enzyme studies with extracts. The two methods of approach supplement each other. Tracer procedure proved a rich source of new information and provided excellent evidence that analytical methods of the enzymologist have validity for the intact organism. (*See* also ISOTOPE: *Uses of Isotopes*.)

Carbohydrate Metabolism.—The second quarter of the 20th century witnessed a striking advance in the elucidation of the manner in which living cells handle small molecules. The processes of breakdown and synthesis of carbohydrates, fats and many of the naturally occurring amino acids are in part understood. The metabolism of carbohydrate in the mammal may be discussed first from the point of view of the interrelations between different organs.

The sugars and amino acids absorbed from the intestine are carried by the portal vein first to the liver. In the liver, the sugars and some amino acids are converted to glycogen or animal starch, a high-molecular-weight substance made up of many glucose units. Glycogen is the storage form of carbohydrate in the liver. The concentration of glucose in the systemic circulation that takes blood to all parts of the body is under the control of the liver. In the normal individual, blood sugar concentration is held remarkably constant at about 80 mg. per 100 ml. When the blood sugar tends to drop below this concentration, the liver feeds more sugar into the blood stream, breaking down stored glycogen for the purpose.

The muscles of the body also store sugar as glycogen, but they cannot reconvert the glycogen to blood sugar. They degrade the sugar in order to obtain energy for work. If the oxygen supply to the muscle is adequate, the sugar is oxidized completely to carbon dioxide and water. If oxygen is in short supply, as may happen during vigorous exercise, the glucose is converted to lactate which may be returned by the blood stream to the liver and reconverted to glycogen. Other tissues of the body use glucose also, of course, but the largest consumer is muscle.

In diabetes mellitus there is a deficiency of the pancreatic hormone insulin. Insulin is necessary for the proper regulation of the blood sugar concentration. In its absence the sugar levels become abnormally high, and some of the sugar spills over into the urine through the kidney. Fat metabolism is likewise interfered with in diabetes. Besides glucose, the so-called ketone bodies—acetone, acetoacetic acid and β-hydroxy butyric acid—also accumulate in the blood and urine. The ketone bodies are products of the incomplete oxidation of fats.

Glycolysis and Fermentation.—The term glycolysis means the process of converting glucose or glycogen to lactate. This occurs anaerobically; *i.e.*, no oxygen is required. Glycolysis may be regarded as a special kind of fermentation (*q.v.*). Fermentation, then, is a more general term referring to a group of anaerobic processes that involve a conversion of carbohydrate to a variety of end products. Glycolysis occurs in muscle and most other tissues of the animal body. In muscle this process has excited interest because of its apparent relation to muscular contraction. It was observed very early that the muscles of animals killed after a hunt contained appreciable amounts of lactic acid. Further studies showed that excised muscle, caused to contract repeatedly by electrical stimulation, also accumulated lactic acid, at the expense of the stored glycogen.

The reactions of glycolysis are understood in considerable detail. The over-all reaction can be expressed by the equation:

$$\text{glucose} + 2 \text{ adenosine diphosphate} + 2 \text{ phosphate} \rightarrow 2 \text{ lactate} + 2 \text{ adenosine triphosphate}$$

Each glucose molecule is converted to two molecules of lactate, and at the same time two molecules of adenosine diphosphate each acquire a molecule of inorganic phosphate to form two molecules of adenosine triphosphate.

This net change actually occurs in a sequence of 11 separate steps. Each of the steps is catalyzed by a separate, specific enzyme (*see* ENZYMES). Each reaction in itself is simple, consisting, for example, of a transfer of phosphate or of hydrogen from one molecule to another or from one position to another in the same molecule, a gain or loss of water or a splitting off of carbon dioxide. The reaction may proceed in either direction, depending on the relative concentration of the reaction components. Some of the reactions, however, proceed in only one direction; *i.e.*, irreversibly. Now, the body can convert lactate to glucose, but it cannot do so by means of the identical path used for the conversion of glucose to lactate. The reversible steps in the latter process are used in the back reaction, but the irreversible steps must be circumvented.

Another feature to be emphasized is the interlinking of the reactions. Adenosine triphosphate (ATP) and diphosphopyridine nucleotide (DPN) participate at several places. A step in the forward direction involves a conversion of DPN to DPNH. For example, glyceraldehyde transfers hydrogen to DPN, thereby reducing it. Other steps involve a conversion of DPNH to DPN. For example, pyruvate accepts hydrogen from DPNH, thereby oxidizing DPNH and thus regenerating DPN. In an analogous manner, those reactions that involve a conversion of adenosine triphosphate (ATP) to adenosine diphosphate (ADP) may be linked with the steps that convert ADP to ATP.

Glycogen and glycerol are also formed from glucose. Other reactions are known to occur with some of the substances formed during glycolysis. Many other enzymes cause oxidation-reduction reactions with DPN and TPN, and phosphate transfers from ATP. To discuss these details further is beyond the scope of this article. The purpose of the discussion has been mainly to give some concrete notion of what is meant when the processes of intermediary metabolism are described as a "network" of chemical reactions.

Some or all of the reactions occur in microorganisms and plants as well as in animal tissues. Thus, the process whereby yeast converts glucose to ethyl alcohol is identical with the process of lactate formation in muscle up through the formation of pyruvate. Here the processes in yeast and muscle diverge. Yeast contains an enzyme, pyruvic carboxylase, which is not present in muscle. This enzyme splits a molecule of carbon dioxide from pyruvate, thereby forming acetaldehyde. The acetaldehyde then reacts with DPNH to form ethyl alcohol and DPN in the presence of another enzyme called alcohol dehydrogenase, which is quite distinct and different from lactic dehydrogenase, the muscle enzyme. Other fermentation processes proceed by a similar sequence of interrelated re-

actions. Some of the individual reactions may be the same as those of glycolysis, but others may not, so that the end products of the various types of fermentation are different, although the processes themselves may have many individual reactions in common.

Energy Utilization.—One of the most important features of glycolysis is the phosphorylation that accompanies the conversion of glucose to lactate. For every molecule of glucose that is degraded, two molecules of adenosine triphosphate are formed from adenosine diphosphate and inorganic phosphate. The energy released in the conversion of glucose to lactate is stored as chemical energy in the adenosine triphosphate. If it were not for this storage mechanism, the energy of the degradation would be lost as heat.

Muscular work requires energy, and this energy is obtained from carbohydrate breakdown by way of adenosine triphosphate. In the process of transferring energy to the muscle fibre, the adenosine triphosphate is reconverted to adenosine diphosphate and inorganic phosphate. Biochemists are currently concerned with the elucidation of the precise manner in which the chemical energy of the phosphate bond is converted to the mechanical energy associated with the contraction and relaxation of the muscle fibres.

Biological processes other than muscular contraction likewise require energy. The synthesis of complex molecules, the transfer of molecules across cell membranes and the conduction of an impulse along a nerve may all be cited as examples. In these and other instances, the chemical mechanism of energy utilization constitutes an interesting problem. Though the final steps in energy utilization may be of very different nature in the individual cases, it appears that the adenosine phosphates play a central role in linking the chemical reactions that release energy with the processes that require energy.

Carbohydrate Oxidation.—When carbohydrate is oxidized to carbon dioxide and water in an animal tissue, the first steps in the breakdown are identical with the steps of glycolysis, up through the formation of pyruvate. The steps whereby pyruvate is oxidized to carbon dioxide and water are known collectively as the tricarboxylic acid or citric acid cycle. They also are sometimes called the Krebs cycle (*q.v.*) in honour of their discoverer, Sir Hans Adolf Krebs. Specifically, pyruvate first undergoes an oxidation to form carbon dioxide and acetyl-coenzyme A, a derivative of acetate. The acetyl-coenzyme A then condenses with oxaloacetate to form, in succession, citrate and carbon dioxide, cis-aconitate, isocitrate, oxalosuccinate, α-ketoglutarate and carbon dioxide, succinate and carbon dioxide, fumarate, malate and finally oxaloacetate. One of the starting materials is thus regenerated by a cyclic path. Pyruvate is not regenerated, however, so that the net effect of going once around the cycle is to form three molecules of carbon dioxide at the same time that pyruvate, a three-carbon compound, disappears.

Oxygen is required for the operation of the tricarboxylic acid cycle. Several of the steps in the cycle require a removal of hydrogen atoms from organic combination, and this hydrogen (H) is eventually transferred to molecular oxygen to form water. The transfer occurs again over a sequence of reactions. The individual steps are all oxidation-reduction reactions, and the enzymes that cause them may be termed respiratory catalysts. An oxidation involves a removal of hydrogen or electrons or both, and a reduction involves an addition of hydrogen or electrons or both. In the first step in hydrogen transfer, diphosphopyridine nucleotide (DPN) (or triphosphopyridine nucleotide, TPN) takes up hydrogen from one of the organic acids of the cycle to form DPNH (or TPNH). Then a flavoprotein takes the hydrogen from the DPNH to form DPN and reduced flavoprotein. This substance is reoxidized by a special group of catalysts, the cytochrome-cytochrome oxidase system.

The cytochromes are similar to hemoglobin, the oxygen-transporting pigment of the blood, in that they consist of proteins linked to iron-porphyrin complexes similar to the iron porphyrin of hemoglobin. The protein portions of hemoglobin and of the cytochromes are quite different, however, and account for the differences in chemical behaviour of these substances. When the cytochromes are functioning in tissue respiration, the iron atoms in the molecules alternate between the ferric (Fe^{3+}) or oxidized form and the ferrous (Fe^{2+}) or reduced form. Reduced flavoprotein transfers electrons to the ferric iron, which is thereby converted to ferrous iron. The ferrous iron is oxidized back to the ferric form by oxygen, which is converted to water.

While these reactions are taking place, adenosine diphosphate and inorganic phosphate are simultaneously converted to adenosine triphosphate. This latter reaction is of the utmost importance just as in the case of the anaerobic reactions, since it represents the mechanism whereby the energy released in the oxidation process is stored as chemical energy that can then be made available to other reactions. Many molecules of adenosine triphosphate are formed during the oxidation of one molecule of glucose. The aerobic phase of carbohydrate breakdown provides far more energy in this way than the anaerobic phase, but in both cases the energy is stored in identical chemical form and must consequently be utilized by the same chemical mechanisms.

The reactions of glycolysis and of many other anaerobic processes are catalyzed by soluble enzymes. The aerobic reactions of the tricarboxylic acid cycle, on the other hand, are catalyzed by a set of enzymes built into the structure of certain cytoplasmic granules, sometimes called mitochondria. Such granules occur in plants as well as in animals. Closely related is another set of plant particles, the chloroplasts. These contain the green pigment chlorophyll and are the site of the photosynthetic process. The electron microscope (*see* MICROSCOPE: *The Electron Microscope*), with its enormous powers of resolution, is providing a wealth of information about the fine anatomical structure of such particles.

Fats and Amino Acids.—A detailed picture is available of the metabolism of fatty acids and also of the synthesis, breakdown and interconversion of many of the amino acids. The path of oxidation of fatty acids terminates in the same tricarboxylic acid cycle used for oxidation of carbohydrate. The metabolic paths of the amino acids are interlocked also with the metabolism of fat and carbohydrate. This is an area subject to active current research, and each year sees marked further progress. In principle, however, the manner in which these substances are handled is similar to that in which carbohydrate is handled. Although the details are different, the chemical changes take place as an interlaced sequence of individual simple steps, each catalyzed by a specific enzyme. The question of how these enzymes are formed may next be considered.

It is characteristic of the action of enzymes that they are not consumed during the reactions that they catalyze. The enzymes must, however, be synthesized initially from their building blocks, mainly amino acids. Tbe mechanism of protein synthesis or of enzyme synthesis was not completely understood in the mid-1960s. It was certain, however, that the problem had greater complexity than the problem of the metabolic fate of small molecules. It is in the chemistry and metabolism of small molecules that the basic similarities among living forms are apparent, but in the chemistry and metabolism of the large molecules, the proteins, nucleic acids and some polysaccharides, researchers must at some stage reach a level of investigation where differences rather than similarities will be emphasized.

Cellular Anatomy.—The development of centrifugation techniques has led to methods for the separation of different functional parts of the cell. If a cell is disrupted by mild treatment, the resulting homogenate can be separated by differential centrifugation into nuclei, mitochondria and microsomes. The mitochondria, containing the enzyme assemblies required for the oxidation of carbohydrates and fats, have been called the "powerhouses" of the cell. The microsomes, on the other hand, are equipped to assemble peptide chains from activated amino acids and thus synthesize proteins. The detailed structure of such particles is revealed by the electron microscope—an instrument that has led to a fusion of interest between cell anatomists and biochemists. (*See* also ANATOMY, MICROSCOPIC; MICROMANIPULATION; ULTRAMICROCHEMISTRY.)

Hormones.—These substances, which may be regarded as regulators of metabolism, are investigated at three levels, to determine (1) their physiological effects, (2) their chemical structure and (3)

the chemical mechanisms whereby they operate. The study of the physiological effects of hormones is properly regarded as the province of the physiologist. Such investigations obviously had to precede the more analytical chemical studies. The chemical structures of thyroxine and adrenaline are known. The chemistry of the sex and adrenal hormones, which are steroids, has also been thoroughly investigated. The hormones of the pancreas, insulin and glucagon, and the hormones of the hypophysis (pituitary gland) are peptides, composed of chains of amino acids. By the mid-1960s the structure of most of these hormones had been determined or were close to elucidation. The chemical structure of the phytohormones, auxin and gibberellic acid, which act as growth-controlling agents in plants, were also known. (*See* PLANTS AND PLANT SCIENCE: *Plant Physiology: Hormones.*)

The first and second phases of the hormone problem thus have been well, though not completely, explored, but the third phase is still in its infancy. It seems likely that different hormones exert their effects in different ways. Some may act by affecting the permeability of membranes; others appear to control the synthesis of certain enzymes. There is also evidence that some hormones control the activity of certain genes. (*See* also HORMONES, VERTEBRATE.)

Genes and Heredity.—Genetic studies have shown that the hereditary characteristics of a species are maintained and transmitted by the self-duplicating units known as genes (*q.v.*) composed of nucleic acids and located in the chromosomes of the nucleus. One of the most fascinating chapters in the history of the biological sciences contains the story of the elucidation, in the mid-20th century, of the chemical structure of the genes, their mode of self-duplication, and the manner in which the deoxyribonucleic acid (DNA) of the nucleus causes the synthesis of ribonucleic acid (RNA). This messenger RNA travels to the ribosomes in the cytoplasm, conveying from the genetic material (the nuclear DNA) directions for the sequence in which the amino acids should be assembled in the proteins which the ribosomes synthesize. The chemical properties of a protein are ultimately determined by the amino acid constituents of that protein and by the sequence in which they are arranged. Thus the capacity of a protein to behave as an enzyme catalyst is determined by the chemical constitution of the gene (DNA) which directs the synthesis of the protein. The relationship of genes to enzymes has been demonstrated in several ways. The first successful experiments were devised by George W. Beadle and Edward L. Tatum (*qq.v.*). Using the bread mold *Neurospora crassa*, they were able to collect a variety of strains that differed from the parent strain in nutritional requirements. Such strains arise as a result of a mutation (change) in the genetic makeup of the parent strain. The growth of a mutant strain might require the addition to the culture medium of a particular amino acid not required for growth by the parent strain. It could be shown that such a mutant had lost an enzyme essential for the synthesis of the amino acid in question.

The development of techniques for the isolation of mutants with specific nutritional requirements led to a special procedure for studying intermediary metabolism. Suppose information is wanted about the chemical mechanism whereby an organism synthesizes a particular amino acid represented by the symbol *AA*. This compound is formed from various precursors by a sequence of chemical steps as follows:

$$\ldots \rightarrow A \rightarrow B \rightarrow C \rightarrow AA$$

Only one of these steps is interfered with in a given mutation. When a particular step is blocked, the mutant carries out the preceding steps in the synthesis, up to the point beyond which it cannot go. Thus, a mutant blocked at the step $A \rightarrow B$ can still form compound *A*, and a mutant blocked at step $B \rightarrow C$ can still form compound *B*. Under these circumstances, compound *A* may be accumulated by the first mutant, and compound *B* may be accumulated by the second. The requirement of the first mutant for *AA* will be satisfied by *B* or *C* also, whereas the requirement of the second mutant for *AA* will be satisfied by *C*, but not by *B*. Blocks at other stages will lead to the accumulation of other substances. One may obtain a family of mutants, all requiring *AA* but blocked at different stages in its synthesis. Each member of such a family will accumulate different precursors. Isolation and chemical identification of the precursors can then lead to a demonstration of the nature of the chemical reaction sequence whereby the normal strain synthesizes the amino acid. Studies of this kind gave results consistent with those obtained both by the isotope techniques and by the techniques of enzymology. The information thus obtained is of value for the understanding of the intermediary metabolism of higher animals as well as of microorganisms, because of the similarities of metabolic processes in all forms of life.

Evolution and Origin of Life.—The exploration of space in the mid-20th century intensified speculation about the possibility of life on other planets. At the same time, man was beginning to understand some of the intimate chemical mechanisms used for the transmission of hereditary characteristics. It was possible, by studying protein structure in different species, to see how the amino acid sequences of functional proteins, *e.g.*, hemoglobin and cytochrome, have been altered during phylogeny (the development of species). It was natural, therefore, that biochemists in the 1960s should look upon the problem of the origin of life as a practical problem. The synthesis of a living cell from inanimate material was not regarded as an impossible task for the future. *See* LIFE, ORIGIN OF. *See* also references under "Biochemistry" in the Index.

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BIOGRAPHY, a narrative which seeks, consciously and artistically, to record the actions and recreate the personality of an individual life. Unlike history it deals with the individual; unlike fiction it records a life that actually has been lived. At the same time the biographer shares with the historian a concern for truth and he shares with the novelist the ambition to create a work of art. Thus the great biographies of the world are those which have presented their subjects as they were but which have gone beyond the mere collection of facts to the creation of a living portrait. Biography is of perennial interest, partly because it deals with famous or notorious or interesting personalities, but more importantly because its subject matter is human nature. Hence biography as an art may legitimately deal with any individual life, no matter how humble, provided it is made the vehicle for a penetrating analysis of human passions and human motives. It is in such biographies that Samuel Johnson saw the greatest value, those "which tell not how any man became great, but how he was made happy; not how he lost the favour of his prince, but how he became discontented with himself" (*Idler*, 84).

Early Biography.—The development of biography as an art form in western civilization may be said to begin with Plutarch (*q.v.*), but the distinction between history and biography is a modern one and it is doubtful whether any writer of antiquity, including Plutarch, clearly perceived its possible existence as an independent branch of literature. The earliest "biographical records" are royal inscriptions recording, in varying degrees of detail, a ruler's victories or other deeds (*see*, for example, BABYLONIA AND ASSYRIA: *Language and Literature*). Such records tended to be panegyric (as, for that matter, do many later biographies). The *Agricola* of Tacitus, composed near the end of the 1st century A.D., is often cited as the earliest known biography, but it might more properly be termed encomium, since it is a highly flattering account of the achievements of the author's father-in-law, Gnaeus Julius Agricola. The idea of human nature

as interesting in itself is also modern; the writing of a man's life was long considered an opportunity for celebrating certain definite moral qualities and it was in these, and not in the subject's individual characteristics, that his interest resided. For example, the chief sources for a knowledge of Socrates, the *Dialogues* of Plato and the *Memorabilia* and *Symposium* of Xenophon, while preserving much information about the personality and ideas of the philosopher, were not directed solely to biographical ends. In the gospel accounts of the life of Jesus Christ, strictly biographical details are exceedingly meagre; for a discussion of this *see* JESUS CHRIST: *Source Problem.* Even in Plutarch the emphasis was on moral instruction; nevertheless the *Parallel Lives* deserves the reputation it has long held as the earliest and one of the most successful of all attempts at biographical writing.

Plutarch's method was to narrate the life story of an eminent Greek statesman or soldier and that of an eminent Roman leader, concluding with a brief comparison of the two men. There are in the *Parallel Lives* 23 such pairs, together with 4 separate lives, making 50 biographies in all. Although admittedly writing with a view to moral instruction, Plutarch attempted to distinguish between apocryphal and authentic sources, and by a skilful selection of anecdote and salient traits of behaviour generally achieved a lifelike and memorable portrait. Since Plutarch's aim was the writing of biography rather than history, he chose whenever possible the revealing anecdote, the characteristic speech, the identifying physical trait which would reveal the man. According to Plutarch in the "Life of Alexander the Great," the most outstanding actions, such as a great battle or a famous siege, are not always the clearest indications of the character of men, but matters of less importance, such as a jest or an expression, sometimes offer better evidence of men's inclinations and their tendency toward virtue or vice.

This emphasis on "the little fact" not only makes Plutarch still one of the most readable of all biographers but begins a tradition which remains in one form or another in all succeeding biographical writing with any pretense to artistic form. The most famous translation of the *Parallel Lives* into English is that of Sir Thomas North in 1579; it was made, however, not from the Greek but from the French of Jacques Amyot (1559). The translation done by several persons under the general editorship of John Dryden (1683–86) was popular in the early 18th century; revised by Arthur Hugh Clough in 1864, it continues to be read. Another well-known translation was that of John and William Langhorne (1770); a modern translation is that of Bernadotte Perrin in the Loeb Classical library (1914–26). Besides these there have been numerous abridgments and such imitations as Thomas Mortimer's *British Plutarch* (1762) and *The Revolutionary Plutarch* (1804) testify to the abiding influence of the *Parallel Lives.*

The ethical preoccupation of Plutarch, his interest in "discoveries of virtue or vice in men," is the dominant mark of biographical writing in the centuries which follow—in the very popular saints' lives of the middle ages, in Giovanni Boccaccio's *De casibus virorum illustrium,* and in such works as the *Monk's Tale* of Chaucer, John Lydgate's *The Fall of Princes* and the influential *Mirror for Magistrates* (1559), where "as in a looking glass you shall see if any vice be in you, how the like hath been punished in others, and whereby admonished." The work of the early English historians and chroniclers, which occasionally contains brief biographical sketches, is coloured by the same desire to point a moral. John Stow, for example, in writing his *The Chronicles of England* (1580) purposes "to celebrate the worthy exploits of our Kings and Governors," but he regards himself not merely as a historian. "It is as hard a matter for the recorder of chronicles, in my fancy, to pass without some colours of wisdom, invitements to virtue, and loathing of naughty facts, as it is for a well favoured man to walk up and down in the hot parching sun and not to be therewith sunburned."

The 16th Century.—Three early examples of biographical writing may be singled out as approaching the art of biography in the modern sense of the word. Although they are marked by a strong ethical purpose and are far from any avowed attempt at impartial portraiture, they may be said to rise above mere factual compilation and to produce in a limited degree a deliberately artistic effect. The first of these, the *History of Richard III,* first published in 1543, was found among the papers of Sir Thomas More (1478–1535) after his execution and has been ascribed to both More and John Cardinal Morton. Whoever was the author, the biographical sketch gives a vivid and damning portrait of the enigmatic king and is written with considerable sense of style, though painted in colours too black to be entirely convincing or artistically effective. Of greater interest is the charming sketch of More himself written by his son-in-law William Roper (1496–1578), which while presenting an undeniably biased picture of the great chancellor is written with sympathy, vividness and obvious sincerity. It may be said to be the first biography in English written of a great man by one who knew him closely and admired him. It had to wait almost 100 years for publication (1626) but it circulated in manuscript during the 16th century. The third 16th-century biography was likewise circulated in manuscript long before it could be published. This is the *Life of Cardinal Wolsey,* written during the reign of Queen Mary by George Cavendish (1500–61), who had been gentleman-usher to Thomas Cardinal Wolsey and who had witnessed both the splendour and the tragic downfall of Wolsey's career. The theme is that of retribution descending upon the haughty cardinal: "If I had served God as diligently as I have the King, He would not have given me over in my grey hairs." The ethical intention is central to the whole work but Cavendish is objective enough to point out both the cardinal's virtues and his faults, so that in effect this early biography succeeds in conveying both the larger moral theme and a lifelike and dramatic impression of Wolsey's personality and his tragic end. The moving account of Wolsey's last years and downfall is sufficient alone to place this work among the best of early biographies.

The 17th Century.—The 17th century witnessed a tremendous outpouring of historical writing, memoirs, diaries, "characters" and essays, all of which have an obvious bearing upon the development of biography. On the one hand they bear witness to the expression of a fundamental interest—the desire to know human nature, the springs of human action, the relative functions of self-love and benevolence as motivating factors in the human personality. Such diverse writings as the essays of Francis Bacon, the *Leviathan* of Thomas Hobbes (1651), François de la Rochefoucauld's *Maximes* (trans. 1694) and *Les Caractères* of Jean de la Bruyère (trans. 1699) share to a large extent in this "psychological" point of view, and the same curiosity as to human nature can be observed in the otherwise ponderous French romances of Gautier de la Calprenède and others, in the comedies of Molière and in the plays and satirical writings of Dryden. On the other hand, it is true that these genres, rather than pure biography, provided the means of expression for such interest and hence served in a sense to divert the full development of biographical writing. The "character," for instance, modeled originally upon the examples of Theophrastus, developed in the 17th century into a fairly popular mode of analysis of human nature. The subjects—whether men dominated by a single vice or virtue, such as the covetous man; or conventional social types, such as the shopkeeper or milkmaid; or even places and scenes, such as the tavern—lent themselves to brief, unified prose analyses peculiarly satisfying to an age interested in human nature and sharply divided on certain great political and theological issues. The brief biographies of his contemporaries which adorn the great *History* composed by Edward Hyde, earl of Clarendon, are masterly but they show the extent to which the formal "character" had invaded the province of biographical writing. Valuable biographical sketches are to be found also in the histories produced in the American colonies at this time—notably in William Bradford's *Of Plimouth Plantation* (written 1630–50 but not published until 1856), in Nathaniel Morton's adaptation of this under the title, *New England's Memorial* (1669), and in Capt. Edward Johnson's *Wonder-Working Providence of Sions Saviour in New England* (1654)—but these are of interest mainly for the information which they give of colonial worthies.

Walton's "Brief Lives."—The most famous series of biographies composed in the 17th century are undoubtedly the "brief lives" written by Izaak Walton (*q.v.*). Though some of the lives—

notably those of John Donne and George Herbert—may be said to belong to the earlier class of encomiums rather than strict biography, Walton is obviously concerned not so much with facts and dates as with building up a unified impression of his subject, and in this he succeeded admirably. In writing the life of Donne, Walton had relatively few resources. He had known Donne only for the last eight years of Donne's life. But he had heard Donne speak, and refers in more than one place to the great eloquence of the sermons; he supplemented this with anecdotes from men such as John Chudleigh and Bishop Thomas Morton, who had known Donne; he utilized Donne's own writings; and, most important of all, he made use of Donne's letters—unfortunately in a somewhat reckless manner, according to modern standards, but the tradition of laying correspondence under contribution for biography can nevertheless be seen in Walton. Apart from its value as a factual biography—and later research has been able to correct Walton on a number of points—*The Life of John Donne* in its emphasis upon the scholar and the preacher succeeds in creating for the reader a unified and living character. Walton has been criticized for inaccuracy of fact and lack of objectivity but his series of biographies continues to be reprinted and read. Part of their charm resides in the author's extreme modesty, approaching naïveté, in the artlessness of his style and in the transparent sincerity and sympathy for his subject.

Other Biographies.—Among other great biographies of the 17th century a high place must be accorded to the learned and engaging Margaret Lucas, duchess of Newcastle (1624?–74), for her delightful biography of her husband William Cavendish, the first duke. *The Life of William Cavendishe, Duke of Newcastle* (1667) seems fulsome and awkwardly naïve—but only by present-day standards; in the devotion with which she portrays her husband and in the vivid picture which she gives of a royalist household of the 17th century she achieves a biographical masterpiece which has delighted readers from that day to this. A valuable companion piece, on the Puritan side, is *Memoirs of the Life of Colonel Hutchinson,* a biography of John Hutchinson written by his wife for their children and not printed until 1806. With a loyalty equal to that of Lady Newcastle, Lucy Hutchinson gives a sincere and truthful picture of her husband, of his relations with other parliamentary leaders and especially of his example to those who regard the Puritans as "an illiterate, morose, melancholy, discontented, crazed sort of men." Among other biographical writings of the century which may still be read with pleasure is the touching *The Life of Mrs. Godolphin,* written by her friend John Evelyn (*q.v.*) the diarist.

Thomas Sprat and Literary Biography.—An interesting example of the 17th-century attitude toward biography is provided by Thomas Sprat, who has the distinction of being the first to attempt the biography of a great literary figure considered solely as a man of letters. In his "An Account of the Life and Writings of Mr. Abraham Cowley," prefixed to the 1668 edition of Cowley's *Works,* Sprat not only recounts the biographical facts of "this excellent man," but also attempts a portrayal of the poet's personality and character and an assessment of his literary work, showing throughout the influences which turned him to writing and the significance of his important productions. In this threefold approach toward the life, the personality and the literary works Sprat interestingly foreshadows the method to be employed later so successfully by Samuel Johnson. Sprat, however, took a solemn view of his subject and destroyed the correspondence of Cowley. Although in his letters Cowley "always express'd the Native tenderness and Innocent gayety of his Mind," such intimate glimpses of the great, Sprat thought, "can scarce ever be fit to see the light." It remained for a later age to recognize the inestimable value of such letters, journals and other private materials.

Biographical Collections.—In one other department of biographical writing the 17th century was to prove a pioneer—the formation of biographical collections. Although John Leland and John Bale had paved the way in the preceding century in compiling lives and lists of writings of the most famous writers in Great Britain, their work was mainly bibliographical and antiquarian and was devoted chiefly to preserving from oblivion the records of manuscripts and books in monastic and private libraries. In the 17th century there was a conscious effort to compile for posterity biographies of great men which would be something more than a mere factual account of their deeds and writings. Of particular importance are the *The Church-History of Britain* (1655) of Thomas Fuller (1608–61), which contains a number of excellent character sketches, and especially his *The History of the Worthies of England* (1662), an interesting forerunner of the *Dictionary of National Biography.* Fuller arranged his "worthies" by counties and interspersed a great deal of nonbiographical material, but the result is a panorama of notable persons which reveals such extraordinary interest in psychological oddities and in biographical detail as to make the collection of absorbing value. "I have purposely interlaced," wrote Fuller, "(not as meat, but as condiment) many delightful stories, that so the reader, if he do not arise, which I hope and desire, *religiosior* or *doctior,* with more piety or learning, at least he may depart *jocundior,* with more pleasure and lawful delight." The *Magnalia Christi Americana* of Cotton Mather (1702) may be regarded as a colonial counterpart of Fuller. In this large compendium Mather records the lives and services of several of the governors of the colonies and of about 60 clergymen of the new world. The biographical sketches are largely factual and well seasoned with eulogy but nevertheless remain a valuable record for posterity. The same resistless urge for recording biographical information and a curiosity for out-of-the-way facts may be seen in the notebooks compiled by John Aubrey (*q.v.*), the antiquary and folklorist, which contain materials for more than 100 biographies of his contemporaries based on observation, on gossip, on all indeed which it seems Aubrey could contrive to collect. His materials were not published until the 19th century and he cannot be termed a biographer in the strict sense of the word. He was credulous and did not exert any consciously critical concern for artistic composition. Nevertheless, in his zeal for acquiring information and above all in his eye for the picturesque and the revealing detail, Aubrey shows more than pedestrian industry and points the way toward a conception of biography which later generations were to find congenial. Some of his materials were utilized by Anthony à Wood (1632–95) in the great biographical collection published at Oxford in 1691–92 as *Athenae Oxonienses: an Exact History of All the Writers and Bishops Who Have Had Their Education in the University of Oxford From 1500 to 1690,* a work of great value and the forerunner of many similar compilations.

The 18th Century.—The great impetus to such biographical collections in the 18th century, however, came from the famous *Dictionnaire historique et critique* (1695–97) of Pierre Bayle, which was translated into English as early as 1710 and inspired a number of similar collections, including the important *A General Dictionary, Historical and Critical* (1734–41) prepared by Thomas Birch. The outstanding example is the *Biographia Britannica* (1747–60), of which 22 articles were contributed by William Oldys. A second edition (1778–93), under the editorship of Andrew Kippis, reached only the letter *F.* This work, a kind of omnium-gatherum, collecting together all the information about "such of our countrymen as have been eminent" and attempting to reconcile the diverse facts about them "in obedience to the laws which reason and the practice of the best authors have established," illustrates the difficulty of compiling a dictionary of national biography; it cannot be said to have furthered the art of biography. A few of the more specialized biographical dictionaries, of which there were so many in the 18th century, may be cited: in the field of literature, Giles Jacob's *The Poetical Register* (1719–20), *The Lives of the Poets of Great Britain and Ireland* (1753), written mainly by Robert Shiels and published under the name of Theophilus Cibber, Horace Walpole's *A Catalogue of the Royal and Noble Authors of England, Scotland, and Ireland* (1758), John Berkenhout's *Biographia literaria* (1777) and David Rivers' *Literary Memoirs of Living Authors of Great Britain* (1798); for the clergy, Edmund Calamy's *An Abridgement of Mr. Baxter's History of His Life and Times* (1702), Nathaniel Salmon's *The Lives of the English Bishops From the Restauration to the Revolution* (1731–33), Richard Rolt's *Lives of the Principal Reformers* (1759) and Erasmus Middleton's *Biographia evangelica* (1779–

86); for naval figures, John Campbell's *The Lives of the British Admirals* (1742–44) and John Charnock's *Biographia navalis* (1794–98); for scientists, John Ward's *The Lives of the Professors of Gresham College* (1740), John Aikin's *Biographical Memoirs of Medicine in Great Britain* (1780) and Benjamin Hutchinson's *Biographia medica* (1789); and, in a category of its own, George Ballard's *Memoirs of Several Ladies of Great Britain, Who Have Been Celebrated for Their Writings or Skill in the Learned Languages, Arts, and Sciences* (1752). Similar collections did not become frequent in the U.S. until the 19th century, although the series by Jeremy Belknap, *American Biography*, dates from 1794 to 1798. The best-known collection is the *Library of American Biography* (25 vol., 1834–48), planned and supervised by Jared Sparks, later president of Harvard college. The 60 lives in this series, several of which were done by Sparks himself, are all somewhat formal and designed to edify.

These collections are significant of a growing interest in biography but the uneven materials which they contain show little awareness of biography as a work of art. The 18th century inherited the concern of the preceding century for psychological inquiry and investigations into the nature of man. Daniel Defoe was able to demonstrate how this interest could be combined into narratives which were in part biography and in part fiction, and the creation of the modern novel in the hands of Samuel Richardson and Henry Fielding developed one line of this interest.

North and Johnson.—In the field of biography proper the first great 18th-century name is that of Roger North, who in the lives of his brothers Francis, Dudley and John North (published in 1742 and 1744) shows an awareness of the interplay of human personality with the worlds of politics, law and learning which makes the series of biographies one of the most vivid and enjoyable of all time. The next major figure is Samuel Johnson, whose theory of biography as a genre, which may not only convey instruction but "enchain the heart," is illustrated in his own work. Particularly important are *The Lives of the English Poets* (1779–81), in which he brings to bear his ripest critical judgment and succeeds in presenting sympathetic and acute portrayals which are of permanent value, and an earlier and justly well-known work, *An Account of the Life of Mr. Richard Savage* (1744).

Boswell's Life of Johnson.—Johnson himself is the subject of what has generally been regarded as the supreme achievement in biography, the *Life of Samuel Johnson* by James Boswell (*q.v.*), published in 1791. The two first met in 1763, when Johnson was already 54, and Boswell spared no pains in documenting himself with all the helps he could muster, through taking notes on the great man's conversation, acquiring and preserving all the correspondence he could find and interviewing all of Johnson's friends who could give information, in order to produce a full and honest record of a life. Although he was not the first to utilize letters as a basis for biography—William Mason had adopted the same practice in 1775 in the "Memoirs" prefixed to the *Poems of Gray*—Boswell made such extensive use of correspondence that thenceforward every biographer has realized the immense importance of this procedure as an aid to lifelike portraiture. Through this method, and above all through his skilful use of reported conversation, Boswell was able to give an unparalleled effect of actuality and lifelikeness to his portrayal of Johnson. Although the fuller treatment of the last years of Johnson's life makes the work unbalanced, Boswell's untiring industry, his wholehearted sympathy with his subject and the art employed in weaving together his materials produced a work that was completely successful in presenting its subject "as he really was." The discovery in the 20th century of successive portions of Boswell's materials only served to confirm the judgment of earlier readers that the *Life of Samuel Johnson* is the greatest of all biographies.

The 19th Century.—Boswell's method continued to be practised in the best of the 19th-century biographies—the *Letters and Journals of Lord Byron* by Thomas Moore (1830), J. G. Lockhart's *Memoirs of the Life of Sir Walter Scott* (1837–38) and Sir George Trevelyan's *The Life and Letters of Lord Macaulay* (1876). In each of these personal knowledge, great sympathy and an intelligent handling of materials combined to produce creative works of art. A high place must also be accorded to the biographies of Lord Nelson (1813) and John Wesley (1820) by Robert Southey, *The Life of Schiller* (1825) and the *Life of John Sterling* (1851) by Thomas Carlyle, and Elizabeth Gaskell's *The Life of Charlotte Brontë* (1857). Although the series of critical essays contributed by Lord Macaulay to the *Edinburgh Review* and later to the *Encyclopædia Britannica* are not solely biographical in form, the vivid presentation and remarkable rhetorical gifts apparent in such essays as those on John Bunyan (1830) and Warren Hastings (1841) reveal Macaulay as a master of the creative gift necessary to the achievement of convincing biography.

In too many 19th-century biographies, however, Victorian ideas of propriety and decorum were allowed to colour the presentation of material so that, even in so good a biography as A. P. Stanley's *The Life and Correspondence of Thomas Arnold* (1844), the reader is left with an impression of moral stature rather than of vitality. The doctrine of "nothing but the good" is as fatal to the art of biography as to that of history. Subsequent research has shown how deceptively facts may be suppressed or actions misinterpreted or the texts of letters silently altered in order to convey one kind of truth but not the whole truth, as in John Forster's impressive *Life of Charles Dickens* (1872–74) or J. W. Cross's biography of George Eliot (1885). The same uncritical methods may be seen to a very large degree in the works of two mid-century biographers, Agnes Strickland's *Lives of the Queens of England* and *Lives of the Queens of Scotland and English Princesses* . . . (1840–59) and Lord Campbell's *The Lives of the Lord Chancellors* . . . (1845–47) and *The Lives of the Chief Justices of England* (1849–57), in which readability, however, compensated sufficiently to ensure them a measure of popularity. In the United States the chief representatives of the same type would be Washington Irving, whose biographies of Christopher Columbus (1828), Oliver Goldsmith (1849), Mohammed and his successors (1849–50) and Washington (1855–59) were long popular, and James Fenimore Cooper, whose *Lives of Distinguished American Naval Officers* (1846) exhibits some of the narrative gifts which the author displayed in his historical novels.

Frequently the Victorian ideal of biography tended to become that of a "life-and-times" work, in which the biographer's desire to place his subject in the full context of his surroundings allowed the background to assume an ever larger place until the personality of the subject was almost lost sight of. The result, as in Thomas Carlyle's studies of Oliver Cromwell (1845) and Frederick the Great (1858–65), proves to be a massive, undeniably erudite combination of history and biography. The outstanding example of this unfortunate development may be seen in the extraordinary work of David Masson, *The Life of John Milton: Narrated in Connexion With the Political, Ecclesiastical and Literary History of His Time* (1859–94), the excessive length and prolixity of which provoked James Russell Lowell's sigh, "We long for the secular leisure of Methusaleh." Many of the "standard" biographies produced in the latter half of the 19th century, and even later, succeed better in presenting all that is known of the subject and his background than in conveying a convincing and lifelike portrait. The biographies of Jonathan Swift (1882) by Sir Henry Craik and of Richard Steele (1889) by G. A. Aitken are still, for example, indispensable for the amount of information which they contain, but their heavily documented and massively erudite approach prompted more than one succeeding biographer to attempt a more concentrated and lively presentation of the human personalities of Swift and Steele. Two important political biographies which in large part successfully resisted the temptation to allow background to obscure the subject of the biography were Viscount Morley's *The Life of William Ewart Gladstone* (1903) and the biography of Abraham Lincoln (1890) by John Hay and John G. Nicolay. Other important biographies produced in the U.S. in the 19th century include the *Life and Times of Aaron Burr* (1857), perhaps the best of the numerous works done by James Parton; the *Life of Albert Gallatin* (1879) by Henry Adams; Moncure D. Conway's *Life of Thomas Paine* (1892); and two presidential biographies, *The True George Washington* (1896) by Paul Leicester Ford and Ida M. Tarbell's *Abraham Lincoln* (1900).

Another of the biographical landmarks of the late 19th century was the *Dictionary of National Biography*, sponsored by the publisher George M. Smith and edited by Sir Leslie Stephen and later by Sir Sidney Lee; it attempted to include all noteworthy figures from the earliest times (exclusive of living persons). The first volume appeared in 1882; the set as originally projected was completed in 1901 and has been kept up to date by successive supplements. A work similar in scope and plan is the *Dictionary of American Biography*, 20 volumes (1928–37; with supplements), published under the sponsorship of the American Society of Learned Societies and edited by Allen Johnson and Dumas Malone. There are similar works in several European countries.

The 20th Century.—Biographical writing in the 20th century reacted somewhat violently both to the tone of Victorian panegyric and to the academic life-and-times accounts so popular in the preceding century. Signs of the approaching change were discernible in the work of James Anthony Froude, whose biography of Carlyle (1882–84), with its detached and even satiric spirit, excited controversy when it appeared. Froude's vivid and unacademic approach may be seen also in his *Life and Letters of Erasmus* (1893–94). In the U.S. Gamaliel Bradford (1863–1932) cultivated a new kind of biography—or "psychography" as he preferred to call it—which sought to portray the essential "inner soul" of the subject by a skilful selection of important and interesting traits, much in the manner of the 19th century French critic, Sainte-Beuve. *Lee the American* (1912) was the first of a series of successful "psychographs," which included *Portraits of Women* (1916) and *Damaged Souls* (1923), among others. More generally, the revolt against Victorian moral ideals, particularly in the period following World War I, affected the biographer's point of view; and the investigations made by Sigmund Freud and others into the realm of the subconscious inevitably opened a large field of inquiry which could not be ignored by the biographer. The "new biography" in consequence was often the record of the inner life, the revelation of previously unsuspected aspects of character—and sometimes the discovery of feet of clay. In form it tended to be, if not streamlined, at least written with brevity in a style marked, sometimes self-consciously, by wit and irony. The influence of Freud is observable in the two epoch-making works of Van Wyck Brooks, *The Ordeal of Mark Twain* (1920) and *The Pilgrimage of Henry James* (1925), as well as in much of the work of Katharine Anthony, beginning with her *Margaret Fuller* (1920). Examples of the sensational and "debunking" biography, as it was called at the time, may be seen in the lives of Washington by William E. Woodward (1926) and Rupert Hughes (1926–30) as well as in *Lincoln the Man* (1931) by Edgar Lee Masters.

Lytton Strachey.—The greatest share of the credit for opening the new era of biographical writing at the close of World War I goes, however, to Lytton Strachey (*q.v.*), whose first important biographical work—short sketches of Henry Edward Cardinal Manning, Florence Nightingale, Thomas Arnold and Gen. C. G. Gordon—appeared in 1918 under the title *Eminent Victorians*. In the preface Strachey enunciated the twofold principle of selection and scrutiny which was to mark all his work. In place of the life-and-letters volumes of Victorian biography, with their great masses of material and "lamentable lack of selection," Strachey proposed "a brevity which excludes every thing that is redundant and nothing that is significant." His richly ornamented style, with its rhetorical pauses and rhetorical questions, its liberal sprinkling of anecdotes, its exploitation of contrast, is perhaps seen at its best in the biography of Cardinal Manning and at fuller length in *Queen Victoria* (1921), which was awarded the James Tait Black prize for biography. *Elizabeth and Essex: a Tragic History* (1928) is less successful and exhibits more of Strachey's mannerisms without the unity of tone which marked the earlier work. In his conscious striving for artistic effects and his very elaborate style Strachey did more than any other person to set the tone of the new biography, and his influence can be seen in the work of many lesser writers who adopted his irreverent attitude toward the past and attempted to imitate his style.

Problems and Purposes of the Biographer.—The yearly publishers' lists demonstrate the popularity of biographical writing but the really great biography is most difficult of achievement. Sometimes the reason lies in the scantiness of records, as in the case of Shakespeare, but more often in a failure to master the wealth of material. If the biographer has new documents which he has uncovered his path is relatively easy and his work, like Gordon S. Haight's *George Eliot and John Chapman* (1940), may revolutionize the subject. Often, however, he is coping with masses of material already well known, and he may find himself in the end as helplessly swamped as the scholar in the preface to Anatole France's *Penguin Island*. Strachey went so far as to say, in the introduction to *Eminent Victorians*, that the history of the Victorian age would never be written—because we know too much about it. "For ignorance is the first requisite of the historian—ignorance, which simplifies and clarifies, which selects and omits, with a placid perfection unattainable by the highest art." It is clear that the highest requisite in the biographer, whatever his material and whatever his motive in writing—whether to justify or defend his subject, to hold up a certain ideal of conduct, to apply a new psychological approach or to present simply a biographical novel—is the equipment which he himself brings to his task. In the first place he must have some sympathy for his subject. "To know the poet you must love him," wrote William Wordsworth, and this holds true for the biographer. Second, there must be absolute sincerity. If the biographer tampers with the facts, if he omits the unpleasant, if he colours or distorts in either direction, he completely fails. Panegyric was the first motive to biography and the panegyrical note, surviving in so many biographies of the 19th century, produced works differing little from the funeral sermon in their twofold aim of perpetuating the memory of the deceased and inculcating virtue by example. This is the reason why Abraham Lincoln refused to read them. "Biographies as generally written," he once remarked to his law partner William Herndon, "are not only misleading, but false." The biographer "makes a wonderful hero out of his subject. He magnifies his perfections—if he had any—and suppresses his imperfections." Such biographies, he concluded, "commemorate a lie, and cheat posterity out of the truth. History is not history unless it is the truth." In modern times, partly because of the example of Lytton Strachey, the aim of the biographer may fairly be said to be that of representing the whole man, "nothing extenuate nor set down aught in malice," and thus to revert to the aim of the greatest of all biographers, James Boswell, who could say confidently of his subject: "And he will be seen as he really was; for I profess to write, not his panegyrick, which must be all praise, but his Life; which, great and good as he was, must not be supposed to be entirely perfect. To be as he was, is indeed subject of panegyrick enough to any man in this state of being; but in every picture there should be shade as well as light, and when I delineate him without reserve, I do what he himself recommended, both by his precept and his example." (Boswell's *Life of Dr. Johnson*, ed. by G. Birkbeck Hill and L. F. Powell, vol. i, p. 30, Clarendon Press, Oxford, 1934.)

This ideal, which André Maurois, one of the most distinguished 20th century biographers, defined as, on the one hand, the bold seeking after truth and, on the other, the concern for the complexity of human personality, is abundantly illustrated by the best of contemporary biographical writing. Beginning with *Ariel, ou la vie de Shelley* (1923) and continuing with a series which includes lives of Disraeli (1927), Byron (1930), Chateaubriand (1938), George Sand (1952), Dumas the Elder (1954) and Victor Hugo (1955), Maurois himself demonstrated that biography may be made as entertaining as a novel without departing from the search for truth and verisimilitude. Among other examples of distinguished work in the 20th century may be cited *Palmerston* (1926) and *The Duke* (1931) of Philip Guedalla; the series of volumes on Lincoln by Carl Sandburg (*The Prairie Years*, two volumes [1926]; *The War Years*, four volumes, [1939]); Lord David Cecil's study of Cowper (*The Stricken Deer*, 1929); *Tennyson* (1923), *Byron* (1924), *Swinburne* (1926), *Curzon* (1934), *Benjamin Constant* (1949), and *King George the Fifth* (1952) by Sir Harold Nicolson; *Lincoln, the President* by James G. Randall, four volumes (1945–55); *George Washington: a Biography*, by Douglas Southall Freeman, six volumes (1948–54); the *Life of Neville*

Chamberlain (1946) by Keith Feiling; *Florence Nightingale, 1820–1910* (1950) by Cecil Woodham-Smith; *Hugh Walpole* (1952) by Rupert Hart-Davis; *Les Frères Goncourt* (1955) by André Billy; Emil Staiger's *Goethe*, three volumes (completed in 1959); James Pope-Hennessy's *Queen Mary, 1867–1953* (1959); Richard Ellmann's *James Joyce* (1959); and Hannah Arendt's *Rahel Varnhagen* (1959).

See also AUTOBIOGRAPHY.

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Biographical Directories: For information about living persons *see* such biographical directories as *Who's Who* (1849–), published annually in Great Britain, and *Who's Who in America* (1899–), revised and reissued biennially in the U.S. These and similar publications, which have proliferated in the 20th century, have no connection with biography as literature but are useful sources of factual information. Specialized directories, such as *Who Knows—and What*, are also useful. A guide to all such publications (and to other biographical sources as well) is Constance M. Winchell's *Guide to Reference Books*, 7th ed. (1951) and supplements. (D. F. B.)

BIOLOGICAL CHEMISTRY: *see* BIOCHEMISTRY.

BIOLOGICAL WARFARE. The military definition of biological warfare is the intentional use of agents for the purpose of producing disease or death in man, animals or crops, and defense against the use of these materials for such purposes. It is essentially public health and preventive medicine in reverse and, except for novel means of deliberately disseminating pathogenic microorganisms, is a form of warfare which nature has waged against man for thousands of years and against which man's modern health practices have produced effective defenses.

Biological warfare—often referred to as germ warfare, bacteriological warfare or BW—represents an attempt by man to examine and control the forces of nature for military use. Unlike the atomic bomb or other blast-effect weapons, biological warfare is essentially antipersonnel in nature, since it does not destroy buildings and machines but is directed at man himself or his food supply.

Weapons of the biological variety are different from other kinds of weapons in that their results are generally delayed over a longer period of time, and it is difficult to determine whether an outbreak of disease among men, animals or plants is the work of nature or of man. For this reason, one cannot say with certainty that a nation has resorted to biological warfare unless documentary or material proof of such use can be obtained, and, because of its very nature, material proof is hard to establish.

Biological warfare has two main divisions. The first includes attacks with "living agents"—different kinds of small living things which may cause sickness or disease in people, animals or plants; these may include disease-bearing or plant-killing insects, bacteria, viruses and fungi. The second type comprises attacks with special kinds of chemicals known as hormones. Called "growth regulators," the best known are those used to kill weeds and other unwanted plants.

Some observers have described biological warfare as an absolute weapon, capable of disabling or destroying the entire population of large cities either directly or by the initiation of self-perpetuating disease epidemics. Other persons have rejected this view and insisted that BW is not even a practical weapon and that it presents no dangers.

The truth probably lies between these two extremes.

It must be assumed that a nation with a reasonably modern scientific program can produce effective agents in adequate quantities. In delivering such agents to the target, either through undercover or open methods, the using nation might (1) attempt to incapacitate a limited number of selected individuals in order to delay military or industrial mobilization and production before the occurrence of open warfare; (2) use biological agents as a part of a general attack in connection with explosives or atomic munitions; or (3) use biological warfare in order to lower efficiency, productivity and morale.

Prevention of an open attack with biological weapons is a military problem, but prevention of sabotage requires constant vigilance by civil agencies. Agents capable of being used or developed for biological warfare may be imported surreptitiously or they may be manufactured within the "target nation" clandestinely. Since biological agents are ideal for covert use, an alert public health system is the keystone to a nation's defense against this type of warfare.

Historical Attacks.—The concept of biological warfare is not new, for war and germs are no strangers to each other. Even with no help from man, germs have entered practically every major military campaign, and more than once germs rather than generals have decided the outcome of a conflict. Plague cut down the crusaders at the gates of Jerusalem. Typhus riddled the Moors in Spain, and dysentery thinned the ranks of Napoleon's Grand Armée as it moved toward Moscow. During the Boer War, typhoid fever laid low more soldiers than bullets did. There were many deaths from tainted beef during the Spanish-American War, and influenza hit military and civilian forces alike during World War I's closing years of 1917–18. In the early days of World War II, malaria and scrub typhus attacked the Allied forces in the South Pacific. These were natural attacks, presumably the accidents of war.

The deliberate employment of germs also has a history of its own. Biological warfare has been recognized and tried since time immemorial. There are enough recorded minor instances of its use to indicate that man has long perceived its value as a weapon. For biological warfare, in a certain sense, can be considered to be aiding nature in the spread of disease and germs, and methods of accomplishing this were available long before the nature of disease and the existence of microorganisms were known.

In ancient times the bodies of cholera and plague victims were dropped over the walls of beleaguered cities, left on ground the enemy was expected to occupy or used to poison water points. Napoleon deliberately flooded the ground near the besieged city of Mantua, in the hope that malaria would weaken the Italians' will to resist. Blankets were contaminated by traders and distributed among American Indians in order to reduce their fighting strength through smallpox epidemics.

These uses of biological warfare in its crudest forms served the purpose of weakening an enemy by decimation of his manpower through means other than actual conflict. Just as in chemical warfare, Germany was one of the first exponents of biological warfare in the modern sense. During World War I, the Germans infected with glanders, an epizootic disease, horses of the Rumanian cavalry and livestock in the United States that were intended for shipment to the Allies in Europe.

The Japanese were alleged to have employed biological warfare against the Chinese during World War II, but these allegations were never substantiated.

In March 1952, during the Korean war, the Chinese communists accused the United Nations, specifically the United States forces, of employing biological warfare against North Korean and Chinese communist forces. These charges were the basis for a propaganda campaign that included protests by the North Korean and Chinese communist foreign ministers, mass "protest" meetings in the Soviet Union and communist China and denunciation by the communist-controlled World Peace council. The United States secretary of state denied the charges. Similar denials were made by the secretary-general of the United Nations, the commander in chief of the UN forces and the U.S. secretary of defense. The U.S. secretary of state challenged the communists to submit their

charges to an investigation by the International Committee of the Red Cross to determine the facts. Refusal of the Chinese and North Korean authorities to permit an investigation by the International Red Cross, together with the categorical denials of the charges by responsible United Nations and United States officials, branded the charges as false.

Types of Agents.—A disease agent must embrace certain characteristics to be an effective biological weapon. It should (1) have a high infectiveness; (2) have a high degree of resistance to such destructive forces of nature as heat, sunlight and drying; (3) be adaptable to rapid dissemination; (4) have the ability to cause high initial mortality or lasting debilitating effects against intended victims, whether man, animals or plants; and (5) be an agent foreign to that particular part of the world against which it is directed so that natural immunity has not been built up against it.

The kinds of germs which might be used in biological warfare attack would depend upon what the user hoped to obtain from its use. If killing large numbers of people was desired, plague, typhus, cholera, smallpox or some similar disease might be used. But if the attacker wanted only sickness, rather than death, diseases such as rabbit fever (tularemia) or undulant fever (brucellosis) (*qq.v.*) could be used. This would not only cripple both fighting and productive forces but would also tie up doctors and hospitals.

Any agent which causes high mortality or morbidity rates and meets the above five requirements might be used against man. These pathogenic agents could be disseminated by a variety of mediums which would cause contamination through bodily contact, air, food or water. The means of dissemination could be aerosol release into ventilation systems; airplane- or free-balloon-dropped bombs or aerosols; and possibly other undetermined means.

In such situations, the majority of biological warfare victims would be those whom the biological agent reached directly. Secondary cases, caused by direct spread of infectious diseases from primary cases to other persons, could occur with the use of some agents, but the greatest danger in biological warfare attack would be to those initially exposed persons.

There are also many diseases that could be used to attack different kinds of animals upon which man depends for both food and clothing. Swine are especially subject to hog cholera. Fowl pest and Newcastle disease might be used against poultry. Rinderpest, sometimes called Asiatic cattle plague, might be aimed especially at cattle or sheep. Foot-and-mouth disease, glanders and anthrax, or woolsorters' disease, could cause untold damage among livestock.

Since meat, dairy and poultry products are important sources of food for both civilians and military personnel, they must be considered as prime potential targets. Other animal products, such as wool and leather, play an important part in maintaining human health. In addition, the production of many biologicals and pharmaceuticals such as adrenalin, liver extract and insulin are entirely dependent upon an adequate supply of glands, organs and secretions from healthy animals.

Many kinds of plant plagues, blights and pests could be used to attack food crops. Diseases could damage grain and fruit, while specially prepared chemicals might also be used in raids on growing crops. Any insect pests or plant diseases that are present in one part of the world but not in another constitute a threat to the food supplies and economic resources in the latter areas. Some, such as the Japanese beetle, European corn borer, Mediterranean fruit fly, boll weevil, citrus cancer and wheat rust either cause extensive losses or are expensive to control or eradicate even in their native habitats.

The danger is intensified by the fact that the most effective method of keeping down losses from known or native plant disease is often the development of new strains which are resistant to specific diseases. Successful introduction of new organisms to which crop varieties are not resistant could therefore cause a great deal of damage.

Protective Aspects.—The best protection against the threat of biological warfare is an informed populace and alert, vigorous public health and agricultural organizations. Basically, protection would consist of detection, immunization, quarantine and inspection in the preventive stage, and individual masks, protective clothing and decontamination during and after an attack or suspected attack.

Although disease can spread quickly, most outbreaks move quite slowly. The plague that swept over London in the 17th century began with a few cases in the autumn of 1664 and took six months to cross from one side of the city to the other. The peak of the epidemic did not come until Sept. 1665. While almost 70,000 people died of the plague, it was not a lightning-quick disaster from which there was no escape. With modern public health organizations the London outbreak could have been stamped out with little or no loss of life.

Nations have come to realize the value of co-ordinated effort in the prevention of epidemics, not only among people but in crops and livestock as well. When a man with smallpox mingled with New York city's crowds for several days in 1947, more than 6,350,000 people living in the area were immediately vaccinated. Only 12 other cases of smallpox resulted. In 1946 Mexican cattle became infected with foot-and-mouth disease. To stamp out the epidemic and prevent it from spreading into the United States, Mexican officials co-operated in the wholesale destruction of infected cattle.

One difficult problem in defensive biological warfare is the rapid detection and identification of disease outbreaks through laboratory methods, since microorganisms and their toxic products cannot be detected by any of the senses. The detection and identification of such agents require laboratory procedure which may take from a few hours to several days.

Mechanical protection against biological warfare is quite similar to that used in defense against chemical warfare. A filtered air supply, either through the use of individual face masks or collective protective shelters, and airtight clothing offer complete protection. However, since it would be impossible for persons to carry on normal living activities for any length of time in impervious suits, such equipment would probably be used only by decontamination squads in areas infected by biological agents.

Military Applications.—Although principally a strategic weapon in a military sense, biological agents could have a tactical use, even though the user might have to wait days or weeks for the effect to be felt. Since tactical plans for major operations must be made well in advance of the projected action in order to control day-to-day tactics and build up supplies and forces, located opponent reserves could be infected so that they would be out of the fight regardless of their location when the attack was launched. The agent's characteristics, the sanitary standards of the intended victims and their protective capabilities against biological agents would have to be of prime consideration for such use.

Biological weapons are uniquely adaptable to sabotage. Very small amounts of biological material could cause extensive damage. They would be inconspicuous in use and their effects would be delayed. Because of the difficulties of detection and the delayed effects, it might be impossible to determine whether sabotage had been committed or an outbreak of the disease was a natural occurrence.

The use of biological agents could be so insidious that it could be done months, or even years, before the actual outbreak of war without detection, thus seriously undermining the fighting strength of a nation prior to open conflict. Biological agents do not destroy manufacturing plants and buildings, but they might effectively neutralize them by making casualties of the workers in the plants, through illness or death, causing a loss in production or other services vital to a war effort. Also possible would be the undermining of the health of a nation by lowering the population's caloric intake through introduction of disease to grain crops or other growing food staples for one or two years before hostilities began.

The value of large-scale use of biological warfare had been neither proved nor disproved by actual military experiences in the 1950s, although research and experimentation had established its advantages as a weapon. It had become known that the quantity

of material necessary to infect varies with the degree of individual immunity. The quantity must be large enough to break through and overcome all the combined immunities, natural or acquired, which may be present. Lower dosages might stimulate body mechanisms and create greater resistance to the particular disease.

The living habits of the peoples of nonsanitary-minded nations, where frequent contacts with animals and disease reservoirs are the mode of life, tend to build up immunities against disease; such populations would not be so susceptible to attack as would the peoples of the more sanitary-minded countries. It would probably be impossible to introduce artificially and spread by epidemic any disease among populations where that particular disease is or has been prevalent. Although it can be assumed that the psychological effect of an open biological warfare attack might equal or exceed the material damages, any group of people living where disease epidemics are common would not be so mentally sensitive to a biological warfare attack as would the people of a section where epidemics are rare. *See* also CHEMICAL WARFARE.

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BIOLOGY (ARTICLES ON). The article BIOLOGY reviews the development and methods of approach of the biological sciences, with emphasis on those that have wide application. The two major branches of biology, which involve the study from many points of view of over 1,000,000 different species of animal life and over 300,000 species of plants, are treated in additional surveys: ZOOLOGY; ZOOLOGY (ARTICLES ON); BOTANY; and BOTANY (ARTICLES ON).

EVOLUTION, ORGANIC describes the evolution of the concept itself, the observations of animal and plant life by which it has been validated, and its post-Darwinian findings. The rock-recorded phase of the evolution of plants and animals is outlined in PALEOBOTANY and PALEONTOLOGY, and that of *Homo sapiens* in MAN, EVOLUTION OF.

Articles devoted to the key factors of the evolutionary process include MUTATION; SELECTION; and VARIATION. Among many other articles illustrative of evolutionary evidences and their interpretation are ADAPTATION, BIOLOGICAL; ANIMALS, PHYLOGENY OF; ANATOMY, COMPARATIVE; PHYSIOLOGY, COMPARATIVE; DARWINISM; DEVELOPMENT, ANIMAL; HOMOLOGY; LAMARCKISM; and NATURALIZATION, PLANT AND ANIMAL.

The study of organisms in relation to the environment of which each is to some extent both a product and a shaping factor is represented in many ecological articles, including ANIMALS, DISTRIBUTION OF; MARINE BIOLOGY; ECOLOGY, ANIMAL; POPULATION ECOLOGY; SOCIOLOGY, ANIMAL; ZOOGEOGRAPHY; and the sections on ecology in ZOOLOGY and PLANTS AND PLANT SCIENCE. PEST CONTROL is concerned with the struggle that man must wage against his nonhuman competitors.

GENE describes the ultramicroscopic units that constitute animated blueprints of heredity. Their laws of function are treated in GENETICS; GENETICS, HUMAN; and HEREDITY; a statistical discussion is given in GENETICS OF POPULATIONS.

Protoplasm, the versatile substance that is encountered in various forms of molecular organization as the basic life-stuff of the animal and plant world, and its unit of architecture are described in CYTOLOGY. Articles dealing with the structure and dynamics of the cell include ANATOMY, MICROSCOPIC; DEATH (BIOLOGICAL); GROWTH; HISTOLOGY; TISSUE CULTURE; and REGENERATION. Articles discussing life on the single-cell level include BACTERIOLOGY and PROTOZOA.

The gap between the sciences dealing with inanimate matter and those concerned with living organisms has been substantially narrowed by the cooperative researches of workers in the biological and physical sciences; these are summarized in BIOCHEMISTRY and BIOPHYSICS. Some of the techniques of biophysics and biochemistry are illustrated in the article dealing with the most minute of self-reproducing forms, VIRUSES.

The major types of form and structure of living organisms are described in ANATOMY, GROSS; MORPHOLOGY; PLANTS AND PLANT SCIENCE: *Anatomy of Plants,* and *Morphology of Plants.* Among the studies of function are PHYSIOLOGY; PLANTS AND PLANT SCIENCE: *Plant Physiology;* REPRODUCTION; and SEX. More detailed listings of articles devoted to function are given in PHYSIOLOGY (ARTICLES ON).

Methods of classification of animals and plants are outlined in TAXONOMY, and biological applications of the science of statistics in BIOMETRY. The cyclical patterns of activity inherent in living things are treated in RHYTHMS, BIOLOGICAL. The effect of the daily duration of light on the functioning of animals and plants is discussed in PHOTOPERIODISM; the consequences of exposure to other forms of radiation are discussed in RADIATION; BIOLOGICAL EFFECTS.

In its search for a precise and comprehensive description of life, biology applies scientific method to some of the oldest philosophical questions. Among the articles reflecting the quest are LIFE, ORIGIN OF; DEATH (BIOLOGICAL); INDIVIDUALITY, BIOLOGICAL.

Many biographical sketches are devoted to leaders of biological thought—for example: ARISTOTLE; DARWIN, CHARLES ROBERT; HUXLEY, THOMAS HENRY; LEEUWENHOEK, ANTON VAN; LINNAEUS, CAROLUS; MENDEL, GREGOR JOHANN; WALLACE, ALFRED RUSSEL; WEISMANN, AUGUST. The deviation from orthodoxy in Soviet biology—especially genetics—is dealt with in GENETICS: *Soviet Genetics;* the leading advocate of this controversial approach is covered in LYSENKO, TROFIM DENISOVITCH.

BIOLOGY, an inclusive term embracing all sciences having to do with living organisms. The biological sciences may be classified according to the nature of the organisms considered, as botany, dealing with plants in all their aspects; bacteriology, with bacteria; zoology, with animals.

Finer subdivisions, such as algology, the study of algae; protozoology, the study of the protozoa; entomology, the study of insects; mycology, the study of fungi; helminthology, the study of parasitic worms; and paleontology, the study of the life of past geologic ages, are frequently employed.

Another method of arrangement involves the mode of approach, as morphology, or the study of form; physiology, the study of function; anatomy, the study of internal structure; cytology, the study of the cell; pathology, the study of disease; ecology, the study of environmental relations; genetics, the study of inheritance; etc. A complex classification, employing categories such as physiological botany or morphological zoology, is often necessary.

Following the old usage of G. R. Treviranus and of Jean Baptiste de Lamarck, biology will be considered as primarily restricted to consideration of problems presented by organisms in general, or at least organisms of many different kinds. The problems of biology are thus the problems common to the three major biological sciences, botany, bacteriology and zoology (*qq.v.*).

Generally, a problem is regarded as one of biology rather than of zoology, botany or bacteriology, if its solution affects ideas in one of the other sciences or even in sciences outside biology.

This article is divided into the following sections and divisions:

I. History
  1. Early Greek
  2. Aristotle as a Biologist
  3. Ancient Biology After Aristotle
  4. The Middle Ages
  5. Revival of Learning
  6. The Rebirth of the Physiological Study of Animals and Plants
  7. Early Attempts to Classify Living Things
  8. Beginning of the Study of Comparative Anatomy and Physiology
  9. Effects of Geographical Exploration on Biological Development
  10. Reproduction of Plants and Its Comparison With That of Animals
  11. Metamorphoses and Alternation of Generations in Animals and Plants
  12. Establishment of the Cellular Nature of Animals and Plants
  13. Organic Evolution; the Origin of Species

14. Biogenesis Versus Abiogenesis; the Origin of Life
15. Change in the Biological Outlook to the Modern Stage
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1. The Biosphere
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4. Theories as to the Origin of Life
5. Plants, Bacteria and Animals
6. The Problem of the Viruses
IV. The Methods of Approach of the Biological Sciences
1. Morphology
2. Taxonomy
3. Embryology
4. Genetics
5. Evolution
6. Physiology
7. Ecology, Biocoenology, Biodemography and Biosociology
8. Economic Biology
V. The Philosophy of Biology

I. HISTORY

Biology, in the widest acceptance of the word, is used to cover all those studies which deal with the structure, nature and behaviour of living beings. It is thus in contrast with the word "physics," which is similarly used to cover the study of the structure, nature and behaviour of such matter as is neither living nor a necessary product of the activity of living things. It happens that certain of the studies classed as biological are intimately bound up with the study of medicine, as, for example, human anatomy, the physiology of the warm-blooded animals, bacteriology and the like. This historical relationship has had certain practical results, and these subjects are sometimes tacitly excluded from what is called biology in a narrowed academic use of that term.

For practical convenience these departments are considered in the article MEDICINE AND SURGERY, HISTORY OF.

The word "biology" was introduced by G. R. Treviranus (1776–1837) in his *Biologie oder die Philosophie der lebenden Natur* (Göttingen, 1802–22). It was popularized by J. B. de Lamarck (1744–1829; *q.v.*) in his *Hydrogéologie* (Paris, 1802); Lamarck perhaps invented it independently. The first English use of the word in its modern sense was by Sir William Lawrence (1783–1867) in his work *On the Physiology, Zoology, and Natural History of Man* (London, 1819). There are, indeed, earlier uses of the word in English, but they are in relation to biography.

1. Early Greek.—Biology may reasonably be regarded as beginning with the Greeks. At a very early date, and particularly at the hands of Alcmaeon of Crotona (*c.* 500 B.C.), we hear of independent investigations of the structure and habits of animals. Thus Alcmaeon described the optic nerves and tubes that lead from the nose to the ear (Eustachian tubes), and he made a beginning of the study of the development of the embryo. The theory of Empedocles (*c.* 490–430 B.C.) of Akragas of four elements, arranged in opposites, came to control medical thought for two millenniums, but more immediately influential was his view that the blood is the seat of the then mysterious "innate heat," taken from folk belief—"the blood is the life." This led to the consideration of the heart as centre of the vascular system and chief organ of the pneuma which was distributed by the blood vessels. Pneuma was identified, in accord with certain philosophical tendencies, with both air and breath. These views of Empedocles were rejected by the important Coan medical school, then becoming prominent, but were widely accepted elsewhere. Notably Diogenes Apolloniates (*c.* 460 B.C.), a contemporary of Hippocrates of Cos, was led to investigate the blood vessels, and his account of the vascular system is the earliest that is intelligible. The Hippocratic Collection (*see* HIPPOCRATES AND THE HIPPOCRATIC COLLECTION; MEDICINE AND SURGERY, HISTORY OF) attempts some sort of classification of animals as early as the 5th century B.C. The author of an early work of the so-called Hippocratic Collection, *On the Sacred Disease*, of about 400 B.C., opened the skulls of goats and found their brains to resemble those of men in being cleft into symmetrical halves by vertical membranes. The large veins of the neck are intelligibly described. The arteries are said to contain air, an idea gained from their emptiness in dead animals. The work *On the Nature of Man*, perhaps of about 380 B.C., ascribed by Aristotle to Polybus, son-in-law of Hippocrates, contains the doctrine of the four humours. These—blood, phlegm (*pituita*), black bile (*melancholia*) and yellow bile (*chole*)—make up the living body as the four elements make up nonliving matter. This doctrine persisted till quite modern times, and traces of it remain in the language and thought of today.

An interesting Athenian biological thinker of the mid-4th century B.C. was Diocles of Carystus. He drew his opinions from many sources, adopting the humours of Polybus and the innate heat of Empedocles, regarding with Aristotle the heart as seat of the intelligence but accepting also Sicilian pneumatism. His observations on the early human fetus are the first recorded. His work *On Anatomy*, based to some extent on human material, has disappeared, and there is no general early treatise on the subject. The best representative of the anatomy of the 4th century is the tract in the Hippocratic Collection *On the Heart*, of about 340 B.C. It refers to the anatomical similarity of man and animals and places the innate heat in the heart. Air enters directly into the left ventricle, where some subtle change of blood into spirit takes place and where, too, the intellect resides. The heart valves are described and experiments are suggested for testing their competence. There is the startling statement—verified by experiment!—that, in drinking, some of the fluid passes to the lungs. This false statement might be ascribed to textual confusion were not the same view expressed in Plato's *Timaeus* and other early writings. The *Timaeus* itself had profound effects on the biological conceptions of the middle ages.

All the early records of biological science before the 4th century B.C. are, however, either completely lost or too fragmentary to permit of adequate reconstruction. Not until Aristotle (384–322 B.C.) do we encounter any complete biological works. Moreover, as our accurate knowledge of Greek biological science begins with Aristotle, so it may almost be said to end with him. The only surviving ancient biological works besides those of Aristotle, prepared without consideration of their application, are by his pupil Theophrastus. A full account of the biological achievements of Aristotle and of Theophrastus would thus contain an almost complete account of our knowledge of pure biological science in antiquity. We shall, however, need to give some consideration to the work of Galen in the 2nd century A.D., though his is applied science.

2. Aristotle as a Biologist.—Of the biological works of Aristotle a considerable number have survived. Among them, four are pre-eminent: (1) on psyche (*i.e.*, on the soul or living principle), usually known as *De anima;* (2) histories about animals, usually known as the *Historia animalium;* (3) on the generation of animals, usually known as *De generatione animalium;* (4) on the parts of animals, usually known as *De partibus animalium*. There are matters in all these that come rather in the department of philosophy (*see* ARISTOTLE) but which must of necessity be considered in any account of the history of biological thought, which they have influenced throughout its course. Such is Aristotle's conception of the nature of the living principle or psyche.

The oldest use of the word "psyche" is in the sense of breath, and breathing is the most obvious sign of life. It was, therefore, natural that from breath the word "psyche" came to mean life, then the soul and again the mind. Aristotle used this term for the principle that differentiates living from nonliving substance. When he began to examine different living things he reached the conclusion that there were different kinds or orders of psyche or soul. In the course of this investigation he came to distinguish between (1) the vegetative soul, (2) the animal soul and (3) the rational soul.

The vegetative soul was the lowest. Aristotle regarded plants as the lowest living forms, and the qualities of life that he distinguished in them were growth and the power of reproduction.

Aristotle considered that while animals had these qualities of the vegetative soul, they also had, of their nature, the power of movement. The movements that they made seemed to him to correspond to what they felt. The animal soul thus possessed,

as he thought, not only the qualities of the vegetative soul but also a second order of qualities which were responsible for the sensitive and motive powers of animals.

Lastly, man had all these qualities exhibited in both plants and animals, but he had also certain others. He could reason and his movements and actions were dictated by his thoughts. His soul, therefore, was equipped not only with the qualities of the vegetative and animal souls but also with rational or intellectual powers.

It will thus be seen that Aristotle was, in the fullest and most definite sense, a "vitalist." Apart from the classification of kinds of soul, Aristotle held certain views as to the relationship of this soul or psyche to the living body. This relationship was determined by the existence of an entelechy, a term which may perhaps be translated for biological purposes as "an indwelling purposiveness." The nature of this entelechy is brought out in his work *De anima,* which claims that the soul is neither independent of, nor is it any part of, the body. He says:

> They are right who hold the soul as not independent of the body and yet as not in itself anything of the nature of the body. It is not body, but something belonging to body. It, therefore, resides in body, and moreover, a particular soul to a particular body. They were wrong who sought to fit the soul into the body without regard to the nature and qualities of that body. For the Entelechy of each thing comes naturally to be developed in the potentiality of each thing, and it is manifest that soul is a certain Entelechy and notional form of that which has the capacity to be endowed with soul.

This, then, is the basic thought in Aristotle's biological work, a thought that is still subscribed to by some biologists of the present day (*see* ENTELECHY; VITALISM). But besides Aristotle's finely wrought biological theories, of which this is one, there is much in his biological writing that does not involve these high topics but is restricted to the ordinary investigations of the working biologist as we know him in our own time. Thus on the phenomenological level we may note Aristotle's magnificent observations on the habits of fishes, some of which, doubted for centuries, were verified in our own time. No less remarkable are his observations on the breeding and development of the octopuses and their allies. His discourses on whales, porpoises and dolphins and on the development of dogfish are also very noteworthy. There is much to justify us in classing Aristotle as one of the best observing naturalists of all time.

The whole course of biology may be represented as the history of ideas on the classification of living things. Something must therefore be said on this subject in relationship to Aristotle.

At first, Aristotle entirely separated man from the lower creatures, distinguishing him among living things by the possession of a rational soul. As his knowledge increased, he became less inclined to make this distinction absolute, and ultimately he admitted that animals in their degree share rationality with man. His final position seems to have been that there is no fundamental distinction between life or soul and mind. This is precisely the attitude of an important school of modern biologists.

In ascribing reason to animals Aristotle is sometimes said to have been influenced by his advance toward something that we should now call a belief in "evolution." It cannot justly be said that he ever attained to a clear view of organic evolution. Nevertheless, it is evident that he was moving in that direction, that he was not far from reaching it and that had he lived a few years more he might well have reached it. It is certainly easy to read an evolutionary meaning into much of his biological writing. Moreover, we see him groping at some "natural" manner of arranging the orders of animals. He is, in fact, striving toward what we should call a classification. The scheme that he actually adopted was to arrange living things in a sort of ladder or scale. This *scala naturae* of Aristotle is of great interest and is worthy of all possible respect. He describes a particular part of this as follows:

> Nature proceeds little by little, from things lifeless to animal life, in such a way that it is impossible to determine the exact line of demarcation, nor on which side thereof an intermediate form should lie. Thus next after lifeless things in the upward scale comes the plant. . . . Of plants one differs from another as to its amount of apparent vitality. In fact, the whole of plant kind, while devoid of life as compared with animals, is endowed with life as compared with other forms of matter. Moreover there is in plants a continuous scale of ascent toward the animal, and of some one is at a loss to say whether they be animal or plant. . . . Thus nature passes from lifeless objects to animals in unbroken sequence, so that scarcely any difference seems to exist between two neighbouring groups by reason of their close similarity.

As a working naturalist Aristotle excelled chiefly in his observations on the habits and lives of animals. He was less fortunate in his investigations of their structure, and less fortunate still in his consideration of the functions of parts. He was, in fact, far less an experimenter than an observer. Some of his successors among the Greeks (*e.g.*, Galen) far excelled him in their experimental skill and ingenuity. But neither Galen nor Aristotle could progress very far without an exact body of knowledge of chemistry and physics on which they could build.

3. Ancient Biology After Aristotle.—Aristotle's botanical researches are lost. We have, however, full botanical works of Theophrastus of Eresus (*c.* 371/370–288/287 B.C.), his heir, his favourite pupil and his successor as head of the Lyceum. Theophrastus, like other ancient men of science, felt acutely the need for a technical terminology. He made some attempts to establish one, and at least one technical botanical term, "pericarp," comes to us from him.

Theophrastus understood the value of developmental study, a conception derived from his master. "A plant," he says, "has the power of germination in all its parts for it has life in them all, wherefore we should regard them, not for what they are, but for what they are becoming." He lays much stress on the different modes of reproduction of plants. He distinguishes between the monocotyledons and the dicotyledons, and he has some interesting passages in which sex is discerned in plants, notably in the palms.

The works of Theophrastus are extremely valuable as the most complete biological treatises that have come to us from antiquity. They contain many excellent observations, but are distinctly inferior in depth, range and insight to the biological works of Aristotle. Pure botanical investigation virtually ended with Theophrastus. Biology was studied at the Alexandrian school, but chiefly in connection with medicine (*see* MEDICINE AND SURGERY, HISTORY OF). There was one important development in Alexandrian times to which we must refer. This was the practice of portraying the forms of plants exactly and artistically for purposes of identification. Science owes this important accessory art to one Crateuas, a herbalist who practised in the 1st century B.C. There are accurate copies of some of the drawings of this artist, and these copies are of the utmost interest to biologists.

The Hellenistic investigator whose writings have had most influence on the course of botany, and in particular on botanical terminology, is the physician Pedanios Dioscorides of Anazarba in Asia Minor. Dioscorides served in the army of the emperor Nero, and a work by him on plants useful in medicine has survived in great completeness and in a large number of manuscripts. Nevertheless, this work is ill arranged, almost devoid of general ideas and steeped in the errors that must always pursue those who follow purely practical ends without regard to theoretical considerations. The work of Dioscorides is essentially a drug collector's manual. Even lower in quality is the *Natural History* of his contemporary, Pliny the elder (*c.* A.D. 23–79). It is immensely interesting as a storehouse of folklore and as a mirror of the follies and superstitions of his age. It cannot be passed over in silence since it was perhaps more read during the middle ages than any work of antiquity except the Bible. From the point of view of a rational development of biological thought, however, Pliny's work is negligible.

The only other important later figure in the biological thought of antiquity is Galen. His magnificent achievements have been considered elsewhere (*see* GALEN). Though his interests were mainly medical, the vigour and independence with which he pursued his researches give him a very important place in the history of biology.

Galen elaborated a most ingenious physiological scheme which was accepted until modern times. It involved three kinds of pneuma or spirit in addition to air. The basic principle of life was drawn from the world-pneuma or air by breathing. Entering the body through the windpipe, it passed to the lung and thence to

the left ventricle, where it encountered the blood. His erroneous but ingenious view as to the change that then took place in the blood remained current till the 17th century. He believed that chyle reached the liver, which indued it with pneuma or spirit innate in all living substance, the natural spirit. It was distributed by the liver through the venous system, ebbing and flowing in the veins. One great branch of the venous system was the cavity now called the right ventricle. The venous blood that entered it had two possible fates. Most ebbed back into the liver, having parted with its "fumes" or impurities, which were carried off to the lung and exhaled—hence the poisonous character of rebreathed air. A small portion, however, trickling through minute channels in the heart substance, dripped slowly into the left ventricle. There it encountered air from the lung and thereby the dark blood was made bright and its natural spirit elaborated into a higher type of pneuma, the vital spirit. This blood, charged with vital spirit, was sent by the arteries to all parts, some going to a network of vessels, the *rete mirabile*, at the base of the brain. There it was charged with a third pneuma, the animal spirit, which was distributed by the nerves. It is to be noted that the *rete mirabile*, absent in most animals, is well developed in cattle, on the examination of which Galen developed his system.

The best presentation of Galen's views is in his great works *On Anatomical Procedure* and *On the Uses of the Parts of the Body of Man*. He introduced many useful terms. Among those still current in anatomy are apophysis, epiphysis, trochanter, diarthrosis, anastomosis and synarthrosis. In fact he provided the bases of the vocabulary of modern anatomy and comparative anatomy.

Perhaps Galen's most remarkable positive achievement was his experimental investigation of the spinal cord, the continuity of which, at different levels, was, he showed, necessary for the maintenance of certain functions. Injury between the first and second vertebrae caused instantaneous death. Section between the third and fourth produced arrest of respiration. Below the sixth it gave rise to paralysis of thoracic muscles, respiration being carried on only by the diaphragm. If the lesion were yet lower the paralysis was confined to the lower limbs, bladder and intestines. Galen's knowledge of the functions of the spinal cord was not extended and indeed was not adequately appreciated until well into the 19th century.

Galen's biological works are among the most influential of all time. Nevertheless he established no school nor had he either disciples or followers. On his death *c.* A.D. 200 anatomical and physiological inquiry ceased completely. The biological dark ages had begun.

4. The Middle Ages.—The biological darkness of the middle ages lifted a little with the translation of Greek works from Arabic versions into Latin. These began to appear in the 11th century but were not common till the 13th. The most important for biology were Aristotle's. These were turned into Latin from a very corrupt Arabic version in south Italy by Michael Scot (d. *c.* 1232) with the help of a Jewish assistant who knew Arabic. During the next 100 years some of the physiological works of Galen also appeared in Latin. Of writers of this age the only one worthy of mention is Albertus Magnus (*c.* 1200–80) of Cologne. Though his biological works followed Aristotle very closely, they betrayed some observational capacity.

Much more observationally effective than the scholars of the time were the craftsmen and artists. From the 14th century their work showed a tendency to the more careful observation of living things, especially plants. This exhibited itself in illuminated herbals, in architectural ornaments and in details in paintings. Toward the end of the 15th century this movement showed itself very clearly.

The artists of the Renaissance period, Sandro Botticelli (1444–1510), Leonardo da Vinci (1452–1519), Albrecht Dürer (1471–1528), Michelangelo (1475–1564) and others, exhibited interest in exact portrayal of animal and plant forms as well as curiosity about the structure of the human body. These great Renaissance figures were curious as to the ways of nature, and it is not misusing words to speak of Leonardo, at least, as a great biologist. The group of movements which came to flower with the beginning of the 16th century placed the student of nature in a peculiarly favourable position. He had the works of science of antiquity on which to start. The craft of printing was at his disposal. He had the representational studies of the great artists before him. He had learned to present details of nature effectively. At last, also, the art of the woodcutter was perfected, so that the figures of the artist could be transferred to the printed page.

5. Revival of Learning.—It was in this happy collocation of circumstances that the first effective biological textbooks of modern times were produced. The movement began in Germany with the botanists. Otto Brunfels (1488–1534) produced the first printed work on plants which relied solely on observation. The drawings are firm and faithful and compare favourably with those of a good modern textbook. As Brunfels was the first, so Leonhard Fuchs (1501–66) was the greatest of the German "fathers of botany." His work appeared in 1542 and is a landmark in the history of natural knowledge. A part of the same movement was the new scientific interest in anatomy. Protagonists of that movement (*see* MEDICINE AND SURGERY, HISTORY OF) were Andreas Vesalius and Bartolomeo Eustachio. More in the class of pure "naturalists" in the modern acceptance of that word were the two French observers Pierre Belon and Guillaume Rondelet.

Pierre Belon (1517–64) of Le Mans spent several years wandering in the near east. He kept careful notes of the natural history of the countries that he traversed. Later he produced books on plants, fishes and birds, which, though borrowing from Aristotle, show also much original observation. Belon clearly grasped the general principles of comparative anatomy, especially as applied to the skeleton. These principles had already been elucidated by Vesalius. More accurate as an observer, though less imbued with comparative principles, was Guillaume Rondelet (1507–66) of Montpellier, a friend of François Rabelais. Rondelet's great work is a painstaking investigation of the fishes of the Mediterranean.

The learning of the time was liable to express itself in the form of encyclopaedias. These were mostly little but compilations. An exception must be made, however, for that of Konrad von Gesner (1516–65), the great Swiss naturalist. His history of animals in five folio volumes covers the topics of quadrupeds, birds, fishes and snakes. Most of the matter is borrowed, but much also is original, notably the section on fishes, which contains also figures of a large number of invertebrates. The work of Gesner is regarded by many as the starting point of modern zoology. To his contemporaries, Gesner was best known as a botanist, but his most important botanical works were not published until 200 years after his death. His figures of animals are superb.

Toward the end of the 16th century all the important departments of biology—anatomy, physiology, botany, zoology—were becoming differentiated and making considerable progress. These subjects were being taught in the universities of northern Italy and especially at Padua, the old school of Vesalius, where Hieronymus Fabricius (*c.* 1533–1619) of Aquapendente exercised most influence. Fabricius made extensive embryological investigations, and his works on the subject are the first to be illustrated with figures drawn from the object. He made many physiological researches. Thus he described the valves of the veins and was one of the first to give an accurate account of the structure of the eye. Other important Paduan teachers of the time were Realdo Colombo, Sanctorius, Andreas Caesalpinus and Giulio Casserio.

6. The Rebirth of the Physiological Study of Animals and Plants.—A remarkable pupil of Fabricius was the Englishman William Harvey (1578–1657), the discoverer of the circulation of the blood. His work on that subject, published in 1628, gave the first rational explanation of the workings of the animal body. (*See* HARVEY, WILLIAM.)

Science of the early 17th century was illuminated by the work of Galileo, of whom Harvey was a pupil. Another disciple, G. A. Borelli, was primarily a mathematician. In his *De motu animalium* (Rome, 1680) he founded the science of muscular mechanics, investigating the motions of animals according to the

laws of statics and dynamics. Many of his conclusions still stand. While Harvey was at work on the special researches associated with his name, optical instruments were being constructed which made it possible to examine the structure of animals more minutely. In 1610 the compound microscope was described by Galileo and through him passed into modern use. The first systematic investigation of living things with the new instrument was made by a group of young men who formed themselves into the first scientific society, under the name of the "Academy of the Lynx," which usually met at Rome at the house of its president, Federigo Cesi, duke of Aquasparta. His early death in 1628 brought the academy to an end, and many of its works perished. We have, however, records of a few of its observations which are peculiarly interesting as the earliest for which the microscope was systematically employed. Cesi himself worked on botanical topics and described the spores of the fern. Other members of the academy issued a work on the newly discovered animals and plants of the new world.

With the collapse of the Academy of the Lynx, systematic microscopical observation ceased for a generation. After 1660, however, there arose a series of great microscopical observers who among them revolutionized the conception of the nature of living things. Of these "classical microscopists," two, R. Hooke and N. Grew, were English; two, A. Leeuwenhoek and J. Swammerdam, were Dutch; and one, M. Malpighi, was Italian. It is interesting to observe that the most important work of all of them, except Swammerdam, was published in England.

Marcello Malpighi (1628–94; *q.v.*) supplemented Harvey's work by describing the capillary circulation which Harvey had not seen. Malpighi demonstrated it in the lung of the frog. He extended greatly the work of Fabricius, and he especially investigated the early stages of the development of the embryo of the chick. He gave accurate representations of the early stages, and notably he showed that in the embryo there are paired branches of the aorta which reunite. These correspond, as we now know, to the vessels in the gills of a fish. Malpighi, who had no evolutionary leanings, had no conception of the nature of these vessels, but his description of them is very good. The bulkiest of Malpighi's contributions are his writings on the anatomy of plants. He gave excellent representations of the cell walls of plants, and he established the broad outlines of the microscopic anatomy of the roots and stems of the higher plants.

In botanical anatomy even more accurate and systematic observations were made by Nehemiah Grew (1641–1712; *q.v.*). Grew placed the study of the anatomy of plants on a firm foundation. He is also remarkable for his statement as to the sexual character of flowers—an observation which he himself ascribes to Sir Thomas Milligan, Savilian professor of geometry at Oxford.

Jan Swammerdam (1637–80; *q.v.*) was perhaps the most accurate and remarkable, as he was the most mentally unstable and short-lived, of the classical microscopists. His first work, *A General History of Insects,* deals chiefly with the modes of transformation of insects and brings out well the different modes of development of the major groups of insects. The text and figures are equally good, and the book itself obtained popular recognition. His magnificent *Bible of Nature,* which is probably the finest collection of microscopical observations ever published, did not appear till long after his death. It is still in current use by naturalists.

Anton van Leeuwenhoek (1632–1723; *q.v.*) made the greatest impression on his contemporaries of all the classical microscopists. He published an immense number of observations of a desultory kind, nearly all in the *Philosophical Transactions* of the Royal society. These observations contain many shrewd judgments. Leeuwenhoek's portrayal of bacteria in 1683 and of spermatozoa in 1677 are triumphs of observation with the optical means at his disposal. He drew and described the structure of striated muscle. He investigated in his own peculiar fashion almost every department of animal and plant life. No one was more influential than Leeuwenhoek in drawing the attention of observers to the minute complexity and beauty of the structure of the animal body.

Of all the classical microscopists the most gifted was Robert Hooke (1635–1703; *q.v.*). He was, however, only to a limited extent a biologist. His important work, *Micrographia,* appeared in London in 1665. In it he has a figure of the microscopic structure of cork showing the boundaries of the cell walls. He refers to these as *cellulae,* and the word "cell" in modern biological nomenclature is probably derived from this. He shows also the cells on the surface of the stinging nettle, and he has a good account of its stinging apparatus. An important botanical observation by him is the growth of a fungus of the group Ascomycetes on damp leaves. He also gives accounts of the structure of moss and of experiments on the sensitive plant. He gives remarkable delineations of the compounded eye of a fly and two gigantic figures of a flea and of a louse. His account of the life history of the gnat is the earliest of its kind and a first-class piece of observation.

The work of the classical microscopists stands somewhat apart from that of other investigators and forms a peculiarly isolated chapter in the history of biology.

7. Early Attempts to Classify Living Things.—The early naturalists, whether botanists, zoologists, microscopists, anatomists or encyclopaedists, seldom made any sustained attempt at systematic arrangement. The encyclopaedic naturalists, such as Gesner, arranged their material according to the obvious divisions of the animal kingdom—fishes, birds, reptiles and the like.

The first trace of any systematic arrangement of plants in accordance with their structure is in the work of Matthias de l'Obel (1538–1616), a Dutchman who went to England in his youth and dedicated his first book (1570) to Queen Elizabeth I. L'Obel attempted to group plants according to the form of their leaves. He succeeded fairly well with the grasses, less well with the other monocotyledons and failed with the dicotyledons, with which he confused the ferns.

More promising was the suggestion of the shrewd investigator Andreas Caesalpinus (1519–1603) of Padua and Pisa, who attempted to class plants according to their flowers and fruits. The scheme formed on this basis was by far the best of the kind that had yet appeared. A small part of it was absorbed into the influential work of Gaspard Bauhin (1550–1624; *q.v.*) of Basel. For the most part, however, it fell on sterile ground and was little noticed till the time of Linnaeus.

So far as general arrangement is concerned, Bauhin was distinctly inferior to Caesalpinus. He gives, however, descriptions of about 6,000 plants. The great merit of his book is that in it, for the first time, the species of plants are placed together in small definite groups or genera. The modern conception of genus and species is to be seen in the work of Bauhin more than in that of anybody else of his time, and his system approaches nearer to a binomial one than any before Linnaeus.

Important steps toward a systematic arrangement of living things were made by the two friends John Ray (1627–1705) and Francis Willughby (1635–72). They formed a scheme for a systematic description of the whole organic world. Willughby was to undertake the animals, Ray the plants. Willughby died early, and Ray became the chief founder of the science of systematic biology. His early attempts on the flora of Cambridge and his treatise on birds were followed in 1682 by his important *New System of Plants.* In this he demonstrated the true nature of buds and used the terms dicotyledons and monocotyledons to indicate a division of flowering plants. He based his system largely upon the fruit but also upon the leaf and other characteristics and especially, following Caesalpinus, upon the flowers. In doing this he succeeded in disentangling a number of the larger groupings of plants now known as families. His work in botany was completed by his *Synopsis of British Plants* and followed up by a *Synopsis of Quadrupeds and Serpents* (1693). The latter contains the first truly systematic arrangement of animals. It is based primarily upon the fingers, toes and teeth.

The systematic arrangement of living things was continued especially by the Swede Linnaeus (1707–78), the greatest of the systematists. Linnaeus brought to bear upon his life work an enormous acquaintance with living things, especially plants, gained in the field. His prodigious industry and power of systematic arrangement would alone have given him a high place among naturalists.

He profited from all the best teachers of the day, visiting many parts of Europe, including the Netherlands, France and England. He was a most inspiring teacher and had numerous pupils, one of whom, Daniel C. Solander, accompanied the English explorer Capt. James Cook and was for many years resident in London. Linnaeus became a sort of biological dictator, and for a century after his time most of the biological work that was done in every country was in his spirit. He had a passion for classification and succeeded in assigning to every known animal and plant a position in his system. This involved placing any specimen first in a class, then in an order, then in a genus, then in a species. The broad outline of his system of classification has remained, though its rigid framework has long since been abandoned.

The chief service of Linnaeus to biology is his method—derived from Bauhin and Ray and impressed upon his contemporaries—of arranging living things into genera and species, with his development of the binomial system. His system extended even to man, and he distinguished *Homo sapiens* from *Homo troglodytes*. His *Systema naturae* went into many editions, the most highly prized being the 10th, to which naturalists still refer when they speak of Linnaean genera and species of animals, and the 12th for plants.

Linnaeus held that species are constant and invariable, a view in which he differed from John Ray. He assumed that all the members of a species were descended from a single pair that had been originally created. He afterward modified this view and came to hold that it was the genera, not the species, which had issued from the Godhead.

8. Beginning of the Study of Comparative Anatomy and Physiology.—The first animal whose naked-eye structure was adequately explored was man himself. The anatomy of man was placed upon a sound basis by Vesalius in his wonderful monograph of 1543. For certain organs of the body Vesalius had no adequate access to human material. Thus his account of the eye and that of the organ of voice were taken from the dog. He was aware of differences in structure between man and animals, and he chose several opportunities in his work to adopt a comparative method. A similar device was invoked by Pierre Belon. During the 16th century several other observers made dissections of animals and compared them with man. None was more exact than Carlo Ruini, a lawyer of Bologna, who published his monograph on the horse in 1598.

As the 17th century advanced there were a number of workers who further extended comparative studies. Of these the classical microscopists were by far the most important; for the most part they worked upon invertebrates. Monographs on various vertebrates were also prepared, as for instance that on the chameleon by the Italian Francesco Redi and that on the chimpanzee or "pygmy" by the Englishman Edward Tyson. Monographs on invertebrates were prepared by Malpighi on the silkworm, by Swammerdam on the May fly, the bee and the snail and by Leeuwenhoek on the development of the flea.

With the great movement initiated by the work of Harvey, something in the nature of comparative physiology became possible. Harvey's masterpiece is in fact in large part a comparative study of the circulation. Of comparative physiology an important exponent was the English country parson Stephen Hales (1677–1761).

Hales began the study of the functional activity of plants, and his work was the most important in that department until the 19th century. He measured the amount of water taken in by the roots and given off by the leaves, comparing this with the amount of moisture in the earth and showing the relationship of the one to the other. He made calculations of the rate at which water rises in the stems, and he showed that this has a relation to the rate at which it enters by the roots and transpires through the leaves. He measured also the force of suction in wood and roots; that is to say, "root pressure." He sought to know that these actions of living plants might be explained as the result of their structure. His most important contribution for botanical physiology was perhaps his demonstration that the air contributes something to the building up of the substance of plants, and in this respect he may be said to have been the discoverer of carbon dioxide. Following this up, he showed that air enters the plant not only through leaves but also through the rind. His experiments and conclusions in the physiology of animals were as important as in that of plants. Here he showed that there is a pressure of the blood within the vessels which can be measured, and that it varies in different circumstances and differs in the arteries and the veins. He even estimated the rate of flow in the capillaries. It is especially characteristic of his work that in all his experiments he sought to give a quantitative expression to his results. Hales was thus among the first to adopt exact methods in biology.

The most accomplished naturalist of the 18th century was R. A. F. de Réaumur (1683–1757), who applied his varied talents to the whole range of the sciences. He made important observations on regeneration in Crustacea, locomotion of starfish, electrical apparatus of the torpedo, marine phosphorescence, growth of algae, digestion in birds, silk of spiders and the nature of coral organisms. His great *Mémoires pour servir à l'histoire des insectes* (1734–42) is remarkable for its physiological interests, for he discusses the effect of heat on insect development and has much on the leaf borers and gall formers. Throughout he emphasizes development and metamorphosis.

Two younger contemporaries and correspondents of Réaumur who showed extraordinary skill in limited fields were P. Lyonet (1707–89) and Abraham Trembley (1710–84). Lyonet had astonishing skill in minute dissection. In 1740 he produced with incredible labour his famous monograph of the goat-moth caterpillar in which he demonstrated no fewer than 3,000 separate muscles. Trembley is best remembered for his monograph on *Hydra* (1744), to the study of which he devoted many years. He showed that it was of animal nature and disclosed its mode of life and reproduction. His book on it is exceptionally beautiful and contains many drawings by his friend Lyonet.

The comparative attitude in combination with exact experiment in biology was peculiarly characteristic of the investigators of the 18th century and separates them from those of the previous period. None pursued the method with greater enthusiasm than the surgeon John Hunter (*see* HUNTER, WILLIAM AND JOHN). He anatomized more than 500 species of animals, many a number of times, as well as many species of plants. His objective was to trace systematically the different phases of life as exhibited in the structure of animals and plants. Both in precept and example Hunter was the greatest influence in connection with the establishment of natural history museums, the subsequent development of which followed lines similar to those which he suggested.

Hitherto comparative studies had been the preoccupation of individual workers. Georges Cuvier (1769–1832), by his immensely powerful position in the French intellectual world, was able to establish a complete and organized school of comparative investigators which may be said to have continued to our own time. His influence was stimulating to research, but it cannot be said that he invariably exerted his power with the greatest discernment. He believed strongly in the fixity of species and thus opposed the views of Lamarck (*q.v.*) and of Étienne Geoffroy St. Hilaire (1772–1844). Nevertheless, by the paleontological school which he founded and which extended into every country, he did more than any other man to collect material on which the doctrine of the impermanence of species became formally founded in the next generation. His *Règne Animale* is still one of the main bases for comparative studies. Among the specific achievements of Cuvier were the creation of the science of paleontology, the exploration of the anatomy of the Mollusca and the systematic treatment of the vast class of fishes.

The tradition of Cuvier was carried to England by Richard Owen (1804–92), who became the first director of the British Museum of Natural History.

While Cuvier and his school led in the comparative study of structure, the comparative study of function, expounded by Hales, was established on a firmer basis by the great German physiologist Johannes Peter Müller (*q.v.*). The latter part of Müller's life was given mainly to zoological research. As a microscopist he

worked out the anatomy of the glandular and cartilaginous tissues and grouped the connective tissues. He was a convinced vitalist, and his doctrine of specific nerve energy remains one of the cornerstones of vitalistic theory.

The study of the paleontology of plants came later than that of animals. A few fossil plants had been described by earlier naturalists. Toward the end of Cuvier's time several figures of plants from the Coal Measures had been published with the generic and specific names that they still bear. Not until 1831 was the technique of their examination sufficiently advanced for microscopic study. The study began to be systematic in 1858 with W. C. Williamson (1816–95), who demonstrated in coal gigantic forms similar to the higher flowerless plants such as horsetails, ferns and club moss. His results were long neglected, but during the 20th century the paleontology of plants came to be nearly on the same footing as that of animals.

9. Effects of Geographical Exploration on Biological Development.—From the end of the 15th century the western nations of Europe were sending forth expeditions east and west, and these brought home knowledge of the natural products of lands newly explored. Thus the idea that each region has its characteristic living things became gradually explicit.

In the 18th century exploratory expeditions began the practice of carrying specially trained naturalists, and thus they enter the history of biology. The three voyages of Captain Cook (*see* COOK, JAMES) mark an era not only in the history of geographic discovery but also in the study of living things. Among the naturalists that Cook took with him were Sir Joseph Banks (1743–1820; *q.v.*) and a pupil of Linnaeus, Daniel C. Solander (1736–82). Both were instrumental in exploring the flora and fauna of the Pacific.

An important voyage which covered the western as well as the eastern hemisphere was that of the "Beagle," which sailed in 1831 and carried the naturalist Charles Darwin (1809–82; *q.v.*). Quite apart from the investigations and theories with which Darwin's name is especially associated, the voyage made known a whole multitude of new forms and helped establish the doctrine of zoogeographical and phytogeographical regions.

By the middle of the 19th century exploration and survey had become recognized as an important duty of the British admiralty. Many scientific expeditions were sent out by that body. The most important was that of the "Challenger" which sailed in 1872. The features of this expedition were, first, the very careful examination of the depth and character of the seas and sea water whereby oceanography was established as a separate science; second, the large number of remote places visited; and third, the magnificent scale on which the scientific results of the journey were published. The reports of the "Challenger" expedition are still in current use by naturalists. The influence of this expedition, coming as a culmination of a series of previous voyages of exploration, was to modify considerably the general view of the range and variety of living things and to enable naturalists to form a picture of life in the ocean, where the geographical regions are distributed vertically rather than horizontally.

10. Reproduction of Plants and Its Comparison With That of Animals.—One of the main gaps in biological thought was the great difference between the nature of animals and that of plants. Especially the mode of reproduction of plants seemed to separate them very widely from animal forms. Because of this, perhaps, have arisen so many legends concerning the "loves of the plants" and vague ideas ascribing sex to these beings. The conception of sex in plants was first lucidly, consistently and accurately set forth, though in elementary fashion, toward the end of the 17th century by R. J. Camerarius (1665–1721). This remarkable observer pointed out that the sex theory could not be made to apply to flowerless plants. The doctrine of the sex of flowers was accepted by Linnaeus and incorporated in a mechanical way into his system. Linnaeus found the sexual parts of plants convenient for establishing his classification.

During the course of the 18th century several botanists succeeded in using the pollen of one species to fertilize the flowers of another species of plants. The existence of hybridization was recognized, and one writer, J. G. Kölreuter (1733–1806) of Karlsruhe, held that the main agent in the fertilization of flowers was the wind, but that some flowers fertilized themselves and that in others insects played a part. With great acumen, moreover, he pointed out that in some plants (*e.g.*, the mistletoe) which did not lend themselves to pollination by the wind, and in which the flowers were of different sexes, the only way of pollination was by insects. Moreover, for this same plant he called attention to the distribution of seeds by birds, later successfully investigated by Charles Darwin. Thus, as he pointed out, the mistletoe depends upon both birds and insects for its existence.

The subject was taken up by several German workers, notably by C. K. Sprengel (1750–1816), who, in his work *The Newly Revealed Mystery of Nature in the Structure and Fertilization of Flowers*, paid special attention to cases in which the sexual parts occurring on a single blossom matured at different periods. Sprengel reached the conclusion that some flowers can be fertilized only by insects, that some are so constructed as to injure and even kill insects that serve them, and that yet other flowers are fertilized by wind. He observed that flowers belonging to the last class always produce large quantities of light pollen, whereas in the flowers of the other types pollen is relatively heavy. He demonstrated the relation of the nectary to the process of fertilization and sought to show that his principles explained all the course of flowers—their position, size, odour, colour, form, date of flowering, etc.

The actual process of fertilization was first observed by the extremely acute and versatile Italian microscopist G. B. Amici (1786–1863). In 1823, working with a microscope which he had himself improved, he saw the tube given off by the pollen grain and its contents perform streaming movements. In 1830 he followed the pollen tube into the ovary and observed it find its way to the micropyle of the ovule. These observations were confirmed by Robert Brown and M. J. Schleiden, and finally in 1846 the process of fertilization in flowering plants was placed upon a firm and recognized basis by Amici himself. Thus the general character of the vital processes of plants was brought into relation with that of animals.

11. Metamorphoses and Alternation of Generations in Animals and Plants.—An obstacle to the conception of living things obeying general laws has always been the observation of the extreme changes that some forms undergo. Such metamorphoses were the subject of exact study during the 17th century by Swammerdam and other naturalists. These observations were extended by many observers during the 18th century and notably by John Turberville Needham (1713–81).

A somewhat isolated position was occupied by John Vaughan Thompson (1779–1847), of whom it is said "few great naturalists have written so little and that little so good." As an army surgeon he spent several years in the West Indies, where he discovered that land crabs undergo a metamorphosis as remarkable as, though utterly different from, that of insects. Subsequently he was stationed at Cork, Ire., where in six miserably printed fascicules he announced a whole series of discoveries concerning life histories, among the most remarkable being his demonstration that barnacles are, in fact, Crustacea which pass through an active, free-living form.

In the early 1840s J. J. S. Steenstrup (1813–97) of Copenhagen described how jellyfish and parasitic worms produce offspring which at no time resemble their parents but which, on the other hand, bring forth progeny similar to the grandparents. Instances of "alternation of generations," as this process was called, were rapidly accumulated by naturalists from many different groups in the animal kingdom. An instance of such a curious cycle is in the common aphis of roses, in which there is an alternation of parthenogenetic and sexual generations. This had, in fact, been observed in the 17th century.

In 1851, a short time after the appearance of Steenstrup's volume, Charles Darwin published his first important monographs on a living group. In these works on the barnacles and allied organisms, he continued the work of Vaughan Thompson in showing that these creatures go through a remarkable metamorphosis, being

born as free-swimming Crustacea and subsequently settling down to fixed life in which they superficially resemble Mollusca, with which Cuvier had classed them. He also linked the living with the fossil forms. Darwin, moreover, demonstrated the curious feature that while individuals of this group were normally hermaphrodite, yet from time to time forms appeared that were male only, and there was at such times true sexual generation.

The interpretation of the phenomena of alternation of generations was unsatisfactory and vague. The botanist Karl Wilhelm von Nägeli (1817–91; *q.v.*) in the 1840s examined the prothallia of ferns and observed their free-swimming spermatozoa. At last in 1850 Wilhelm Hofmeister (1824–77; *q.v.*) gave a consecutive account of the actual process of generation in the fern, having observed the whole process of development from a single cell into the prothallus. He saw how the prothallus matured specialized cells, which, after conjugation, gave rise to the more conspicuous and well-known asexual form. He had demonstrated alternation of generations in the fern. He went on to show that the mode of production of the embryo in the pines and their allies was in certain ways intermediate between that of flowering plants and that of the ferns. Thus, by 1860, it was established that fertilization in flowerless plants consists in the blending together of the spermatozoid and the egg cell, and that in flowerless plants there is a definite alternation of generations.

Observations on the sexual character of plants, on the alternation of generations and on metamorphoses gave absorbing interest to the investigation of generation in general and stimulated the study of embryology of both animals and plants. These studies led to the firmer establishment and wider application of the cell theory and to the accumulation of facts used as data by the founders of the evolutionary school.

12. Establishment of the Cellular Nature of Animals and Plants.—The appearance of cell walls is to be seen in many microscopic drawings of plant tissues made in the 17th century by the great classical microscopists. They distinguished between the various tissues of the higher plants, although they knew nothing of the substance within the cell wall. Not until the 19th century was there any adequate attention given to living substance of the cell. In some of the accounts of the microscopic appearance of the tissues of animals, cells had been vaguely distinguished, though much less definitely than in plants. During the 18th century little important microscopic work was done. At the beginning of the 19th century, M. F. X. Bichat (1771–1802), perceiving that the different parts of the body such as bones, muscle, nerves, blood vessels, cartilages, etc., had a different macroscopic appearance, succeeded in analyzing them into 21 "tissues," each of which had a certain microscopic unity. Out of this discovery arose the study of histology (*q.v.*), the word being introduced by Richard Owen (1845) and still in current use.

Between the 17th and early 19th centuries advances were made in the knowledge of unicellular organisms. *Vorticella* had been described in 1667, bacteria in 1683, *Paramecium* in 1702 and *Amoeba* in 1755. Several monographs dealing with unicellular plants and animals had appeared, but no advance had been made in appreciation of the real nature of these beings, which was first grasped by Felix Dujardin in 1841. In 1833 Robert Brown in his investigations on plant fertilization had discussed the nucleus and found it a normal accompaniment of the cell, but he had only a vague idea of the nature either of cell or of nucleus.

The term "cell theory," to cover the idea that all living things are composed of these elements, was coined by Theodor Schwann (1810–82) in 1839 and was given popularity by his writings and those of M. J. Schleiden (1804–81). The idea is often ascribed to these two men but was really a very gradual growth in which many workers were involved, among whom the names of J. E. Purkinje (1787–1869), M. H. Rathke (1793–1860), Johannes Müller and G. G. Valentin (1810–83) should also be mentioned. Schwann has the special merit of showing how the ovum is itself a cell. Finally, he passes to a general statement as to the cellular origin of animals and plants. We may note that he introduced the word "metabolic." The word "protoplasm" was introduced by Purkinje, and the conception of this substance as the physical basis of life was the work of Max Schultze (1825–74).

With the final establishment of the cell theory, histology became a special science and was admirably developed by the Swiss Albrecht von Kölliker (1817–1905), a pupil of Johannes Müller. The subject was extended into the department of disease by yet another pupil of Müller, Rudolf Virchow (1821–1902; *q.v.*).

13. Organic Evolution; the Origin of Species.—By most older writers, species were treated as fixed and definite—as though their characteristics had been made once and for all and had never altered. Thus in the opinion of Linnaeus there are "as many species as issued in pairs from the hands of the Creator." Even Linnaeus, despite his systematizing obsession, began to see that it is often very difficult to separate species one from another. He did not move from his original position of creative fixity of species, but simply substituted the genus for the species as the original creation. He thus reached the conclusion that "all the species of one genus constituted at first one species."

Many early naturalists adumbrated the doctrine of the evolution of organic forms. The first who clearly set forth the idea as applied to existing living things was G. L. L. Buffon (1707–88). His great scientific work, *Natural History, General and Particular*, appeared in 44 volumes, and its publication occupied 55 years, 1749 to 1804, being completed after his death by one of his assistants. It aimed at containing all scientific knowledge and was the first modern attempt of the kind. In different parts of his great work and in other works Buffon expressed himself variously on the subject of organic evolution, but he moved further and further from the position occupied by Linnaeus. He finally accepted the conception that species alter in type from time to time, but that at each alteration they retain some marks of their previous type, as the pig, for instance, retains digits now in disuse but formerly used. He thus came to the conclusion that many species are degenerate forms of others; that the ape, for example, is a degraded man and the ass a degraded horse.

Similar views were set forth even more clearly by Erasmus Darwin (1731–1802), the grandfather of Charles Darwin. Erasmus Darwin held that species change in course of time and that these changes are the result of influences upon the individual from without and are passed on to the offspring. Thus he was a believer in the inheritance of acquired characteristics, a conception which was further developed by his younger contemporary Lamarck (*q.v.*), whose *Zoological Philosophy* appeared in 1809. Lamarck held that for living organisms there existed a "natural order." He thought that if all the species that have ever existed were known, they would be found to form a long ladder or scale in which each would differ but little from the next. This view Lamarck derived ultimately from Aristotle. The gaps that he could discern between the existing series he ascribed to the destruction of the intermediate links. These gaps he hoped would be filled in by paleontological discovery. We owe the word "biology" largely to Lamarck, but still more we owe to him the conception of biology as a comprehensive and self-contained study. Since, according to Lamarck, species shade into each other, it seemed to him improbable that they were permanently fixed. In reaching this conclusion, he laid much stress, as did Charles Darwin after him, on the peculiar development of domesticated animals. There must, he thought, be some agent acting to produce variations from the original type. This agent Lamarck believed to be environment.

He thus reached the conclusions, first, that species vary under changing external influences; second, that there is a fundamental unity underlying the diversity of many living things; and, third, that the diversity of living things is subject to a progressive development. The mechanism of that development Lamarck held to be use and disuse of acquired characters.

Discussion of the conception of the progressive development of living things with its corollary, the inconstancy of species, was raised by many writers in the first half of the 19th century, among them the French naturalist Étienne Geoffroy St. Hilaire and the German poet Goethe (1749–1832). In England a writer who attracted much attention was T. R. Malthus (1766–1834), whose important *Essay on Population* was first published anonymously in

1798 during the French revolutionary era; its tone and argument are not unrelated to the social views of the time—views which had their influence upon Darwin. Indeed, it is not too much to say that the *Origin of Species* is one of the secondary products of the utilitarian philosophy of which the chief exponent was Jeremy Bentham and the chief social product was the French Revolution itself.

The *Origin of Species* by Charles Darwin appeared in 1859. For the detailed nature of the views there expressed *see* DARWIN, CHARLES ROBERT. It created a revolution in thought in England and to a lesser extent in France and Germany. As is well known, it deeply influenced Karl Marx. The cause of that change in opinion was not so much the doctrine of the impermanence of species, which had been voiced by many before Darwin, as that Darwin displayed to his readers the details of a process which could be seen in daily operation. Moreover, in setting forth his hypothesis of the action of natural selection he placed before his public a mechanism which he believed, and they believed, was sufficient to account for the process in question. His theory appealed specially to the practical minds of the English naturalists, who required an explanation of the process before they would altogether accept it. The theory naturally had less effect upon certain more philosophic thinkers, whom the actual evidence for the existence of evolution had already convinced.

In 1852, seven years before the publication of the *Origin of Species*, the philosopher Herbert Spencer (1820–1903) had set forth doctrines of evolution in which that word was probably used for the first time in literature to describe the idea of a general process of production of higher from lower forms. Sir Charles Lyell, of whom Darwin professed himself a disciple and who deeply influenced Darwin's whole thought and work, used the word 20 years earlier in a similar though less general sense. The word "evolution" was seldom used by Darwin himself, but the particular application given to it by Spencer rapidly caught on, and "Darwinism" and "evolution" were often treated as synonymous terms. The doctrines of Darwin, however, applied only and were meant to apply only to the world of life; nor even there can we regard the words "Darwinism" and "evolution" as truly synonymous, for it is quite possible to conceive of organic evolution that is independent of such Darwinian factors as natural selection or sexual selection. The phrase "survival of the fittest" was also coined by Spencer and caught on in the same way as did "evolution." Evolutionary doctrines were diffused by a host of expert biologists who were rapidly converted to the Darwinian point of view. Among them T. H. Huxley (1825–95; *q.v.*) in England and Ernst Haeckel (1834–1919; *q.v.*) in Germany were especially prominent.

Since Darwin, and especially in the 20th century, doubt has been cast on the evolutionary efficacy of those factors on which Darwin himself laid most stress. The conclusion that species do in fact give rise to other species has earned almost universal acceptance, and on the general relation of living things within the larger groups there is no wide divergence of opinion. It cannot be said, however, that any general agreement has been reached as to the process by which the great variation in living things has been produced, nor can it be claimed that there is any consensus as to the relationship of the main groups of living things to each other. Despite these reservations it cannot be gainsaid that the history of biology since the days of Darwin may be treated as in large part a commentary on his work. The stimulus which he gave to comparative morphology has given rise to a truly prodigious literature dealing with plant and animal forms. His work has acted as a less stimulating influence on those departments which deal with function, and comparative physiology remains in a relatively rudimentary state. The study of inheritance and of genetic characters, however, may be traced back directly to his example. A large part of the work since about 1880 in this direction has been done in confirmation or refutation of his views. (*See* DARWINISM.)

14. Biogenesis Versus Abiogenesis; the Origin of Life.—All the older naturalists, following Aristotle and Theophrastus, accepted spontaneous generation at least of the lower forms of life. According to them, spontaneous generation was the normal mode of production of certain organisms. These views were universal until the middle of the 17th century and the advent of microscopic research.

The exploration of microscopic life soon revealed that many cases of apparently spontaneous generation were, at least, complex. Malpighi showed that galls were not spontaneously generated but were associated with the larvae of an insect. He traced these to their development as free-living forms but failed to infer that each was the result of an implanted egg. On the other hand, the increasing power of the microscope revealed the existence of more and more minute organisms which seemed to appear out of nothing. Thus Leeuwenhoek saw such organisms in infusions of broth and other substances. Such infusions, at first perfectly clear, became in a few days turbid with vast numbers of minute, actively moving bodies, which were for this reason called Infusoria.

The first scientific treatment of the question of spontaneous generation was made by the Italian Francesco Redi (*c.* 1626–97). His experiments were admirably designed and his conclusions lucidly set forth. He exposed fresh meat in jars covered with fine gauze, using as controls meat in other jars not so covered. Soon in the open jars larvae of flies developed, while eggs corresponding to such larvae were deposited on the surface of the gauze above the closed jars, but no larvae ever developed within the closed jars themselves. Redi traced the larvae to their parents and showed conclusively that their generation could be only through parent forms.

With the extension of microscopic observation the problem became more complex, and during the 18th century the battle on the subject of spontaneous generation raged back and forth. On the one hand it was shown that by boiling or chemically treating a medium, organisms appeared in it slowly or not at all. On the other hand, cases were adduced in which microscopic organisms did so appear, despite all precautions. About the middle of the 18th century the controversy reached an important stage in a discussion between John Turberville Needham and the versatile Abbé Lazzaro Spallanzani (1729–99). This discussion is interesting since it was practically repeated about 100 years later between Pasteur and his opponents. In 1748 Needham published what was in effect a repetition—made in conjunction with Buffon—of the experiments of Redi of the previous century. His experiments, however, were more refined than those of Redi, since he aimed at excluding even microscopic organisms. He came to the opposite conclusion to that of Redi, and inferred that microscopic organisms are generated spontaneously in organic substances. His apparatus consisted of a phial filled with broth, the mouth of the phial having been closed with mastic after the broth had been boiled. Needham's observations were good, but his methods were defective and his deductions obscure. He was effectively answered by Spallanzani, an investigator and writer of very great ability, who made important contributions to several branches of biological science. Some of Spallanzani's experiments to test the truth of spontaneous generation were so exactly like those of Pasteur in the 19th century that the figures of Pasteur might be used to illustrate the memoirs of his predecessor.

The controversy concerning spontaneous generation continued in much the same state until 1859. During the previous years Pasteur had shown that putrefactive and fermentative changes in organic substances, and especially in fluids, were attributable to organisms. The question was as to the origin of the organisms. Pasteur was well aware of the controversy between Needham and Spallanzani and took the side of Spallanzani. By 1859, the year of the *Origin of Species*, Pasteur was engaged in acute controversy as to the origin of life. The matter was brought to a head by a very fine series of studies which Pasteur published in 1861.

Spallanzani, in his experiments, had heated sealed phials containing putrescible substances. Their contents remained indefinitely without any sign of putrefaction or fermentation. These processes did not take place unless or until the phial was opened. The only effective criticism made on the experiments of Spallanzani was that by heating he had altered not only the infusions themselves but also the air contained within the phial. To this Pasteur had his answer. It was the most triumphant of his experiments and beautiful in its simplicity. He introduced into a flask

an infusion of fermentable fluid. The neck was then drawn out into a long S shape, narrowed but left open. The flask and its contents were then raised to boiling point repeatedly and finally left at rest. The flask was left for days, weeks, months, undisturbed. No fermentation took place. Finally, the neck was severed, thus exposing the fluid to the fall of atmospheric dust. In a few hours the liquid began to ferment and organisms could be demonstrated under the microscope.

This is the critical experiment in a demonstration that there is no such thing, under present terrestrial conditions, as abiogenesis (spontaneous generation). The issue has been raised in various forms at various times and by various observers, but experiments comparable with those of Pasteur have always been devised in rebuttal. So far as any biological doctrine can be said to be firmly established, it is the doctrine that all living things are the product of living things. It is understood that this doctrine does not prejudge the question as to the first origin of life, nor does it prejudge the question as to whether life may have arisen at more than one date and in more than one place, nor does it prejudge the questions as to whether there are forms of life beyond microscopic vision, nor whether there are forms of existence between the living and the nonliving, nor does it prejudge the nature of viruses. It does, however, give to the biologist a conception of the nature of life comparable in its value as a standard of scientific research with the doctrine of the conservation of energy in the hands of the physicist. By chance, the movements which led to this demonstration on the origin of life were almost exactly contemporaneous with the movement which led to the establishment of the doctrine of organic evolution. Thus the modern period of biology may be said to have opened about the year 1860. (*See* also REPRODUCTION.)

15. Change in the Biological Outlook to the Modern Stage.—The whole outlook on the nature of living things underwent a complete and profound change in the period of about 20 years following 1860. This change may be ascribed to a variety of causes:

1. The discovery of the essential identity in the mode of reproduction of animals and of plants.

2. The discovery of the essential identity in the living substance of animals and of plants, and the emergence of the conception of protoplasm.

3. The examination of methods of nutrition and of respiration, and the realization that these too are fundamentally the same for all living things.

4. At first the differences of the food supply of animals and of plants seemed an insuperable barrier to this last step. Gradually, however, there emerged the conception that the chlorophyll apparatus was concerned with the manufacture of organic substances necessary for the nutrition of both animal and plant. The elaboration within the plant body, from atmospheric gases, of material for absorption into tissue came to be recognized as part of the mechanism of living nature as a whole. The view of the balance of life and of organic nature as one huge mechanism came to the fore.

5. The reduction of all living processes to terms of the cell.

6. An evolutionary view of life gave a new conception of what may perhaps be called the economics of nature. Thus there arose the tendency to examine the manner of life and habits of living things involving also their relations to other forms of living things.

7. The conviction that, so far as scientific experience extends, all living things are derived from living things and are not generated from nonliving things.

The combination of these conclusions and tendencies introduced so much alteration in the approach of biologists to the material with which they deal that we may speak of entering an entirely new era. During this new era much attention has been concentrated on genetics and the process of heredity. For long, under evolutionary influence, the subject of variation in animals and plants was intensively studied. It is, however, apparent that the real problem to be solved is why the offspring resembles, not why it differs from its parent. This is perhaps the main modern biological problem. It may be observed that Aristotle, the first biologist, most clearly visualized this very problem.

The conceptions of living substance and of organic evolution led naturally to the idea of the historic continuity of the protoplasm of the germ cells. For the protoplasm of the germ cells is clearly in a different position from that of other cells in conveying something of itself directly to the next generation. It is the vehicle of the hereditary elements, whatever these may be. This view was stressed by August Weismann (1834–1914), who gave the name "germ plasm" to the continuous factor. For him the offspring resembled the parent simply because it was derived from the same substance. Adult individuals are temporary fortresses formed to protect the continuous and deathless line of the germ plasm. This plasm has passed through the countless generations that have been. Locked in its still mysterious complexity are the possibilities of all the generations that will be.

Is the germ plasm homogenous or do only some parts of it carry the hereditary qualities? The question can be answered only by examination of the structure and behaviour of the germ cells, and notably of their nuclei. This task occupied many observers during the later 19th century and first half of the 20th. Since inheritance comes equally from both parents and since the spermatozoon consists almost exclusively of nucleus, it soon became clear that it is the nuclei that carry the main hereditary elements. Weismann asked whether the germinal nuclei could have characters impressed upon them from without. He concluded, on experimental and theoretical grounds, that they could not, and that acquired characters were not hereditable. Subsequent research supported him in the sense in which he understood the term "acquired." The problem, however, took a new turn with the passage of the 19th into the 20th century.

In the last decade of the 19th century numerous examples of discontinuous variation or "saltations" accumulated. William Bateson (1861–1926) collected these (1894) and gave much attention to them. Papers on such saltations written between 1866 and 1869 by an obscure Moravian priest, the abbot Gregor Johann Mendel (1822–84; *q.v.*), were rediscovered simultaneously by several workers in 1900. Mendel demonstrated that in certain cases these saltations occurred according to certain simple mathematical rules. As it happened, the phenomenon of nuclear subdivision in the germ cells had been the subject of intensive microscopic analysis during the previous decades, and the phenomena of "Mendelism" were soon seen to be explicable in reference to these. A major preoccupation of biologists since 1900 has been the tracing of the parallelism between the deportment of the germinal nuclei and the structure and function of the formed organism; that is, between the "genotype" and "phenotype."

Here we are beyond the range of the historian and within the realm of current science. It may be well to end by summarizing the main streams of biological activity during the 20th century.

1. Intensive study of species—taxonomy and systematics—has become centred mainly in the great national collections. Although no compendious definition of the idea of species has been reached by taxonomic methods, the direction of genetic research suggests that a more exact definition of that term is being approached.

2. The physical, physiological and biological associations of living organisms—ecology—have become main objectives of field studies which have become largely concerned with population problems. The subject is recognized to be of human and practical as well as scientific and theoretical importance.

3. Analysis of the behaviour of the germ-cell nuclei in relation to phenotype characters has developed as the independent science of genetics, with many subdivisions. Genetics is now a main topic of biological research and has already acquired profound implication with almost every department of biology.

4. The process of physiological analysis has gone far. Attention has turned to the consideration of the interdependence of functions and even to their integration so as to consider the organism as a whole. The result is a picture of bewildering complexity in which an immense number of chemical and physical processes go on simultaneously, crossing, recrossing and modifying each other within the limits of each cell. Thus the physiology of

a protozoan is, if anything, more, not less, complex than that of a "higher" organism.

5. Study of viruses has become intensive, leading to a blurring of the conception of "vital" phenomena. It is still doubtful whether a virus can be described as living and, indeed, as to what we mean by living. In any event it is as yet impossible to say whether or not a virus can be said to breach Pasteur's law of universal biogenesis.

6. Underlying much biological thought of the early 20th century was a sense that "the substance of life," like inert matter, must be resolvable into ultimate particles—"quanta" of life, comparable with "quanta" of inheritance (Mendel) and "quanta" of energy (Planck). Thus, with the rediscovery of Mendel (1900), biology entered a stage comparable with that which chemistry had entered far earlier, when the molecular theory was first scientifically expounded. (C. Sr.)

II. THE LIVING ORGANISM AS A NATURAL BODY

1. Definition.—It is first essential to understand what is meant by a living organism. The necessary and sufficient condition for an object to be recognizable as a living organism, and so to be the subject of biological investigation, is that it be a discrete mass of matter, with a definite boundary, undergoing continual interchange of material with its surroundings without manifest alteration of properties over short periods of time and, as ascertained either by direct observation or by analogy with other objects of the same class, originating by some process of division or fractionation from one or two pre-existing objects of the same kind. The criterion of continual interchange of material may be termed the metabolic criterion, that of origin from a pre-existing object of the same class, the reproductive criterion.

A few inanimate systems satisfy the metabolic criterion; the best example, and one that has rightly been the source of poetic analogy, is afforded by steady flames, which have a definite boundary, may remain unchanged for an appreciable time and are continually taking up oxygen and producing carbon dioxide and water.

Physical systems not undergoing chemical change and so providing less perfect analogies are provided by waterfalls, the spouts of waters from fountains and whirlwinds, though in the last case the boundary throughout is indefinite. In none of these cases is the reproductive criterion satisfied. The reproductive criterion is necessary to distinguish living organisms from the systems just enumerated, which are known to arise in ways other than by fragmentation of pre-existing members of the class. Since in many cases the history of any particular object to which the definition is to be applied may be unknown, it is necessary in stating the reproductive criterion to introduce the idea of classes of different kinds of organisms that can be recognized by characteristics of form and behaviour.

Logically, the property of the class of living organisms, to subdivide into a number of such classes of lower order, is to be regarded as an empirically established property of the same kind as a number of other general properties investigated in biology. It is necessary to include such a restriction in the definition to make it workable. Otherwise, however well a cat were fed and however carefully its carbon dioxide output were determined, it would be impossible to ascertain that it was alive, in spite of a continuing capacity to tear the upholstery, unless observations had been made at the moment of birth. Both a cat and an oak tree are known to be alive because the metabolic criterion can at any time be shown to apply to both, and because both are recognized as members of the class Cat or Oak Tree, no members of which have ever been observed to arise except from pre-existing cats or oak trees.

In applying the metabolic criterion, the qualification over short periods of time is introduced because living organisms may grow, positively, or more rarely negatively. When marked disturbance of the metabolic process and its final cessation take place, the organism is said to have died. In practice, the classificatory principle is applied more or less unconsciously in all judgments of the existence of life. Most animals are recognized as alive by power of spontaneous movement, but enough data are available to indicate an overwhelming probability that, if a body can demonstrate complex spontaneous movements, it also satisfies the more general requirements.

Certain difficulties may, however, arise in applying the definition in rare cases. The satisfaction of the metabolic criterion may be suspended in the case of latent or suspended animation, in seeds and in a few small invertebrate animals that can be dried and are then capable of exposure to temperatures little above absolute zero (−273° C.). Such cases could be taken care of by indicating the conditions under which the experiments implied by the definition were to be performed.

2. Properties of Living Matter.—The matter composing the bodies of living organisms may be conveniently termed living matter. This term will be employed to mean the entire material of a living organism, protoplasm (*see* Cytology) being used to mean the colloidal organic system of substances in which active metabolic change occurs.

Elements.—When living matter is subjected to chemical analysis in the ordinary way, it is of course killed, but no change in mass has ever been shown to accompany death, so that analysis will at least indicate the elements present. The commonest atomic species is found to be hydrogen, the next commonest oxygen, most of both being combined as water; after these follow carbon and nitrogen. The water that can be removed from an organism by drying at 105° C. is quite variable, but usually lies between 50% and 90% of the live weight. Of the dry matter left over, carbon will constitute about one-half except in cases in which there is a massive mineral skeleton. The average content of the other elements can be judged from the mean composition of terrestrial plants. Terrestrial animals will be higher in nitrogen and sodium, lower in potassium, silicon and aluminum; vertebrate and other organisms with calcareous skeletons will have more calcium, marine organisms more chloride, and often more water, than terrestrial.

Mean Percentage Mass of Elements in Terrestrial Vegetation

O (oxygen)	70	B (boron)	0.001
C (carbon)	18	Zn (zinc)	0.0003
H (hydrogen)	10.5	Rb (rubidium)	0.0002
Ca (calcium)	0.5	Ti (titanium)	0.0001
N (nitrogen)	0.3	Cu (copper)	0.0001
K (potassium)	0.3	Br (bromine)	0.0001
Si (silicon)	0.15	Mo (molybdenum)	0.00005
Mg (magnesium)	0.07	Y (yttrium) and rare earths	0.00004
P (phosphorus)	0.07	Ni (nickel)	0.00002
S (sulfur)	0.05	V (vanadium)	∽0.00002
Cl (chlorine)	0.04	Pb (lead)	0.00002
Na (sodium)	0.02	Li (litbium)	∽0.00001
Fe (iron)	0.02	U (uranium)	∽0.00001
Mn (manganese)	0.007	Ga (gallium)	∽0.000003
F (fluorine)	0.003	Co (cobalt)	0.000002
Ba (barium)	0.003	I (iodine)	∽0.000001
Al (aluminum)	0.002	Ra (radium)	0.0000000000001
Sr (strontium)	0.002		

It has become customary to divide the elements found in living matter into groups; many schemes have been proposed, but in most cases the general underlying thought may be expressed in the following way:

Water as the dispersing medium: hydrogen, oxygen.

Organic structural elements forming the main organic compounds in the bodies of organisms: hydrogen, oxygen, carbon, nitrogen, sulfur, phosphorus and, in some cases—in much smaller amounts—chlorine, bromine and iodine, and possibly selenium and arsenic.

Elements of the ions involved in regulating water exchange and electrical phenomena: hydrogen, sodium, potassium, magnesium, calcium, chlorine, sulfur as SO_4^{2-}, carbon as HCO_3^-, oxygen in cations. Boron in plants may belong here.

Skeletal elements, forming hard inert structures: silicon, calcium, magnesium and rarely strontium and barium; iron, manganese and possibly aluminum in bacteria, carbon as CO_3^{2-}, phosphorus as PO_4^{3-} and, in small amounts, fluorine. The elements of the organic structural compounds (hydrogen, oxygen, carbon, ni-

trogen and sulfur) may also form skeletal material, such as cellulose, chitin or keratin.

Biocatalytic elements attached to organic compounds as parts of the catalytic machinery of the organism: iron, manganese, copper, zinc, calcium, magnesium, molybdenum and cobalt in some organisms. Gallium and boron in plants may belong here, as may vanadium in plants and animals and possibly scandium in plants.

Elements of no known function: lithium, rubidium, caesium, beryllium, lanthanum and other rare earths, germanium, titanium, antimony, silver, gold, mercury, lead, chromium, nickel, platinum, present in minute amounts in some organisms, also extremely small amounts of the strongly radioactive elements.

Certain organisms have a curious capacity for accumulation of specific elements for no apparent reason. Selenium is thus concentrated in a number of plants, notably certain species of *Astragalus,* in such quantities as to constitute a grave agricultural problem in certain localities. A number of plants, notably club mosses (*Lycopodium* species) concentrate aluminum. Barium is present in great quantities in the inner seed coat of brazil nuts and also accumulates in the chorioid layer of the mammalian eye. Arsenic is concentrated in many marine Crustacea, though in a relatively nontoxic form. Vanadium is likewise concentrated in some of the sea squirts (Tunicata) and in certain fungi.

The abundance or rarity of an element in an organism is no certain indication of its physiological importance. In the mammalian liver, the rarest element of known function is cobalt. Of this there are on an average about 14,000,000 atoms per cell. There is, however, no theoretical reason why an element should not play a part at a much lower concentration. Rubidium is vastly commoner than cobalt, but since it is probably transported with potassium, its abundance is of little direct physiological significance. The rarest element detected in mammalian tissue is radium, with about 23 atoms per cell. In spite of the numerous speculative suggestions that have been made, it is obviously improbable that the radioactivity of radium is of significance in cell physiology, for most cells would have to wait many years before one of their few atoms disintegrated.

Compounds.—When an attempt is made to analyze an organism in terms of compounds, it is found that a large number of relatively simple substances can be obtained, but that the bulk of the material consists of highly polymerized organic compounds colloidally dispersed in a dilute solution of electrolytes. Of these polymerized substances by far the most important are the proteins.

The compounds that can be isolated from living organisms are noteworthy for their extraordinary diversity. It would probably be possible to isolate from any organism more different kinds of organic compounds in true solution than there are kinds of inorganic minerals in the earth's crust. The detailed consideration of this vast array of substances belongs to biochemistry. These relatively simple compounds would be found to consist mainly of material undergoing chemical changes, rather than to be the machinery by which such change, termed metabolism, is brought about.

Enzymes.—The metabolic machinery by which chemical changes are brought about consists of enzymes. Essentially an enzyme is an organic catalyst capable of accelerating a specific reaction. All enzymes that have been isolated have proved to be proteins. In many cases special groups, attached to the carrier protein, can be recognized. Such are termed prosthetic groups. The prosthetic group may contain a metal, Fe, Mn, Cu, Zn or, in general, one of the biocatalytic elements, or as a coenzyme it may consist of organic compounds linked in various complex ways. The vitamins thiamin (B_1), niacin (nicotinic acid amide), riboflavin (B_2) and pyridoxin (B_6) owe their biological importance to the fact that they are essential components of the prosthetic groups of various enzymes. They are in fact part of the general machinery of living. Until recently it was usually believed that the enzymes constituted a small proportion of living matter. In 1939 W. A. Engelhardt and M. N. Ljubimova indicated that the protein myosin, long known as one of the main constituents of muscle, is inseparable from the enzyme adenosinetriphosphatase, which plays a part in muscular contraction. It is almost certain that the two substances are identical. It is also realized that the respiratory pigments, such as hemoglobin, are not essentially different from enzymes. The view in the early 1960s was that the functional proteins of living matter are for the most part enzymes. Living matter therefore is in its most fundamental aspect a highly organized system of enzymes dispersed in an aqueous solution. It is uncertain to what extent the supposedly unaltered proteins derived from tissue extracts are present in the cell in the forms studied in the laboratory.

Electrical Phenomena.—All biological activity appears to be accompanied by electrical changes. This has long been known in the case of rapid changes in animals and is employed daily in medical diagnosis with the electrocardiogram. It is, however, apparent that electrical phenomena are far more general than this. All living organisms exhibit potential gradients when points on their bodies are led off to sufficiently refined potentiometers. Many biochemical mechanisms exist which might be postulated as giving rise to potential gradients. The elementary fact that various ionized salts play an important part in the composition of living matter would suggest that diffusion and membrane potentials might easily arise. A full explanation of biological potentials is, however, not forthcoming, and many different factors are certainly involved. Some investigators have regarded the electrical fields exhibited by organisms as their most fundamental property. It must, however, be realized that electrical fields can be demonstrated very generally in nature. The whole concept of a field represents a high degree of abstraction. The field is known only by the behaviour of the test objects introduced into it. In the absence of such it is unobservable, and there may well be great objections to basing a far-reaching theory on an unobservable abstraction which is apt to develop exactly those properties that the investigator wishes it to have.

Optical Activity.—A general character of all organic compounds produced in organisms is their optical activity. In almost every case, when an organic compound found in an organism possesses an asymmetric carbon atom, with four different groups attached tetrahedrally, one of the two possible mirror-imaged configurations is found exclusively or in great excess over the other. When the same compound is synthesized in the laboratory from its elements, the two configurations tend to be equally abundant. Louis Pasteur, who investigated this phenomenon, regarded it as a fundamental property of organisms; it is presumably dependent on the structure and extreme specificity of the enzymatic systems involved in biological synthesis.

Dynamic Properties.—Passing to dynamic properties it is clear that the living systems are not in equilibrium. A continual source of energy is necessary to maintain their integrity. If this source of energy is cut off, death intervenes. Two sources of energy are theoretically available to any organism, the chemical energy of compounds in its immediate environment, and the energy of radiation impinging upon the surface of the organism. In general, green plants and some coloured bacteria utilize incoming radiation; all other organisms utilize the chemical energy of compounds directly or indirectly derived from the photosynthetic products of such green plants and coloured bacteria.

Studies With Radioactive Isotopes.—The discovery of artificial radioactive isotopes by I. Curie and F. Joliot in 1934 and the separation of natural stable isotopes first achieved by H. C. Urey and others have provided a new biological instrument of immense power which has revolutionized general concepts of the chemical processes of organisms. These discoveries have permitted the marking of chemical compounds passing into the organism in such a way as to make possible the recognition of the metabolic products of the individual dose of material administered. Such a method was indeed first applied by G. Hevesy in 1923 in a study of lead translocation in plants, using lead isotopes from natural radioactive material, and later was extended, notably by Hevesy and A. Krogh, using radiophosphorus, and by R. Schoenheimer, using natural stable isotopes of hydrogen and nitrogen.

The immense development of isotope production in atomic energy plants after 1945 made these techniques available in all large laboratories by the mid-1950s. The resulting addition to biologi-

cal knowledge is comparable only to that resulting from the invention of the microscope in the 17th century.

The most striking general result of these studies was the demonstration that practically every chemical system of the organism is in a continuous state of change, being remodeled with a quite unexpected rapidity. The most spectacular demonstration is perhaps provided by the case of an antibody in the blood of an animal that is gradually losing its immunity. It might be supposed that in such a case the antibody would slowly be destroyed by a relatively simple process. Actually studies with food materials containing the heavy isotope of nitrogen N^{15} indicate that even during the period of loss of immunity the antibody is still being synthesized, though destruction is in excess of production. In every case investigated, the chemical structure of living matter seems to be in a state of continual formation (anabolism) and dissolution (catabolism). When anabolism dominates, growth takes place; when catabolism dominates, a decrease in size takes place and, in its most fundamental aspects, death ultimately occurs.

Cell Structure.—The properties so far discussed are primarily biochemical; prior to their discovery certain other general properties of living matter were apparent. Of these, one, implied in the very term organism, is of great significance, namely the tendency for organisms to have a definite structure. Two fundamental grades of structure are manifested. In the more complex plants and animals individuals are usually constructed of units known as cells. The term was introduced by Robert Hooke in 1665 to describe what would now be regarded as the empty cell walls in a piece of cork, though Hooke was aware of the juices that filled the cells in living plants. Since early in the first quarter of the 19th century it has generally been recognized that such cells are almost universally present in the higher animals and plants, forming the structural units of such organisms. This generalization is usually described as the cell theory and attributed to M. J. Schleiden and Theodor Schwann, though at least in some aspects it was held by Lamarck prior to 1809 and no doubt formed part of the intellectual apparatus of many workers during the succeeding two decades. Each cell typically consists of a central, usually spherical, nucleus and an outer heterogenous region termed the cytoplasm. The substance of the two together is usually termed protoplasm by biologists, though in spite of a distinguished history the term by mid-20th century had little utility and might well be abandoned. Within the cytoplasm a great variety of liquid spaces (vacuoles), reserve materials (metaplasm) and highly differentiated structural elements (mitochondria, vacuoles and plastids in plants, etc.) are often present. The cell is bounded by a membrane, the nature of which has given rise to much discussion; it probably varies from organism to organism and from stage to stage in development. In plants, a cell wall, at least initially composed of cellulose, surrounds the cell membrane.

An important step in the development of the cell theory was the discovery that there exist many organisms which consist apparently of a single unit of general structure comparable with the cells of the higher plants and animals. Such organisms are generally said to be unicellular. There is a modern tendency to speak of them as acellular, meaning not divided into cells. Since the number of cells varies enormously in the many-celled organisms, there is no logical reason why the number should not be one, and the term unicellular will be used. Such usage is in line with G. A. Baitsell's ingenious suggestion that since the cell is the smallest unit, either of a multicellular or unicellular organism, to exhibit all the properties of living matter, it may in some respects be regarded as a molecule of living matter. The transition from the unicellular to the multicellular condition represents one of the great events in organic evolution.

Among the higher unicellular organisms there is no doubt that the fundamental structure of both nucleus and cytoplasm is essentially comparable with that of the cells of multicellular species. Among the bacteria great diversity in cell structure appears to exist and no generalization is at present possible. If cellularity be defined as the condition of consisting of one or more structural units, then it is a characteristic of all living organisms at some stage in their life history; if it implies a definite cell structure with at least nucleus and cytoplasm, it is probably not a universal character. All organisms, however, show some degree of structural heterogeneity though in the smallest this can only be demonstrated by means of the electron microscope.

As is indicated below, the nucleus, which contains highly polymerized deoxyribonucleic acid combined with protein to form nucleoprotein, is certainly involved in maintaining and transmitting the specific inherited characters of the organism; while it is usually assumed that ordinary metabolic processes largely occur in the cytoplasm.

The evidence for the genetic function of the nucleus is unequivocal, but many investigators have concluded that it also plays an important role in the control of metabolic activities of the cytoplasm. During cell division, at least in multicellular organisms and in a number of unicellular forms also, the dividing nucleus is seen to form a number of discrete chromosomes, each of which somehow reproduces to provide the chromosomes of the daughter nuclei.

The development of the electron microscope after World War II added greatly to knowledge of the fine structure of the cell.

In general the cytoplasm appeared to consist of a fluid ground substance traversed by a reticulum, or network, of hollow strands or membranes and containing also a number of discrete bodies known as mitochondria, the existence of which had been known from ordinary optical studies since the end of the 19th century. The reticulum in the otherwise clear cytoplasm was believed by some workers to be involved in protein synthesis.

The mitochondria have a characteristic structure, being divided by large numbers of double-walled partitions. Preparations of relatively pure mitochondria can be obtained by centrifugation. They undoubtedly consist in considerable part of the enzymes that are involved in respiratory metabolism and in the mobilization of energy in the biochemically convenient form provided by high-energy phosphate linkages.

Specialized cell organelles, notably the green plastids of plants, were found to have very elaborate types of fine structure. A particularly interesting aspect of electron microscopic studies was the discovery that flagellums of motile cells in both the plants and animals have an extremely characteristic structure in which nine fibrils are arranged peripherally and two centrally. Few morphological discoveries have so clearly demonstrated the essential uniformity of living beings as this.

The existence of double refraction and the difficulties that have arisen in attempts to determine the viscosity of cytoplasm suggest that liquid crystals are important.

Size.—There is evidently an upper size limit to organisms, of the order of about 325 ft. The nature of the limitation is probably mechanical, but is certainly expressed in many different ways. A tree of ordinary form is unlikely to exceed this limit; as Galileo showed in 1638; if it grew taller it would bend under its own weight when displaced ever so little from the vertical by the force of the lightest breeze. In the large whales, the greatest of marine animals, simple mechanical stability presents little problem in the water, but other difficulties, notably the fact that with a constant shape the volume of the tissues to be nourished increases as the cube of the length, while the absorptive surface of the gut increases as the square of the length, will ultimately set a limit to the maximum size attainable by an organism of any given form. These problems have been discussed intermittently by physicists and biologists since the 17th century, and are most completely treated by Sir D'Arcy Wentworth Thompson in his classical treatise, *On Growth and Form* (1917; rev. ed., 1942), a work as remarkable for the wealth and ingenuity of the illustrative material as for the beauty of its prose style.

The lower limit of size raises more difficult questions. The definition of a living organism that has been given above is framed to exclude the smaller, crystallizable viruses. The larger viruses, such as the smallpox virus, seem to have properties comparable with those of bacteria, suggesting that the lower limit of the mean diameter of an organized cell is unlikely to be less than the order of magnitude of 0.1 μ (*i.e.*, $\frac{1}{250,000}$ in.). Assuming

a normal chemical composition, it is improbable that the space enclosed in such a cell could contain the full complement of chemical machinery present in the larger cells of animals and plants.

Growth and Change.—In both reproduction and in the widespread phenomenon of regeneration there is seen a clear tendency on the part of living matter to grow and to change until it achieves or returns to some characteristic form or pattern. This is most strikingly shown in monozygotic twinning in which the two pieces of a very early embryo that has fallen apart, either naturally or artificially, form not two half embryos but two perfect individuals. The degree of development of this property is variable, but some indication of its presence can always be found (*e.g.*, in wound healing).

Irritability and Adaptability.—A general property of living organisms usually recognized but not easy to define is variously known as irritability, adaptation or adaptability. The terms are often used in different senses. By irritability is meant the capacity of an organism or a part of an organism to respond in a specific way to some change, or stimulus, in the surrounding medium. There is no immediate clear-cut distinction between the classical cases of irritability, exhibited by a nerve attached to a muscle which contracts when the nerve is pinched, and the much simpler reaction of a piece of ice, which melts when the temperature of the environment is raised. It is, however, probable that all the cases normally regarded as involving true irritability involve the release of energy in amounts disproportionately large compared with the energy of the stimulus.

By adaptability is meant the capacity of an irritable organism to effect a response of such a kind that the chances of its persistence in a living state are increased. In nonmotile organisms such as cocciform bacteria, adaptability is mainly shown in the possibility of the organism becoming able, in the course of time, to deal metabolically with substances present in its environment in a way that promotes its growth but that initially was impossible. In rapidly dividing unicellular organisms it is obviously difficult to distinguish such individual adaptation of cells from the accidental appearance of adapted mutations. It is therefore quite possible that true irritability and adaptability are not exhibited by all organisms. In motile organisms adaptability is of enormous importance, and is exhibited in a great variety of ways, varying from the simple movements of a unicellular green plant from darkness to light to the most complicated aspects of human behaviour.

Uniformity of Class.—Even in framing the definition of a living organism it has been necessary to introduce the concept of different classes of organisms. It is a remarkable though seldom recognized fact that within a given size range a group of organisms may be the most uniform set of objects in any small volume of inhabited space. Thus a flock of starlings or of juncos is a class of far more uniform objects than the stones in the meadow they are visiting. This uniformity is also shown at a lower level in the cells of a given organ. It may well be an expression of the fundamental molecular mechanism of inheritance and development, for it is doubtful if such specific uniformity is met with in nonbiological structures until a molecular order of magnitude is reached. The number of different biological species is admittedly enormous; more than 1,000,000 animal species and more than 300,000 plant species are known. It is now generally held by those most experienced in the matter that, at least in multicellular organisms, real discontinuities in breeding populations do exist, and that in general plants and animals can be separated into specifically distinct groups.

III. THE BIOSPHERE AND ITS INHABITANTS

1. The Biosphere.—The high temperature of Mercury and the low temperatures of the outer planets would prevent anything like terrestrial living matter from occurring on their surfaces. Mars is the only planet on which there is any reasonable prior expectation of the existence of living matter. The atmosphere of Venus appears to be without water vapour and to have an equatorial temperature at the base of the reflecting layer of about 100° C. These circumstances alone make the existence of living matter very unlikely. Mars clearly possesses a little water, perhaps entirely present as solid and vapour. Although the reflection spectrum of the greener patches on Mars is not like that of a green leaf it does resemble that of a lichen or dried moss. At mid-20th century many authorities, notably G. P. Kuiper, believed that the possibility of the existence of a low type of plant life on Mars is very reasonable.

The region of the earth in which organisms are found is known as the biosphere, a term introduced by Lamarck, but little employed until the publication of W. I. Vernadsky's remarkable book *La Biosphère* in 1929. The biosphere extends vertically upward in the free atmosphere to a height of at least 32,800 ft., as bacteria and fungal spores have been collected at that altitude. In the vicinity of high mountains, notably Mt. Everest, birds have been observed flying at altitudes as great as 27,000 ft. Terrestrial animals reach 22,000 ft. on Mt. Everest, at which elevation R. W. G. Hingston found immature jumping spiders. In the opposite direction the biosphere extends to the greatest depths of the oceans and to a few thousand feet below the land surface. Bacteria are found in water percolating through newly exposed rocks in mines, and apparently live in petroleum at considerable depths. The vertical range of green plants is less than that of bacteria and animals, the greatest altitude recorded being 20,340 ft. for glacial larkspur (*Delphinium glaciale*) in the Everest region, while in the sea living algae seldom occur below 1,000 ft. The biosphere thus presents a curious fundamental structure, in that the vertical range of consumer organisms is greater than that of the producing organisms on which they depend for energy sources. The greater downward distribution of consumers in the sea is explained by the gravitational sedimentation of particles of organic material ultimately derived from plants. The greater upward extent is probably because of minute organic fragments, such as pollen grains, being carried up mountains by wind. Such particles would be suitable food for minute insects, such as springtails (Collembola) on which the Everest spiders may feed. A tendency to fly upward but at a definite distance from the ground has been observed in some mountain insects and would also bring animals above the limit of vegetation. The biosphere may be characterized as the region in which liquid water can occur, the region in which many interfaces, liquid-solid, solid-gas, gas-liquid, can exist and the region in which incoming radiation other than the shortest wave lengths meets opaque matter, and, in the absence of organisms, is dissipated as heat. The importance of liquid water is immediately apparent, since organisms consist so largely of this material. The importance of interfaces is less obvious, but much ecological work suggests that large bacterial populations only occur in natural unpolluted waters in relation to solid surfaces, and the phenomena involved may be of great theoretical interest. The biological importance of soil lies largely in the great surfaces available on the submicroscopic particles of which it is composed. The significance of incoming radiant energy is of fundamental importance on account of the unique properties of the green plant.

2. Energy Cycle in the Biosphere.—The green plants of the biosphere constitute a mechanism by which a part of the solar radiation falling on the surface of the earth is diverted from immediate dissipation as heat and appears as the chemical energy of various organic compounds. The fundamental photosynthetic reactions occur only in the presence of a special pigment that is activated by light. Their over-all effect may be simply written:

$$\underset{\text{carbon dioxide}}{6CO_2} + \underset{\text{water}}{6H_2O} \longrightarrow \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{oxygen}}{6O_2}$$

but glucose is certainly not the primary product of photosynthesis (*see* PHOTOSYNTHESIS). Moreover, largely owing to the work of C. B. van Neil, a number of reactions of this general type are now known in purple and green photosynthetic bacteria, which do not necessarily produce oxygen. From the standpoint of the general economy of the biosphere the important feature of photosynthesis is that carbon dioxide is made to react with a hydrogen donator in such a way that a more reduced carbon compound is produced and a more oxidized by-product is derived from the hydrogen donator. Oxygen, the typical oxidized by-product, is a gas and

largely diffuses into the atmosphere; the reduced carbon compound forms part of the body of the photosynthesizing organism and on the death of the latter may contribute to solid decomposition products. The result of photosynthesis is thus to maintain an oxidized and a reduced zone in the biosphere. The oxidized zone comprises the free atmosphere, most of the oceans and inland waters; the reduced zone, part of the soil, oceanic and lacustrine muds, many sedimentary rocks and the bodies of organisms themselves. Since oxygen is continually lost in sediment formation when ferrous iron is oxidized to ferric, as is obvious when the reddish crust of weathering on gray or greenish igneous rocks is observed, and since carbon is lost to sediments as coal, petroleum and as more dispersed organic carbon, the supply of CO_2 must either be continually decreasing or must be replenished by volcanoes. The former view leads to difficulties and the latter, which implies that life is dependent upon continued vulcanism, is now usually accepted. If allowance be made for the CO_2 that has gone to make the limestones and other calcareous sediments, the rate of loss is seen to be greatly increased. Viktor M. Goldschmidt estimated in 1934 that the mean annual requirement of volcanic CO_2 is $3 - 6 \times 10^{-6}$ g. per square centimetre of the earth's surface.

The fraction of solar energy reaching the earth's surface that is trapped by the photosynthetic mechanisms of plants is very small. In 1944 Gordon A. Riley, whose estimates allow for the great ocean surfaces of the earth, concluded that between 0.06% and 0.18% of the incident radiation was so used. Later work appeared to suggest that the true value is nearer the lower than the upper limit. The fundamental limitations which reduce this efficiency to so low a value are probably distributions of rainfall on land and distribution of certain essential materials such as combined nitrogen, phosphorus and iron in the ocean. These distributions set limits to the amount of photosynthetic machinery that can exist in the biosphere. About 30% of the energy accumulated by plants is used in their own metabolic processes. According to Raymond L. Lindeman (1941, 1942) approximately 10% of the energy fixed by plants is transferred to herbivorous animals. Most of the remaining energy, roughly 60%, is degraded to heat by bacterial decomposition on the death of the plant body. The amount stored in the sediments is small, and of this the amount that could become available later as fuel is but an insignificant fraction of the total. (*See* also ECOLOGY, ANIMAL.)

3. The Self-Sufficiency of the Green Plant.—All the available evidence indicates that most green plants can grow in the presence of light on a medium containing only inorganic compounds. A complete medium thus consists of water, oxygen, CO_2, inorganically combined nitrogen (ammonia or nitrate), phosphate, sulfate, potassium, magnesium and minute amounts of a variety of other elements (trace elements), Fe, Mn, B, Cu, Zn, Mo, possibly Ga and some others. In at least some cases Ca, Na, Cl, Si, Co and Al are also necessary. No organic carbon compounds are needed in the majority of cases.

4. Theories as to the Origin of Life.—Some investigators, notably S. Arrhenius and by implication W. I. Vernadsky, have concluded that life has no historic origin, and that the earth was populated by minute organisms wafted about the universe by light pressure. Present knowledge of the short-wave ultraviolet radiation implied in the excitation of auroras casts doubt on this hypothesis as this radiation would probably destroy such free cosmozoa even if they were perfectly dry. The alleged recovery of bacteria from the interior of meteorites is not generally accepted. It is important to note that no observations clearly indicating the contemporary genesis of living matter in nature have ever been made.

It might be supposed that since the green plant is self-sufficient, and could repopulate the earth in its present state if all life were destroyed, the initial organism was a photosynthetic organism, capable of coping with an environment that provided purely inorganic compounds. The capacity to do this, however, involves so elaborate a chemical mechanism that such a view is tantamount to accepting an act of special creation, removing the problem from the realm of science.

The antithetic view is to suppose a gradual evolution of organic compounds, some of which could serve as food for the evolving systems derived from others. This view has been ably supported by A. I. Oparin. The chief difficulty that the second theory must face is the nature of the energy sources involved in the evolution of organic matter. Oparin suggested that hydrocarbons, formed by the action of superheated steam on iron carbide, might be the starting point of the chain of synthesis leading ultimately to primitive organisms. This view in effect suggests that the energy source is thermal, some of the energy of the initially hot earth being stored chemically until temperature conditions permitted its utilization. Oparin's views are not entirely in accord with modern geochemical knowledge, in particular his initial source of hydrocarbons is quantitatively inadequate. An intermediate hypothesis, apparently due to J. B. S. Haldane, is that simple photochemical reactions, not involving chlorophyll, preceded the evolution of living matter.

A great advance along these lines was made in 1955 by S. L. Miller, who found that a large number of amino acids and other simple organic compounds are formed when mixtures of methane, ammonia and water vapour are submitted to a silent electric discharge for a few days. Short-wave ultraviolet light, which is less easy to use in the laboratory, would have provided a comparable energy source early in the history of the earth. By the early 1960s it appeared reasonably certain that oxygen was absent from the earth's early atmosphere, and since the exact mixtures of gases, provided it contained carbon and nitrogen compounds, water vapour and no oxygen, apparently would make little difference to the result, it may be concluded that in the early stages of terrestrial history the liquid water at the earth's surface contained amino acids and other organic compounds in solution, perhaps in appreciable amounts. It appeared likely that solid organic matter, dark in colour and comparable with some of the inadequately characterized components of modern humus, would form at the same time.

The polymerization of the amino acids to form polypeptides and proteins raises certain special chemical problems, but at least the initial stages in the origin of living matter appear to be understood.

5. Plants, Bacteria and Animals.—Though the tendency to form classes of similar objects is characteristic of living organisms, the arrangement of these classes in higher categories presents many difficulties to the biologist. These difficulties are perhaps most acutely felt when an attempt is made to generalize the ordinary idea of plant and animal to cover the microscopic forms of life that have been described in increasing numbers since A. Leeuwenhoek first applied his minute but powerful lenses to infusions and pond water. Among the multicellular forms no difficulty arises. Plants are recognized primarily by their lack of special contractile tissues capable of causing spontaneous movement (except in cases where single-celled stages possess flagellums), by their cellulose cell walls and usually by their possession of the green pigment, chlorophyll. All animals possess special mechanisms that result in movement, though in many cases the movement is that of the water in which they may live rather than movement of the animal through the water. Almost all animals lack cellulose; if they appear to contain photosynthetic mechanisms, as in the case of reef-building corals, some flatworms and some bivalve mollusks, this is due to the presence in their tissues of symbiotic unicellular plants (*see* SYMBIOSIS). Even the criterion of motility has to be defined in a rather arbitrary way. The possession of either ciliated or flagellated epitheliums or of muscle cells is perhaps the most characteristic feature of multicellular animals. Many plants possess conspicuous if limited powers of movement, notably the sensitive plant, *Mimosa pudica*. In such cases, however, the mechanism is totally unlike that found in animals. A less obvious, if more fundamental, distinction may be traced in the nature of sexual reproduction in multicellular animals and plants. Although the criteria that separate the two groups may seem formal and arbitrary, there is now no doubt which multicellular organisms are plants and which animals. The plants are arranged in about 12 major groups, the animals in about 22 major groups or phyla. (The number of these groups varies from author to author and is subject to change as knowledge increases. See *Taxonomy* below.)

There is a great array of minute and simple forms that do not have a nuclear membrane. The genetic material, though probably present as chromosomes, certainly bears a different morphological relationship to the rest of the cell from that found in the higher forms with a distinct nucleus and cytoplasm. These organisms are sometimes placed in a group distinct from that of the true multicellular animals or plants. This group, for which the terms Monera or Mychota have been proposed, includes true bacteria and their allies the actinomycetes, the latter being filamentous forms which include *Streptomyces*, from which streptomycin is obtained, and *Mycobacterium*, a genus including the organism causing tuberculosis. The Mychota also include a large group of photosynthetic organisms commonly known as purple and green bacteria and blue-green algae. The purple and green bacteria use either reduced sulfur compounds or preformed organic matter as oxygen acceptors in the photosynthetic reaction, instead of producing ordinary molecular oxygen. The blue-green algae perform ordinary photosynthesis as do the higher plants. They often form massive populations in summer in ponds and shallow lakes. They are certainly more closely related to what ordinarily would be regarded as bacteria than to the other organisms commonly called algae.

The single-celled organisms in which discrete nuclei are present provide a difficult problem in classification. The most logical arrangement at first sight is to place all of them in a single kingdom, the Protoctista (from the earlier term "Protista"), separated from the Mychota by the presence of a discrete nucleus and from the higher plants and animals by their single-celled condition. Unfortunately within a given group of obviously allied forms it is possible to find single-celled species, species forming aggregates of unspecialized cells and multicellular species with quite well-differentiated tissues. It is also possible to find obviously related species, some of which are photosynthetic, some feeding like animals and some living on dissolved organic matter. By the early 1960s it could be stated with some degree of certainty that all the higher terrestrial plants are derived from unicellular forms which would ordinarily be called green algae. It was quite uncertain from which of the many animallike protoctists the multicellular animals arose.

For the purpose of classification of individual species, which must be defined well enough to permit general recognition, an elaborate system is needed, but this must inevitably be somewhat artificial. For the purpose of understanding the economy of nature, we may roughly divide organisms into:

Typical green plants dependent solely on inorganic foodstuffs and radiant energy (holophytic nutrition).

Typical animals ingesting solid food of plant or animal origin (holozoic nutrition, or in some cases parasitic).

Typical bacteria and colourless plants taking up dissolved food passively or by external secretion of enzymes into the medium (saprobiotic or parasitic nutrition).

When it is remembered that the entire cycle is dependent on the green plant it will readily be understood that the mass of green plants exceeds that of the other types. On account of their small size, bacteria undoubtedly greatly exceed green plants in individual numbers, but the mass is small. Animals are usually relatively selective in their food habits, and may be confined to eating parts of plants, or they may be carnivorous. This permits a much greater diversity of type than found in plants, though the number of individuals is smaller. Whether the specific diversity of bacteria approaches or exceeds that of animals remains uncertain. If all animals have species-specific bacterial diseases, the number of species of bacteria is clearly greater than that of animals. (*See* also beginning paragraphs of PLANTS AND PLANT SCIENCE.)

6. The Problem of the Viruses.—In 1892 D. Iwanowsky observed that the causative agent of the mosaic disease of the tobacco plant could be passed through filters designed to retain visible bacteria, but when a minimal dose of the filtrate was inoculated into a healthy plant, the causative agent behaved like a living parasitic organism, increasing in quantity within the host. During the succeeding 40 years a number of plant and animal diseases were recognized as caused by such filterable viruses. In 1935 W. M. Stanley, reinvestigating the tobacco mosaic virus, which can be obtained in great quantity, found it to consist, when outside the body of the host, of a crystallizable protein. Once in the host the presence of the virus causes the production of more viruses. Subsequently a number of other viruses, mainly causing plant diseases, were obtained in pure crystalline form.

In the early 1960s it was clear that the term virus included a great variety of infective particles which resemble each other only in passing conventional bacterial filters and in multiplying in suitable hosts. Some of the largest are probably comparable with minute bacteria, while the smallest, such as the agents of foot-and-mouth disease or of silkworm jaundice, have a diameter of only 10 $m\mu$ ($\frac{1}{10,000,000}$ mm.) and appear to consist of pure ribonucleoprotein. The tobacco mosaic virus, which was studied in great detail, consists of rods about 280 $m\mu$ long. These rods were believed to be formed of an outer protein and an inner ribonucleic acid fraction which can be separated and recombined in the laboratory. The protein from one strain can be combined with the nucleic acid of another strain, giving somewhat different symptoms when it infects a tobacco plant. In every case the symptoms follow the source of the nucleic acid. To use the expression of communication engineers, the information required to produce the specific symptoms is carried by the nucleic acid. It is possible even to use the nucleic acid without the protein to produce infection. When this is done the virus recovered from the infected plant consists of protein and nucleic acid. The protein has obviously been produced by the infected plant. It seemed probable that broken strands of nucleic acid under 280 $m\mu$ long cannot carry the information needed to produce an infection; at least when full-length intact rods were absent from electron microphotographs of a preparation, the latter was not infective.

By the mid-1950s a very curious situation became known in the case of some bacteria which carry a latent virus or bacteriophage which can be made pathogenic by ultraviolet light treatment. The latent provirus could not be extracted from the bacterial cell; it appeared to consist solely of nucleic acid and to be incorporated in the nuclear material, genetically known as chromosomes, of the bacteria. When it becomes active it produces bacterial dissolution which spreads through the culture. Some resistant cells may be infected but survive and these may now carry not only the provirus but also other genes apparently associated with it on the chromosome of the original strain from which the provirus was derived. This very peculiar type of hereditary transmission is called transduction. It emphasizes the fact that in the small viruses we have systems which exhibit the reproductive criterion of living matter, but by themselves not the metabolic criterion, stripped to its bare essentials. Though in many ways the crystallizable and other small viruses bridge the gap between dead and living matter they can only reproduce in pre-existing cells and so cannot represent an evolutionary stage in the history of life on earth. In the early 1960s it appeared by no means unlikely that some viruses have arisen by escape from the genetic material of the organisms that harbour them. (*See* VIRUSES.)

IV. THE METHODS OF APPROACH OF THE BIOLOGICAL SCIENCES

1. Morphology is the study of form. By itself, applied to a single organism, it can give but a momentary picture of the structure of the organism, proceeding from the larger features to the organization of the tissues (histology; *q.v.*) and of the cells (cytology; *q.v.*). The introduction of increasingly powerful methods, notably electron microscopy and X-ray diffraction analysis, has begun to give, in certain special cases, information on structure between the microscopic level and the molecular level. The results of such studies indicate that fibrous protein molecules play a great part in ultramicroscopic morphology, as for instance in muscle. The opening up of globular protein molecules to form fibrous molecules, and the reverse process, may be of considerable importance in the life of the cell. There is much indirect evidence that even the most fluid-looking cytoplasm is structurally oriented at a submicroscopic or molecular level.

In some very simple cases the morphology of an organism can

be analyzed not merely formally, but causally also, by geometrical or mechanical methods. The spherical form of marine eggs is doubtless entirely explained by the tendency of a liquid drop to possess a minimum surface.

It is, however, by no means certain that whenever a form is encountered for which a simple physical explanation can be given, that explanation is inevitably correct. There is much evidence that organisms by quite elaborate growth processes develop forms that simulate the forms due to much simpler physical forces. In such cases it is probably legitimate to assume that the final form is less subjected to physical strain than would be some other structure no harder to build embryologically, but not suggesting a simple physical process.

Of itself morphology usually raises questions, but does not answer them. Only when morphology (*q.v.*) becomes either comparative, physiological or developmental does it acquire significance.

2. Taxonomy.—Comparative morphology leads to the immediate recognition of a limited number of fundamental structural plans. Within such plans an immense diversity is possible, but groups of individuals tend to form populations of considerable uniformity, which in the higher organisms with sexual reproduction form interbreeding units. The study of the classificatory arrangement and the rational placing of newly discovered types within it constitutes taxonomy or systematics. Even among the higher plants and animals in which the criteria for classification are reasonably well established, the process of description is by no means complete. The comparatively recent (20th-century) discovery of the okapi and the giant panda indicates how large animals living in inaccessible regions may remain unknown. Birds are doubtless more completely studied than any group of like size and importance, yet the African peacocklike bird, the type of a new genus, *Afropavo congensis*, remained undescribed until 1936.

In the ocean there are doubtless many surprises still in store. A new major group of Crustacea, the Cephalocarida, was discovered by H. L. Sanders in 1953 in Long Island sound, a body of water studied for a century by naturalists. When the taxonomy of fossil forms in relation to recent species is taken into account, remarkable cases of unexpected affinity continued to be uncovered. The most extraordinary event of this kind in the 20th century was the capture of a coelacanth fish *Latimeria chalumniae* off the southeastern coast of South Africa; the group was previously supposed to have been extinct since the Middle Mesozoic. A somewhat comparable case is provided by G. E. Pickford's demonstration that the black octopuslike animal *Vampyroteuthis infernalis*, encountered by several deep-sea expeditions, and apparently a common animal at great depths in tropical latitudes, is not an octopus but the last survivor of a Jurassic group of cephalopod mollusks, differing radically from both the octopod and decapod types, though rather more closely related to the ten-armed cuttlefishes than to the Octopoda. An even more dramatic discovery was announced by R. Kozlowski in 1938. Examining particularly favourable material of the fossil group of graptolites, which had previously usually been regarded as coelenterates, he discovered that the skeleton is more complex than had been thought, and corresponds in its detailed structure with that of the living marine organism *Rhabdopleura*, which in fact can hardly be other than the last surviving graptolite; yet its soft parts place it in the phylum Hemichordata, the group of invertebrates most closely related to the vertebrates. The great graptolite populations of the early fossiliferous rocks thus appear to be offshoots from the same stock that must have been evolving to produce the vertebrates at the same time.

The justification of interest in taxonomy is not, however, dependent solely on these dramatic discoveries of affinity, nor on the great practical importance of taxonomy as the keystone of economic biology. Modern taxonomists are much concerned with the nature of their fundamental unit, the species, and of how species came into existence. This matter cannot be discussed until the problems of genetics have been considered. (*See* TAXONOMY.)

3. Embryology.—While morphology can give but a momentary static picture, the introduction of time as well as the three spacial dimensions permits the study of the dynamics of morphology. The individual is seen to run through a series of complicated stages, starting with a superficially simple cell, that finally reaches in the case of higher plants and animals an extremely complicated structure of many cells. The process normally involves growth or increase in size, cell multiplication, and differentiation or specialization and arrangement of cells in various ways to form the different tissues and organs of the adult body. The process by which this orderly series of changes takes place has fascinated biologists from Aristotle to the present day, but in spite of much of the best intellectual effort of the past century having been expended on the matter, it is still extremely difficult to understand. Normally, in the higher animals and plants, the process of development is initiated by the fusion of two cells, the egg or ovum derived from the female parent, the spermatozoon derived from the male parent. This fusion, or fertilization, seems to have a twofold function. The entry of the sperm appears to act as a stimulus to division by the egg cell. This stimulus is not always needed; some eggs develop unfertilized, and are said to be parthenogenetic. In many cases artificial stimuli such as shaking, heat shocks or a great diversity of chemical treatments suffice to start the egg dividing, though rather special conditions have to be fulfilled to obtain well-developed organisms from such eggs. Such special conditions are set by the fact that in the formation of most eggs and of almost all sperm, the cells from which they are derived lose half the normal complement of chromosomes. The second function of the sperm is to restore the full complement of chromosomes to the zygote or fertilized egg. Sometimes the haploid, reduced or halved number of chromosomes, is sufficient for further development. Sometimes in artificial parthenogenesis a division of chromosomes without a division of the egg cells restores the correct number. More usually debilitated haploid embryos are produced which die young.

It is very important to note that the egg cells differ, at least in the higher animals, from the other cells of the animal forming them in their competence to produce all types of cells appropriate to the species. In most cases the adult cells cannot do this. The difference, however, is not entirely sharp because many highly organized animals are capable of regenerating parts that have been removed accidentally or experimentally. It is apparent that the different cells of an animal undergoing regeneration differ widely in their capacity to take part in the process, and it is rare to find clear evidence that any cell other than a fertilized or parthenogenetic egg can give rise to all specifically appropriate tissues. During development the competences of the dividing cells of an embryo are more and more restricted. It is natural to inquire whether in the embryological history of the egg cell itself this restriction has occurred, the whole set of competences being restored as the egg matures, or whether a certain group of dividing cells is separated from the others, as germ plasm, retaining a full set of competences to be expressed by some when a new generation of gametes is formed. August Weismann's theory of the continuity of the germ plasm implies the special isolation of such an immortal group of germ cells within the soma, or nonreproductive body of the organism. As of the early 1960s no clear answer to this question had yet been obtained. It is certain that young unripe eggs cannot develop, but it is not certain that this is due to loss of competence, to be regained during later development.

In practically all multicellular organisms division of the egg produces a ball or mass of cells. In multicellular animals the ball, or blastula, becomes two layered, by one of a number of possible processes of gastrulation, and later begins to show, in all bilaterally symmetrical forms, a marked anteroposterior and dorsoventral polarity. In vertebrates and in echinoderms and a few other animals, the cells of the embryo can be shown to have become irreversibly determined to produce one particular kind of tissue shortly after polarity is established. In many other animals, including most mollusks and segmented worms, determination apparently proceeds much earlier. In the vertebrates this determination process has been shown, mainly through the work of Hans Spemann during the first quarter of the 20th century, to depend initially on a particular region of the upper side of the aperture, or blastopore,

through which the inner layer of the embryo has turned during gastrulation. Experimental transplantation of this organizer region from one embryo to another permits the production of secondary axes, expressed as nervous systems, eyes, ear vesicles and other structures. Joseph Needham, C. H. Waddington and their collaborators demonstrated in 1935 that the major effect of this organizer region can be imitated by a substance extracted from a variety of animal tissues with the chemical properties of a sterol. A number of other materials unrelated to natural sterols are also effective. A renewed attack on the problem by M. C. Niu strongly suggested that nucleoproteins are involved. It is, however, certain that the full process of determination of the axial structures involves far more than the mere local production of a specific evocator substance. Evidence of the existence of a variety of such substances exists, but above all it is the cells of the egg, as the reacting system, that are probably of greatest importance. Just as, in fertilization, an unstable system is stimulated to divide by the entry of a spermatozoon or by other agents, so in embryonic development the production of the main axis is doubtless the response of an unstable system of immense complexity to a stimulus that normally is provided by the local appearance of certain substances in the dorsal blastopore lip.

Much of the subsequent development of the organism can be shown to depend on the presence of secondary and tertiary organizers that are formed in local regions of the body. Thus in the usual method of formation of the eye, an organizing stimulus from the developing eye cup causes the epidermis above it to develop into a lens.

An interesting hint of the way that polarity is developed can be derived from the remarkable experiments of Ross G. Harrison. By rotating the region of a salamander embryo that would normally form a limb or an ear, or by transplanting the region to the opposite side of the embryo with or without rotation, Harrison was able to show that the three spacial dimensions of these organs are not determined at the same time. The tissue is set on its way to becoming a leg or an ear before it is restricted to becoming a right or left leg or a right or left ear. Joseph Needham ingeniously indicated that this phenomenon discovered by Harrison is comparable with the stages in the orientation of molecules in the formation of liquid crystals.

As well as considering the nature of the processes by which qualitative differences in different groups of cells are established, embryologists have been much concerned with problems relating to progressive form change during development, due to differences in rate of growth of different parts of the developing organism. Such differences have long been known in the human organism. It is easy to see that the young fetus has a disproportionately large head. In later development, both prenatal and postnatal, the trunk must therefore grow more rapidly than the head to establish the adult form. All embryological development of organs, as opposed to internal development of special cell structures, may in fact be regarded as due to the existence of a system of differential growth rates. Such systems are, however, best analyzed in the later stages of development. In many cases it is found that a rule connects the dimensions reached by any part y, in relation to the size of the whole organism x, such that

$$y = bx^k$$

In such a case if $k = 1$, the growth of the organism is uniform or isoauxetic (isogonic in older literature), if $k \neq 1$, the growth of the part is heteroauxetic (heterogonic in older literature). The general application of this rule is due to J. S. Huxley. In cases in which the value of k remains constant during phylogeny or evolutionary change, any evolutionary size change will result in a change in shape. In such cases the adult of the smaller species will have a form comparable with an earlier smaller stage of the larger species. It is probable that many cases of extreme development of horns have resulted merely from high values of k in an evolutionary line that is increasing in size. D'Arcy Thompson pointed out that if a drawing of a plant or animal structure be made on graph paper, by applying a uniform transformation or distortion to the co-ordinate grid of the paper it is often possible to derive close representations of allied genera. This implies a geometrical ordering of growth rates as we pass from organism to organism.

A remarkable aspect of heteroauxetic growth has been considered by Needham, who found that the equation $y = bx^k$ held not merely for the morphological aspects of development, but for the biochemical aspects also. Thus over a great variety of vertebrates the total calcium of the growing embryo increases as the dry weight raised to the power of 1.17 ± 0.04. Such results suggest a fundamental biochemical ground plan for growing embryos.

For many years after the publication of Charles Darwin's *Origin of Species* in 1859, the chief interest of embryology lay in the aid given by comparative studies of development to the tracing of phylogenies or lines of descent. The fundamental postulate on which this work was based is the belief that the embryos of related organisms are more closely alike than the adults. This generalization, based on the work of C. H. Pander and K. E. von Baer early in the 19th century, is undoubtedly true as a statistically probable statement, but many clear exceptions exist. The basis of the principle is probably to be found in the simple proposition that any variation introduced early in the development of a pattern will have a greater ultimate effect than one produced later.

The extraordinary self-regulative powers of organisms, however, may make possible the development of two almost identical structures by diverse means. This is seen not only in comparative embryology, but in many cases in which the mode of development of an organ is strikingly different from the mode of its regeneration after operative removal.

Such problems introduce the concept of homology, which is conveniently mentioned in relation to embryological studies. The fundamental concept involved in homology is related to the ideas employed by mathematicians in the study of the very primitive geometry known as topology. Here all lines that form closed curves on a plane, without crossing each other, are equivalent to circles. This is essentially the type of geometry employed when a morphologist says that the wing of a bat and the arm of a man are homologous, meaning that although the bones have different shapes, at least all the principal parts of the skeleton, with many of the associated soft parts, bear the same relationship to each other (*see* Homology).

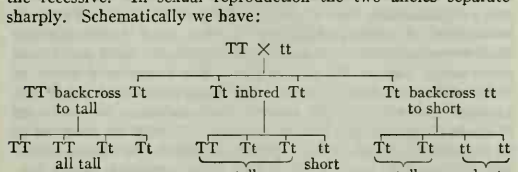
The concept of homology is less sharp than that of topological equivalence; where organs are so different in adult life as to permit no point to point comparison of the relationship of parts, the possibility of such comparison in the embryo or the existence of a similar relationship of the part to the whole is often used as a criterion of homology. The reverse situation of different modes of development, leading to two clearly homologous and similar organs, is also known. The modern biologist regards homology as based on community of descent, and so is apt unconsciously to regard structures as homologous on account of an evolutionary relationship postulated on other grounds. The idea of homology is, however, older in its topological than in its evolutionary aspects. Though no theorems of topology have found a place in biological theory, the general elementary topological point of view is of great assistance in understanding the comparative aspects of form and development. (*See* Embryology; Invertebrate Embryology; Vertebrate Embryology; Embryology, Experimental.)

4. Genetics.—That like in general produces like has been known from time immemorial; that the process is not entirely regular has also been realized at least since attention was paid to the breeding of domesticated plants and animals, as is testified by the expression sport or throwback. The obscurity that enveloped the whole process of variation and inheritance is an extraordinary example of the difficulty of arriving at a clear description of even a relatively simple phenomenon without carefully controlled and logically planned experiments. Even though the practice of circumcision, let alone foot binding or head deformation, should have indicated that direct interference with the body of an organism has no effect on its offspring, the idea was retained with an extraordinary tenacity by many biologists in the face of a wealth of negative evidence.

Though some insight into the phenomena of inheritance was gained by plant hybridization in the first half of the 19th century, it was not until 1865 that Gregor Mendel published his series of classical experiments on peas, which laid the foundations of modern knowledge. It is remarkable that, athough these experiments were certainly known to some continental investigators, their profound significance entirely escaped notice until 1900, when Hugo de Vries, Carl Correns and Ernst Tschermak rediscovered the forgotten paper and provided confirmation from their own results.

The principles enunciated by Mendel were extended to animals by L. C. M. J. Cuénot in 1902 and by William Bateson and R. C. Punnett in 1903–05.

In its simplest expression Mendel's results (*see* GENETICS) may be described in the following way. If a tall pea be crossed with a short pea, the resulting progeny are all tall. If such hybrids be inbred, the statistical composition of the resulting population approximates to three tall to one short. If the tall hybrids are backcrossed to the original tall stock, all the offspring are tall. If the backcross is made to the original short stock, the resulting population approaches the ratio one tall to one short. Mendel's success was due primarily to his incisive choice of a simple alternative situation, and to his application of numerical enumeration to the resulting populations. The general scheme of inheritance was explained as depending on a pair of factors, or genes, as they are now called. In every individual one member of the pair comes from one parent. In the case under consideration, whenever the tall gene (T) is present the plant is tall, so that a short pea is characterized by both members of the pair being short (t). Tall is said to be the dominant member of the pair of alleles, short the recessive. In sexual reproduction the two alleles separate sharply. Schematically we have:



Further experiments can be done to indicate the difference between the pure homozygous dominant TT and the heterozygous Tt. When Mendel performed experiments with several pairs of characters at once, yellow or green seed, smooth or wrinkled seed, he found that the distributions of the different characters were entirely independent of each other. In the simplest case, usually used in such experiments today, that of the backcross to the pure recessive, four equal classes would result. In 1906 Bateson and Punnett found that this was not invariably true. Some pairs of characters tended to be "attracted," as did their opposite alleles, so in a backcross of this kind two classes are larger and two smaller than would be expected. Though the explanation given by Bateson and Punnett has proved erroneous, the discovery was of the most fundamental importance. In 1902–03 W. S. Sutton, and also C. Correns, M. F. Guyer, W. A. Cannon, T. Boveri and H. de Vries, had pointed out that the distribution of the chromosomes in sexual reproduction corresponded with the distribution of the Mendelian factors in inheritance. Mainly as the result of the domestication of the fruit fly *Drosophila melanogaster*, the small fly often seen around bananas and other fruits in shops and pantries, T. H. Morgan, C. B. Bridges and A. H. Sturtevant were able in 1913 to indicate that although many more characters than chromosomes existed, the chromosomal nature of the genes could be accepted on the supposition that each chromosome consisted of a string of genes, the alleles paired one by one along homologous chromosomes, but that at certain stages interchange of segments of the string could take place. The attraction observed by Bateson and Punnett, now called linkage, is thus explained by a linear cohesion of the genes. Where attraction is strong the chain between the genes is rarely broken, where weak, more often broken. Since the chance of breakage might be expected to increase with the length of the chain, the frequency of crossing over between linked genes was used as a measure of their hypothetical distance. By 1914 it was apparent that four linkage groups existed in *Drosophila melanogaster*. One group followed the sex determination pattern in the way that would be expected if it were associated with the X sex chromosome. Of the other three, two were large groups, that were reasonably associated with the two large pairs of V-shaped chromosomes, the fourth very small and reasonably associated with the small fourth pair of chromosomes. Cases then were found that seemed best explained by the abnormal presence of extra chromosomes in certain flies, and cytological examination confirmed these findings. The whole structure received a most dramatic confirmation by the discovery in 1933 by T. S. Painter, E. Heitz and H. Bauer that in the salivary glands and other cells of the larval *Drosophila*, as in certain other flies, the chromosomes become enormously enlarged, and when appropriately stained exhibit a fine characteristic banding. The bands vary in width and are recognizable as individual structures from cell to cell. Painter and Bridges both found that in cases in which abnormal arrangements of genes in the linear linkage groups occurred, there were similar abnormal arrangements in the banding. In this way it was possible to correlate positions of genes in the linkage map with position of bands on the chromosomes. The linear order was demonstrable in both cases, but the initial assumption that the distance is strictly proportional to the frequency of breaks was found to be incorrect. Essentially similar results are indicated by studies made in almost all major groups of organisms from bacteria to man.

The establishment of the detailed chromosomal theory of inheritance was perhaps the most remarkable autonomous achievement of biology in the first half of the 20th century. It tells, however, nothing about the nature of the changes, or mutations, in the inherited complex of characters that are the raw material of genetic research. Such changes take place rarely; any one gene mutates about once in 100,000 to 1,000,000 chromosome generations, but since there are many genes the frequency of any kind of change is high. Most mutations, however, are recessive lethals; they lead to the death of the organism which is homozygous for them, and can only be detected by specially devised experiments. Visible changes occur less frequently, and again are mainly recessive.

The commonest type of dominant to appear is one in which the heterozygote shows a marked difference from the original stock, but in which the homozygous dominant never appears, dying early in development. Such cases where the mutant is a visible dominant, but a lethal recessive, are generally due to losses of small sections of a chromosome (deficiency). The ordinary type of mutation is also called a point mutation, and clearly does not consist of a mere loss or deficiency, for in some gene loci a great array of different alleles are known.

In 1927 H. J. Muller showed that the frequency of occurrence of changes of all these kinds can be greatly increased by administration of X-rays. Later L. J. Stadler found that point mutations could be induced by ultraviolet light, the wave lengths most effective being those most strongly absorbed by nucleic acids. Though the radioactivity of the earth and the incoming cosmic radiation produce ionization, as do X-rays, the natural mutation rate is too high to be explained on the basis of natural ionization of this sort. M. Delbrück concluded that random molecular changes because of thermal agitation are responsible for point mutations.

The most striking insight into the nature of the gene is, however, derived from unicellular organisms. Immunological studies have shown that the bacteria of the genus *Pneumococcus*, the causative agent of ordinary bacterial pneumonia, can be divided into a number of types which differ in the antibodies called forth by their presence in experimental animals. The virulence and antibody-producing properties of the bacterium appear to be due to the presence of a carbohydrate sheath, which is chemically different in the different strains. Under some conditions the sheath is lost in culture.

Certain sheathless strains derived from one type can be converted into a sheathed strain of another immunological type by treatment with extracts of this second type. In 1944 O. T. Avery

and his co-workers isolated the effective material in the extract and found it to consist of a highly polymerized deoxyribonucleic acid. Such substances, combined with proteins, form the nucleoproteins of chromosomes. It is therefore not unnatural to suspect that the specific sheath-inducing material is chemically and functionally related to at least a fraction of a gene, and that part of the diversity exhibited by genes is due to diversity in the chemical structure of the enormously complex polymers of deoxyribonucleic acid. This belief is strengthened by the extremely high dilution in which the substance acts, apparently implying self-perpetuation of its molecules once they are in contact with the bacterium.

It is generally believed that the cytoplasm plays a part in heredity, though its role is hard to define. In 1943 T. M. Sonneborn found that, in a race of the single-celled animal *Paramecium*, a gene exists which cannot act in the absence of a particulate cytoplasmic factor, possibly comparable with a virus, but that this factor cannot be formed in the absence of the gene. In yeasts the ability to metabolize certain sugars depends on genetic constitution; but there is evidence that, even in the absence of the appropriate genes, the requisite enzymes are transmitted in cell division, provided the substrate sugar is present. In the hen's egg the supply of glycine is independent of the glycine content of the food of the parent, but when this food is deficient in the amino acid, the egg appears to be deficient in the mechanism for making more glycine, and chondrodystrophic chicks result. Cases of this kind promise to provide much further information as to the ultimate mechanism of gene action in development.

By the latter 1950s it was suggested that certain materials, probably deoxyribonucleic acids, act as templates or patterns on which specific enzymes and other substances are constructed. The templates may be activated in some way by the initial presence of a small amount of enzyme to be synthesized, or may be inactivated by certain molecules which form more or less stable combinations that block further synthesis. (*See* also NUCLEIC ACIDS.) The limitation of potency of embryonic cells as development occurs may be attributable to the inactivation of inappropriate templates. There was a little direct evidence of a process of secretion by localized regions of chromosomes at specific times in development, and also for significant changes in nuclear function during early development. The science of developmental genetics had made a good beginning but an enormous amount remained to be done. (*See* GENETICS; HEREDITY; GENE.)

5. Evolution.—The idea that the various forms of living organisms, including man himself, have arisen by gradual transformation of pre-existing types is very old. In its beginning it no doubt merges into mythology. As a scientific hypothesis it was sporadically held by a number of 18th- and early 19th-century biologists. Apart from considerations based on a belief in the literal interpretation of the Old Testament, the main objection to such a hypothesis of evolution lay in the lack of any obvious mechanism by which the process might be brought about. The modern history of the evolutionary hypothesis may be taken as beginning on July 1, 1858, when a joint paper by Charles Robert Darwin and Alfred Russell Wallace was communicated to the Linnaean Society of London. The paper was the result of Darwin's long preoccupation with the matter of the origin of specific differences, starting with his speculation on the nature of the peculiar fauna of the Galápagos Islands. Wallace had spent much time in both South America and Malaya. He conceived his ideas rapidly and communicated them to Darwin by letter. Both authors had been influenced by T. R. Malthus' famous *Essay on the Principle of Population*, 1798. Darwin and Wallace suggested that since all organisms tend to increase geometrically, there must always be a large mortality. Since variation is known to take place extensively, and some at least of the variations are inherited, the mortality will be differential, removing the poorly adapted and favouring the well adapted. A progressive increase in adaptation should therefore take place. The whole hypothesis was examined in a masterly way in Darwin's *Origin of Species*, 1859. At the time that this work was written, practically nothing was known as to the origin of variation, as Darwin fully realized. The nature of the hereditary process was also misunderstood. Nevertheless the fundamental process of natural selection as put forward by Darwin and Wallace remains the keystone of modern evolutionary theory, and can now be rigorously applied to the theoretical treatment of populations containing given proportions of individuals carrying Mendelian genes that alone or in combination promote or diminish the chances of survival of the individuals bearing them.

The main arguments in favour of the evolutionary hypothesis are that it gives a rational interpretation of the uniformity in both general structure and in function found throughout vast groups of organisms; that it accounts for the gradual specialization, observed when the fossils of a given group, such as the horses or elephants, are arranged in temporal sequence; and that it explains the orderly geographical distribution of species and higher groups of plants and animals on the surface of the earth. No really serious objections to the hypothesis have ever been successfully advanced, and the occurrence of evolution is now accepted as a matter of course by practically every serious student of biology.

The acceptance of the general principle, however, indicates nothing about the uniform or multiple origin of life. Moreover, even in those phyla normally provided with hard and easily fossilized shells, the fossil record is extremely imperfect, so that there is often much doubt as to the course that the process has taken. The most extraordinary of the imperfections is the complete lack of any instructive fossils covering the first two-thirds of the earth's history, after which practically all the large phyla or major groups of animals, with the exception of the vertebrates, appear in a reasonably advanced condition in the Cambrian rocks. The immense Pre-Cambrian hiatus has received many explanations, none of them entirely satisfactory. The most reasonable of such explanations is that until fairly effective carnivorous animals were developed, fossilizable hard parts were unnecessary and so did not evolve. For example, a worm or arthropod could develop a hard chitinous jaw which might not fossilize, but which might provide the conditions for evolution of skeletal armour that would fossilize. It must be accepted as an important, though rather mysterious, fact in the biological history of the earth, but cannot be used as an argument against subsequent evolution in the 500,000,000 years that have elapsed since the fossil record began.

The evidence pointing to the occurrence of evolution tells us nothing about its mechanism. Investigations beginning about 1920, notably by J. B. S. Haldane, R. A. Fisher and Sewall Wright, of the theoretical properties of populations composed of individuals bearing different genes conferring different survival values, have greatly developed the original Darwinian hypothesis. The fate of a particular variant is found to depend largely on the size of the population in which it occurs. In small populations there is a significant chance of new types becoming established by chance mutation, whatever the origin of such may be. In large populations change can only be effective through natural selection. G. G. Simpson in 1944 reviewed the available evidence derived from the study of fossils, and concluded that the initiation of a new direction in evolution is often a matter of chance variation in a small population, which, consisting of rare individuals, seldom leaves fossil remains, while the stately progression of more and more adapted forms, as exhibited in the evolution of the horse, is a slow transformation controlled by natural selection in large populations.

The main uncertainty in modern evolutionary theory would appear to concern the origin of discontinuous breeding populations or species, and the role of geographical isolation in such a process. Some zoologists, notably Ernst Mayr, have assembled much evidence to show that while one species can be transformed out of all recognition by the evolutionary process, it can only produce a single successor type unless its population is split by some external barrier. This view is probably sound in the case of most groups of animals. In plants, numerous complications provided by chromosomal variation of a kind little known in animals possibly make geographical isolation a less important prerequisite for multiple production of species. Since two isolated groups will rarely vary in identical ways and will usually be subject to dif-

ferent ecological (environmental) conditions, they will tend to evolve differently. At a subsequent meeting, if they have become sufficiently different genetically they will be unable to interbreed successfully. (*See* EVOLUTION, ORGANIC; SELECTION.)

One of the most remarkable results of studies of the genetics of natural populations is the discovery of the widespread abundance of recessive lethal genes. It is probable that in many cases heterozygotes have selective advantage not only over the homozygous lethal (which is obvious) but also over the homozygous nonlethal or wild type. The most dramatic case of this sort is sickle-cell anemia in man in which the heterozygotes exhibit immunity to certain forms of malaria.

6. Physiology.—The results of the study of the physiology of the simplest organisms are almost exclusively biochemical. General physiology, if it is to embrace the functioning of all forms of life, must be regarded largely as the physiology of cell metabolism. The results of such studies indicate that certain types of reaction catalyzed by enzymes take place in the protoplasm of the most disparate organisms. There is evidently a common set of reactions characterizing the metabolic activity of all organisms. Individual parts of the whole system may be omitted in one species or another. This is made possible in part by the normal presence of more than one set of machinery for gaining the same end, though under different conditions. The widespread occurrence in the same cell of enzyme systems permitting oxidative metabolism or anaerobic glycolysis as sources of energy is an outstanding example.

Superimposed on the basic machinery there is a quite fantastic diversity of mechanisms by which particular materials can be used as sources of matter or energy, and by which specific products of metabolism are elaborated. There is little doubt that the general diversity of such processes reaches its maximum development in the free-living bacteria, which may be regarded as specialized on the biochemical level.

Though bacteria may possess motile flagellums or show a capacity for independent movement in other ways, the group as a whole is at the mercy of electrostatic and molecular forces. The larger unicellular organisms, however, have been liberated from such forces by virtue of size alone; they are too big to be absorbed on clay particles or to be pushed around by the thermal agitation of the perennial Brownian dance. They begin, therefore, to show directed movement in response to external changes in the medium, and so become subjects for classical physiological studies.

The increase in size which puts such organisms outside the range of molecular agitation introduces its own problems. The organism in moving meets a new element of the external world which first acts on its surface, at an appreciable distance from some or all of the machinery involved in producing the movement. The distance may only be a few thousandths of a millimetre, a fraction of the length of a cell; but it is evident that, whatever the scale of the phenomena, the molecular structures at the surface of the part moving forward first receive a stimulus, or indication of a change in the outer world. It is not necessarily this part of the cell that produces the movement that will be modified by the stimulus. Thus we find even in single-celled organisms clear evidence of a receptor mechanism receiving stimuli, the result of which is transmitted by a conductor mechanism to an effector mechanism producing an appropriate change in the movement or other activity of the organism. In both the Flagellata and the Infusoria among the Protozoa (*q.v.*) a visible fibrillar conductor path may be developed. The receptor organelles are less conspicuous except where they are represented by red "eye spots" or stigmata in green flagellate cells, which apparently are light sensitive. Presumably the whole external surface may act as a receptor organ to chemical or tactile stimuli. In the best-developed cases the effector organs of unicellular organisms are cilia or flagellums. We have thus developed within a single cell a system of the same general kind that is built out of cellular units within the bodies of multicellular animals. In the latter the system consists of sense organs of more or less complexity, of the nervous system and of muscles and other kinds of effector organs (glands, electric organs).

The highly organized nervous systems of multicellular animals apparently always consist of aggregates of nerve cells or neurons, drawn out into long conducting fibres. These fibres do not anastomose (interjoin). The nervous impulse is transmitted from cell to cell across a special boundary region or synapse, in which the rate of conduction is low and at which complete blocking of the impulse may occur. It is usually supposed that the properties of the more elaborate nervous systems are as dependent on the nature of the synapses as on the arrangement and nature of the fibres.

In the higher plants, which show limited power of motion, the effective stimuli are usually constants such as gravity, acting on growing and changing organs, or slowly changing events, such as length of daylight. The response is usually expressed in terms of growth rather than in any movement of fully developed cells. There can be little doubt that whatever the nature of the nervous impulse, similar if slower types of conduction can pass from cell to cell wherever cytoplasmic bridges or connections exist between such cells. This is certainly true of the cells of ciliated epitheliums covering the gills of bivalve mollusks. Cytoplasmic bridges occur between plant cells no less than in animals, and presumably are involved in what is loosely called protoplasmic conduction. Some such phenomenon may therefore probably be regarded as general in all but the smallest organisms.

The transmission of stimuli by cytoplasmic conductors, either unspecialized bridges or highly specialized nerve fibres, is not the only form of co-ordinating mechanism whereby the different parts of the body of a large organism can be maintained in functional relationship with each other and with the external world. Wherever there is a movement of fluid from one part of the organism to another, there is a possibility of the transport of hormones or chemical messengers. This mode of conduction is naturally developed most completely in organisms with well-developed vascular systems. It is best known in the higher or vascular plants, in which form is largely regulated by the local production of a hormone, auxin; in the arthropods (insects and Crustacea), in which a complex of organs in the head regulate moulting, metamorphosis and the maturation of the genital organs; and in the vertebrates, where a very elaborate endocrine system is developed. There are indications of comparable phenomena in some worms and in the cephalopod mollusks (squid, cuttlefish, octopus, etc.).

In proceeding from the simplest organisms to the more complex, the physiologist passes from a realm in which the enzymatic biochemistry of cell metabolism is paramount to a realm where the co-ordination of cell activities becomes more and more emphasized. In plants this is expressed largely in the elaboration of growth patterns and in responses to the slowly changing ecological variables of the seasons. In animals the effects of free movement, of the exploration of the external world by receptor organs, with subsequent action of an increasingly discriminating kind, become more and more apparent. The process reaches its highest development in man, the human nervous system presumably being the most complicated structural and functional pattern yet to appear in the material universe.

The study of animal behaviour does not strictly fall within the meaning of biology adopted at the beginning of this article, since it is by nature practically confined to examination of motile organisms included in the animal kingdom. In the present century a strong school of psychologists, the Behaviouristic school, has insisted that a scientific psychology can be elaborated only in terms of externally observable behaviour, without any reference to the subjective condition of the organism studied. Insofar as this condition is only known in terms of verbal behaviour, the restriction was less radical than might at first appear.

Any observed response given by an organism to an environmental change may be innate (instinctive) or independent of previous experience, or learned or dependent on previous sensory stimuli received in the life of the animal. It is probable that certain of the protozoa or unicellular animals can exhibit very simple kinds of learning. Following W. H. Thorpe, it is possible to distinguish four types of learning. Habituation is the disappearance of an innate response to repeated mild stimulus (*e.g.*,

odorous or mild mechanical irritation) that initially causes reactions of avoidance or inhibition of movement. Associative learning is the transference of the capacity to elicit an innate response from its normal stimulus to some previously indifferent stimulus that is associated with the normal stimulus. Latent learning is transfer of the property of eliciting response from one stimulus to another under conditions that do not permit the production of the response until the association has been formed. Thorpe regards the process of imprinting of K. Lorenz as a special type of learning. This process, discussed below, seems legitimately regarded as a peculiar type of latent learning. Insightful learning is the term given to production of entirely new responses to new situations, integration of diverse elements of previous experience presumably always being involved. Habituation and association occur throughout the mobile members of the animal kingdom with polarized nervous systems. Latent learning certainly occurs in both arthropods and vertebrates. There is no evidence of insightful learning except in the highest vertebrates, and the exact level at which it appears was not certainly established as of the early 1960s. (*See* PHYSIOLOGY; ANIMAL BEHAVIOUR; PSYCHOLOGY, COMPARATIVE.)

7. Ecology, Biocoenology, Biodemography and Biosociology.—The study of the relations of individual organisms to their environments is very ancient; much unsystematized information on what is now called autecology (the study of the relation of the individual organism to its environment) is included in the traditional lore of hunters, fishermen and agriculturalists. The realization that different requirements of different species led in any given kind of habitat to the formation of rather constant mixtures of populations in dynamic relationship and characteristic of the habitat may also have had a prescientific history. It did not, however, play any great part in scientific thought until the early part of the 19th century. The first contributions to what is now called synecology (the study of the relation of groups of organisms to their environment), or perhaps better biocoenology, or the study of biological communities, by Alexander von Humboldt, A. Grisebach and other workers early in the 19th century, were devoted solely to plants. The idea of the animal community and of the fully integrated biological community or biocoenosis is largely the result of the study of shallow water populations in the sea, notably by A. F. Möbius. During the closing years of the 19th century the very fertile idea of an inevitable sequence of communities leading to a climax characteristic of the climatic conditions of the region was developed, largely by E. Warming in Europe and by H. C. Cowles and F. E. Clements in the U.S. between 1895 and 1910. The introduction of animals into the scheme followed, largely due to the work of V. E. Shelford. The developed descriptive science of synecology has been admirably set out by Clements and Shelford in their book *Bioecology*. The successional method of study, though intending to be dynamic, never developed a truly quantitative mode of approach. During the third and fourth decades of the 20th century biodemographic investigations, *i.e.*, studies of the dynamic properties of nonhuman populations, proved particularly important. The most notable contributions to this subject have been due directly or indirectly to Raymond Pearl, A. J. Lotka, V. Volterra, G. F. Gause, Thomas Park and A. C. Crombie.

In the simplest case, if we consider the growth of a population of an organism reproducing by simple division at a constant division rate with an infinite food supply, and no external limitations, the rate of increase will be proportional to the number of organisms (n) and to the division rate (b), or formally,

$$\frac{dn}{dt} = bn$$

No such rate is possible for long in any real case. Some limitation is always present. If we assume that a given volume of space or habitat can support a maximum population k, the simplest mathematical expression giving a continuous function for the population asymptotically approaching k is:

$$\frac{dn}{dt} = \frac{bn\ (k-n)}{k}$$

Here we have the rate of increase governed by the initial reproductive rate (b), by the number of individuals (n) which are available to reproduce and by the proportion of vacant spaces as a fraction of the maximum population $\frac{k-n}{k}$. Although in any given case there is no a priori reason to suppose that the reproductive rate is depressed by this fraction, the resulting integrated form of the equation, which gives a sigmoid curve known as the Verhulst-Pearl logistic, is, in general, observed in the growth of populations, of many individual organisms, of some human institutions and probably of whole biological associations also.

We may regard the expression $(k-n)/k$ as what engineers would call a negative feedback term. The equation set up assumes that the environmental effect implied by this term operates instantaneously. In practice this is most unlikely. If any appreciable time lag in the operations occurs the system is thrown into oscillations, though these may fade away. Experimental verification of this was achieved in populations of the water flea *Daphnia*.

The simplest and most fundamental result to be obtained from investigations involving more than one species indicates that if two species co-occur in the same habitat, they cannot form permanent stable populations if they occupy identical niches in the habitat; *i.e.*, if their requirements are identical, save in rare cases in which some external factor keeps both populations at levels far below those appropriate to the available food supply. This can be easily established by maintaining protozoa in a culture tube with a single species of food bacterium or yeast. If two species are cultivated separately they both may form stable populations of as many individuals as the food supply can support. If they are mixed together one species always displaces the other. In some cases it has been shown that environmental factors varying within limits tolerated by either species separately can determine which species will survive and which disappear in competition. If the artificial niche is diversified either by provision of a refuge into which the less successful competitor can go and the more successful cannot, or by introduction of two kinds of food, one of which the less successful competitor alone can eat, stable mixed populations are possible, but in such cases two niches are in effect available.

In nature, when two species are found apparently occupying the same niche, it is reasonable to conclude that actually they have slightly different ecological requirements, or that the mixed population is not stable, environmental changes now favouring one species, now the other.

Other results derived from the same type of investigation relate to interaction of two species, one of which feeds on the other. In such cases, under some conditions, fluctuations will be set up, the predator first increasing at the expense of the prey, then decreasing as the latter becomes so rare that it can seldom be captured, and later increasing as the supply of prey recovers during the period when most of the predators have died of starvation. Though very regular fluctuations do occur in some animal populations, it appears that the classical cycle of the kind just described seldom is realized in nature. The ten-year fluctuations observed, for instance, in the arctic hare or snowshoe rabbit of Canada must have some other cause.

The mathematical investigation is here justified because it provides a number of criteria by which actual cyclical variations can be compared with theoretical ideal cycles. The main difference between model theoretical systems and actual populations seems to be in the greater proneness of the former to oscillation, suggesting that in nature special mechanisms exist which stabilize the biological community.

Studies of both ecology and population genetics have made clear the importance of differences between small and large populations. It is, however, primarily among animals that the existence of active interrelations among freely motile organisms has permitted the development of true social phenomena. A good many cases have been reported of animals living best at a certain population density, below which adverse effects of undercrowding appear. This has been claimed many times among the Protozoa, and although many of these claims are unconfirmed by subsequent work, it seems

probable that some are correct.

W. C. Allee was particularly assiduous in demonstrating the beneficial effects of definite minimum numbers of metazoan species under unfavourable surroundings and rightly regards this as a widespread property of living organisms. That such effects operate in nature has been demonstrated by an ingenious experiment of W. T. Edmondson, who found that the tube-building wheel animalcule, or rotifer, *Floscularia conifera* has a higher expectation of life if as a larva it settles on an older animal than if it attaches to a neighbouring fragment of a water plant. These effects of aggregation are, however, merely possible prerequisites to sociality. No special socially integrated behaviour is exhibited by the component members of the group. True social life exhibiting such behaviour has been developed only in the Hexapoda, or insects, and in the vertebrates. The manifestations of sociality are, however, very different in the two groups.

The social insects are mainly found in the Isoptera, or termites, and in the Hymenoptera, or wasps, ants and bees. In both cases the colony is to be regarded as an immense development of the family, in the termites the patrogynopedium or association of both parents with offspring, in the wasps, ants and bees the gynopedium or association of the female parent alone with the offspring. The family group is specialized so that very few members are potentially capable of reproduction, the majority forming a sterile caste which includes infertile members of both sexes in termites and infertile females only in the social Hymenoptera. It is usual for the sterile caste of termites to be divided into two subcastes, the more numerous workers and the less numerous soldiers. Similar or more elaborate division into subcastes occurs in many but by no means all ants.

The mechanisms by which the fundamental caste distinction between fertile queen and infertile worker is established, even among a single group such as the bees, turn out to be astonishingly varied. In some cases, notably the stingless bees (*Melipona*) of South America, caste appears to be determined genetically. In other cases, such as the familiar bumblebees (*Bombus*) of the northern hemisphere, the main difference between queens and workers lies in the amount of food that they received as larvae. In a third group of cases, there appears to be a social hormone produced by the integument of the queen that alters the behaviour of workers which receive the material and inhibits the development of their ovaries. In the honeybee (*Apis mellifera*) this queen substance prevents workers from building royal cells in which specially fed queens are reared. In some species of ants very complicated situations involving seasonal growth patterns appear to be involved in caste production.

Extremely specialized stereotyped behaviour is developed along with this morphological specialization of individuals. The behaviour may change, young bees being nurses, older bees food gatherers, and elaborate sets of fixed reactions permit remarkable responses such as the solar compass reaction of ants or the honey and pollen dances of bees. Though these responses may depend on past experience, there is no unequivocal evidence that any integration of previous fragments of past experience to meet a radically new situation is ever exhibited by insects. The small size of the body, and so of the nervous system, probably limits the possibilities of learning in the social insects. In the social vertebrates no morphological polymorphism (capability of wide variation of form) other than sex has been developed. In man, the species showing the most elaborate social development, complex inherent responses are so little developed that their existence is a matter of debate. All forms of learning are greatly developed, insightful learning reaching its maximum manifestation. The whole series of vertebrate classes show examples of social species, and, although the level of organization of all species save the primates is low compared with the highest social insects, several special properties of vertebrate groups clearly foreshadow certain human developments. Whenever a group of a vertebrate species occupies a restricted space, the phenomena of prostasia or social dominance tends to develop. This phenomenon was first described systematically by T. Schjelderup-Ebbe, working on domestic chickens. In this case, in a unisexual flock, a pecking order tends to develop, bird *A* pecking all the members of the flock, bird *B* all save *A*, etc. In such cases the order usually becomes linear, except when there are so many birds that the chance of every bird encountering every other often enough to establish the order is very small. The phenomenon is independent of sex, though when both sexes are present the males are usually higher in the hierarchy in the forms studied. Prostasia is known in fishes, reptiles and mammals, as well as in birds. The phenomenon is well developed in wild social groups of primates and elaborations are easily observed in human society. It seems probable that it is not often found in a well-developed form outside the vertebrates.

Another phenomenon apparently widespread among the higher vertebrates is the development of tradition, in the sense of a set of techniques for performing certain functions in the life history, not based on innate behaviour. The problem has been little studied in mammals outside man, but appears to be well developed in certain species of birds. There is, for example, evidence that in such species the song or the method of nest building is based not on innate behaviour but on experience of the bird in associating with older individuals of the same species. This phenomenon is even more clearly restricted to the vertebrates than prostasia, and has become one of the leading characters of the Hominidae.

Related to the development of tradition, there is a very remarkable phenomenon in birds, termed imprinting by Lorenz. If certain species of birds are reared by foster parents, they early learn to behave toward the foster parent as if they belonged to that species. This behaviour may persist for months after removal from the foster parents. At the first breeding season the bird will seek a mate of the species by which it was reared rather than that to which it belongs. In certain cases birds may learn to regard human beings or inanimate objects as their normal companions, and go through mating ritual in the presence of such persons or objects. This phenomenon appears comparable with the establishment of fixation and fetishism in human psychopathology.

Early imprinting of a comparable type is doubtless involved in learned traditional behaviour of all kinds in both birds and mammals that exhibit the phenomenon, and is certainly of fundamental importance in maintaining the cultural characteristics of human groups. (*See* ECOLOGY, ANIMAL; POPULATION ECOLOGY; SOCIOLOGY, ANIMAL.) (G. E. HN.; X.)

8. Economic Biology.—The application of life principles to the control, development and improvement of living things for the financial, physical or aesthetic benefit of man has been termed economic biology. All animals, plants, bacteria and viruses are involved whenever they affect man or his possessions. Man has always used the animals and plants around him for food, clothing, shelter and recreation. Many animals and plants also cause annoyance and disease or destroy man's accumulated possessions. All of these complex relations between man and living organisms are the concern of economic biology.

Numerous subject matter disciplines have been established for developing and expanding knowledge in particular areas. Only the principal ones are dealt with here.

Animal Husbandry—the feeding, care and breeding of domestic animals: horses, mules, oxen, water buffalo and camels for transportation; cattle for meat and dairy products; sheep for meat and wool; swine for meat; and poultry for meat and eggs. Numerous by-products result from the processing of animals for meat, such as hides and fertilizer. (*See* ANIMAL BREEDING; FEEDS, ANIMAL.)

Wildlife Management—the control and management of wild animals (mammals and birds) to maintain ample numbers for hunting and trapping. The commercial hunting of wild game for food is of minor importance, but hunting for sport is a major recreational activity in the United States and elsewhere. Pelts for fur are obtained either by trapping or by rearing animals, such as mink and fox, on "fur farms." (*See* WILDLIFE CONSERVATION.)

Animal Pest Control—a special aspect of wildlife management concerning the control of mammals or birds that are injurious. Rats and mice infest dwellings, warehouses and grain storage facilities; the destruction and contamination of grain by these rodents causes a tremendous annual financial loss. Other examples are predators, such as coyotes, wolves, foxes and bears; starlings and English sparrows, which are a nuisance in cities; and pocket gophers, which destroy agricultural crops.

Fisheries—the propagation, management and harvesting of fish and

other aquatic animals (whales, crabs, lobsters, shrimp, oysters and clams) for food, sport (recreation) and numerous nonedible products such as pearls, glue, cod-liver oil, fish oil, fertilizer, etc. Commercial food fisheries are of major importance on an international level since many nations depend on their fisheries for a considerable portion of their food supply. (*See* FISHERIES; FISH CULTURE.)

Economic Entomology—the control or eradication of insects injurious to man or his possessions. All plants, all mammals and birds (both domestic and wild), all stored products (grain, processed food, lumber) and all wood structures are subject to insect attack. Insects also are vectors of animal and human diseases (malaria, yellow fever) and plant diseases (Dutch elm disease, curly top of sugar beets).

Control of an insect pest is accomplished when its numbers are reduced to a point at which financial loss is negligible. Eradication presumes that all pest individuals have been killed in a given area. Numerous insecticides, both organic and inorganic, are applied as sprays, dusts and fumigants. Cultural methods (time of planting, summer fallowing) have been used successfully in the control of insects attacking agricultural crops. Varieties of crop plants resistant to insect attack have been successfully developed. There are instances in which it is possible to alter some factor of the environment (temperature, moisture) resulting in unfavourable conditions for insect development. Some outstanding successes of insect control have been accomplished by the promotion of insect disease epidemics and by the introduction, propagation and distribution of parasites and predators of the injurious insect. (*See* ENTOMOLOGY.)

Apiculture—a branch of entomology concerned with the care, management and breeding of the honeybee for the production of honey and wax, and for pollinating agricultural and horticultural crops. (*See* BEEKEEPING.)

Sericulture—a branch of entomology concerned with the care, feeding, management and breeding of the silkworm moth for the production of silk. This industry is most highly developed in such countries as Japan, China and Thailand.

Parasitology—the investigation and control of the internal and external parasites of man and of domestic and wild animals. Most of the internal animal parasites are included among the roundworms (Nemathelminthes), flatworms (Platyhelminthes) and Protozoa. Most of the external animal parasites are either insects or near relatives (chiggers, mites, ticks). (*See* PARASITOLOGY.)

Veterinary Medicine—the care, alleviation and prevention of disease of domestic animals primarily, but of wild animals on occasion. (*See* VETERINARY SCIENCE.)

Agronomy—the planting, culture, development of improved varieties and harvesting of field crops for food (wheat, corn or maize, barley, rice, sugar beets, sugar cane), forage (hay and pasture for livestock) and fibre or oil (flax, soybeans, peanuts). Here plant breeding is a most important tool. The development of hybrid corn is an outstanding example of the improvement of crop plants by plant breeders. (*See* CROPS; PLANT BREEDING.)

Soils—a study, often considered a part of agronomy, that concerns itself with the chemistry, biology, classification and improvement of the medium in which plants grow. The proper handling of soil (plowing, cultivation, fallowing), use of natural and commercial fertilizers and the use of plants for improving the soil (green manures, legumes) are the domain of the soils expert. (*See* SOIL.)

Horticulture—the planting, culture, development of improved varieties and harvesting of fruits, vegetables, ornamental trees and shrubs and flowers. Here again the plant breeder has been of invaluable assistance in developing new and greatly improved varieties. (*See* HORTICULTURE.)

Weed Control—the controlling of unwanted plants by chemicals or other means. Numerous chemicals are available commercially for use as sprays or for treating soil prior to planting for the control of weeds. Many of these are selective and effective against only certain types of plants. (*See* WEED.)

Plant Pathology—the control of plant diseases that often reach epidemic proportions and cause tremendous financial loss. Many of these diseases are caused by other organisms (fungi, bacteria and viruses). Two principal lines of attack have been developed: the breeding of immune or resistant varieties of plants (*e.g.*, wheats resistant to black stem rust); and the use of chemicals, applied either as sprays or dusts, to destroy or inhibit the disease organisms. (*See* PLANT DISEASES.)

Forestry—the planting, culture, management and harvesting of forest trees for lumber, wood pulp, poles, railroad ties and numerous other commercial products. (*See* FORESTS AND FORESTRY.)

See also AGRICULTURE; ANIMAL; FOOD SUPPLY OF THE WORLD; PLANTS AND PLANT SCIENCE; ZOOLOGY: *Economic Zoology.*

(C. E. MI.)

V. THE PHILOSOPHY OF BIOLOGY

Good biological work has been accomplished by investigators of the most varied philosophical outlook, from Neo-Thomism to sceptical naturalism. No inevitable metaphysic evolves from the study of biology, or indeed from that of any other natural science. Nevertheless some of the general conclusions that have been set out in the preceding discussion have a philosophic interest, defining the limits of reasonable belief about the nature of the external world.

As far as scientific method permits the exploration of the human environment, it seems impossible to recognize definite categorical discontinuities. The difficulty of defining a living organism is an example of this. The definition adopted is arbitrary to the extent of depending on the linking of two properties, metabolism and reproduction, which logically might be independent. Moreover, in the course of analysis it becomes necessary to arrange all the phenomena of nature in a more or less linear continuous sequence of classes, and then to describe events comprised in the class of more complex phenomena in terms of events in the classes of less complex phenomena (principle of hierarchical continuity). Within each class, however, there are numerous interrelations observed between events of the same order of complexity. It is thus possible to recognize a number of more or less autonomous disciplines, each permitting generalization, but ordered so that the more complex events treated by one discipline can also be analyzed in terms of less complex events treated by another discipline.

It is thus possible to establish a body of generalizations about human society independent of the behaviour of individual men, a number of generalizations about individual behaviour without consideration of the physiology of the sensory, conductor and effector mechanisms involved and a large body of generalizations about muscle or nerve physiology without considering the molecular mechanisms involved. Such autonomous disciplines may seem sterile and uninteresting; it is, however, important to realize that they can be constructed.

It is considered by a growing minority of biologists that the various phenomena studied by parapsychologists may indicate that at a certain level of complexity properties of the universe become apparent that are not demonstrable in simpler systems. The simplicity postulate, or law of parsimony, commonly called Occam's razor, that theoretical entities used in explanations must not be multiplied beyond necessity, should always be kept in mind in dealing with this difficult field. All the evidence that has accumulated since 1858, in astrophysics and cosmogony no less than in geology, biology and anthropology, suggests that the simpler systems were in existence prior to the complex. The hierarchical arrangement of the sciences thus is apparently correlated with a temporal order of kinds of events.

It is a particularly striking property of the hierarchy that the events of a more complex kind involve the emergence of new qualities. The maintenance of the nonequilibrium steady state of metabolism, reproduction, irritability, modification of response by previous experience, tradition and social phenomena represents such new emergents. The emergence of such new properties, as evolution proceeds, must be regarded as a general property of the universe. Fortunately again a variety of philosophic systems provide for such a recognition.

A further point of interest is that photosynthesis on the one hand and reproduction followed by natural selection on the other provide a mechanism by which the local emergence of physically less probable systems from physically more probable can take place. Though it has frequently been supposed that physical evolution is at an end, there is no reason to suppose that this is true of social evolution. The period of time since the first stone implements were made is perhaps 300,000 years, one-fifteen-hundredth of the time since the animals that have left the oldest fossils lived. There is then a good right to hope that social evolution is only in its early stages.

These stages, moreover, have for the most part taken place in a period during which systematic knowledge was undeveloped. Vernadsky regarded the envelope of the earth as now passing from a stage determined primarily by biological processes to one determined by conscious human effort.

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BIOLOGY, MARINE: *see* Marine Biology.

BIOLUMINESCENCE. Any light with a negligible amount of accompanying heat is spoken of as a luminescence or a cold light. It is to be contrasted with an incandescence, where the heat production is large and the light is directly associated with the high temperature. Luminescences may result from various procedures and the word is usually accompanied by such prefixes as radio-, electro-, crystallo-, tribo-, chemi-, etc. These prefixes indicate, respectively, luminescence from previous exposure to radiation of various kinds, or from electrical excitation, from crystallization, from rubbing materials together, or during a chemical reaction. Fluorescence is a type of radioluminescence in which materials emit light while they are being irradiated, whereas in phosphorescence the light continues after the irradiation.

Y. HANEDA

FIG. 1.—FUNGUS MYCENA LUX-COELI PHOTOGRAPHED BY DAYLIGHT (LEFT) AND BY ITS OWN LUMINESCENCE AT NIGHT (RIGHT)

The word phosphorescence, then, strictly applies only to light production at low temperatures by certain substances called phosphors, after previous exposure to light or radiation of other kinds. However, common usage has applied it incorrectly to the glow of phosphorus, or of the firefly, the sea, dead fish or meat, or wood, the so-called fox fire of forests. Light of the sea, or of fish, flesh or wood, is always due to living organisms of various kinds and should more properly be called bioluminescence or biophotogenesis. Such light is the result of a slow oxidation of material manufactured by the organism and hence is an example of chemiluminescence.

Luminous Organisms.—At least 40 different orders of animals and two groups of plants contain luminous species.

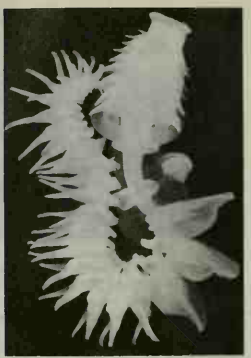
Plants.—The plant groups are the bacteria, which are responsible for the luminescence of flesh, and the fungi, responsible for the luminescence of wood. Either the fine strands of fungus mycelium, which penetrate the wood, or the fruiting body, the mushroom, or both, may be luminous.

Luminous bacteria are so small that individuals cannot be seen by their own light, although natural colonies are easily visible. They may be cultured on artificial media, and they form excellent material for the experimental study of bioluminescence. They are not pathogenic to man but are known to infect living animals, giving rise to a natural luminescent disease of sand fleas, shrimp, midges, caterpillars and some other insects that is eventually fatal. Luminous bacteria may also live symbiotically in light organs of fish. It was at one time believed that the luminescence of all luminous animals, even the firefly, was due to symbiotic luminous bacteria, but this view is incorrect.

The characteristic of the light of bacteria and fungi, which distinguishes them from all other luminous organisms, is its uniform intensity, shining night and day, independent of stimulation. Other organisms light only when disturbed or stimulated in some way. This stimulation produces the glow in the wake of a ship, or as waves break on a shore or when a school of mackerel swims through a mass of luminous organisms.

Animals.—Phosphorescence of the sea is largely due to protozoa, of which the radiolaria and dinoflagellata (including *Noctiluca*) are luminous. The latter may develop in such enormous numbers that the sea is a pink or red by day and a vivid sheet of flame by night. Larger patches of light in the ocean are mainly due to coelenterates, jellyfish, siphonophores, or ctenophores (comb jellies). The latter are often very abundant and show the interesting phenomenon of loss of luminescence in sunlight or on bright illumination by electric light. The luminescence again appears on stimulation after about one-half hour in the dark. The ctenophores and coelenterates probably contain more luminous species than any other group, the sea pens or pennatulids showing an especially brilliant luminescence that travels over the colony of polyps in the form of a wave. Nerves carry the impulse that sets off luminescence of each polyp, giving rise to the wave of light. The scintillating light that appears when the marine growth on old piles or rocks is gently stroked frequently comes from colonies of hydroids, some species of which are luminous. (*See* Ocean and Oceanography: *Phosphorescence.*)

One nemertean worm (*Emplectonema*) is luminous. It lives coiled on an ascidian at depths of 120 ft. in bays along the coast of Japan. Among the true worms or annelids, some earthworms and many marine forms (*Chaetopterus, Polynoe, Tomopteris, Polycirrus* and *Odontosyllis*) are luminous. *Odontosyllis* is the well-known fire worm of Bermuda, which swarms in great numbers during certain months of the year, a few days after full moon. The worms rise to the surface of the sea from coral rock 55 minutes after sunset and shed their eggs and sperm with an accompanying brilliant display of luminescence. The swarming lasts 15 to 30 minutes.



GEORGE G. LOWER

FIG. 2.—LUMINESCENT PARCHMENT WORM (CHAETOPTERUS)

Although the worm *Chaetopterus* lives in a parchmentlike tube buried in the sand and never comes out in the open, its body is covered with gland cells that secrete a bright luminous slime when the animal is disturbed. *Tomopteris* is pelagic, but *Polynoe* and *Polycirrus* live among other marine animals, shells and sponges. The luminescence of sponges may be due to luminous animals living on them, but at least one species appears to be self-luminous.

Luminous mollusks are represented by *Pholas dactylus* (a bivalve), *Phyllirrhoe* and *Plocamopherus* (nudibranchs), a land snail (*Dyakia*), a fresh water limpet (*Latia*) and a marine gastropod (*Planaxis*), together with the cephalopods, of which many members produce light. The cephalopods and deep-sea fish possess the most complex lanternlike luminous organs. Among the echinoderms, only the brittle stars (ophiuroids) possess luminous members.

Among the crustaceans, mysids, copepods and ostracods (*Cypridina*) contain many luminous forms, while the schizopod and decapod shrimps possess members with true luminous organs or photophores, often consisting of lens, reflector and pigment screens —veritable lanterns on a microscopic scale. These light organs once were mistaken for eyes. The ostracods and some shrimp eject into the sea an abundant luminous secretion from large glands, thus surrounding themselves with a liquid fire.

Some myriapods and springtails are luminous, as are the larvae of the fly *Arachnocampa* that live in New Zealand caves and beetles (firefly, glowworm and the elaterid *Pyrophorus* of the West Indies). All stages of metamorphosis, including the egg, of some fireflies are luminous. The word glowworm is applied to the larva of the firefly, or to some adult female fireflies that are wingless and hence look like a worm.

The most remarkable luminous insects are beetles of the family *Phengodidae*, related to lampyrids. The males are like any other beetle in appearance, while the fertile females are grublike and larviform, often two inches long. In the North American genus *Phengodes*, the female and larvae possess a row of bright greenish luminescent spots on each side of the body, while the South American form, *Phryxothrix*, has in addition a red light on the head, hence its local name of *ferrocarril* or "railroad" worm. The red light is the colour of a glowing cigarette.

Y. HANEDA

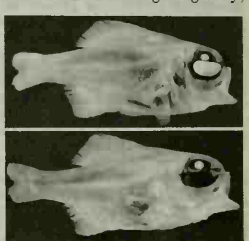
FIG. 3.—LUMINOUS ELATERIO BEETLE (PYROPHORUS HAVANENSIS): (ABOVE) LARVA; (BELOW) ADULT

Balanoglossus and the ascidians (*Salpa* and *Pyrosoma*) are also luminous. The latter forms large colonies of minute animals floating on the sea, each individual possessing two luminous spots.

Finally, mention should be made of the fish, both elasmobranchs and teleosts, that contain luminous members. The deep-sea forms are often bizarre in appearance and sometimes contain the luminous organ on the end of a long process dangled before the animal. Others have rows of lights like portholes along the sides of the body. Most fish are self-luminous, but some forms, such as *Photoblepharon, Anomalops, Monocentris, Equula, Acropoma* and *Physiculus* give off light by virtue of symbiotic luminous bacteria. They possess luminous organs especially designed to nourish the bacteria. In *Photoblepharon* and *Anomalops* from the Banda Islands in Indonesia, the large oval light organs are situated just under the eye and contain rows of long tubular cells full of bacteria. A copious network of blood capillaries supplies oxygen. The light is constantly emitted, as with other luminous bacteria, but the fish can turn off the lights so that as the fish swim the lights blink on and off in a regular rhythm. This is accomplished in *Photoblepharon* by a black fold of skin drawn over the light spots like an eyelid. In the closely related *Anomalops* the whole light organ is hinged at one end and turned inward toward a groove or pocket to obscure the light.

The sponges, alcyonarians, bryozoans, May flies, termites and spiders contain forms reported to be luminous but light production by these species is still doubtful.

It is rather surprising that it is chiefly land or marine animals that are luminous. No phosphorescence is to be noted in great inland bodies of fresh water, no matter how ancient geologically, and despite the fact that they are deep and contain organisms closely related to marine species that are luminous. In Lake Suwa, Japan, there is a luminous shrimp, but luminescence in this case has been shown to be due to infection with luminous bacteria, not to self-luminosity. The only fresh-water luminous animals are the New Zealand limpet (*Latia*) and the larva of a firefly that lives in tropical pools and streams and breathes by tracheal gills.



Y. HANEDA

FIG. 4.—LANTERN-EYE (PHOTOBLEPHARON PALPEBRATUS): (ABOVE) ORGAN GLOWS WITH LUMINOUS BACTERIA; (BELOW) ORGAN COVERED BY FOLD OF SKIN

In general, luminous organs or regions are glandular, and the luminous material may be ejected (extracellular luminescence) as a slime or a secretion, which in the deep-sea squid, *Heteroteuthis dispar*, replaces in function the black ink of the common squid. On the other hand, the luminous material may remain within the photogenic cells (intracellular luminescence) as in the firefly and organisms possessing photophores. There is always a mechanism—either trachea or a rich blood supply—for supplying the organ with abundant oxygen, a fact that indicates light production is usually an oxidation. However, in the ctenophores dissolved oxygen is not required.

Use of Animal Light.—Regarding the use of luminescence to the animal, very little can be said with certainty. In deep-sea forms that live in perpetual darkness, it would seem that the organs must be lanterns for seeing or recognition. Many luminous forms live where light penetrates, and it has been suggested that the luminescence may be used at night as a warning to scare away predaceous animals that might molest the luminous forms, or as a lure to attract creatures upon which the luminous animal feeds. These suggestions remain to be proved; but it is known that in the firefly the light acts as a signal or attraction to bring the sexes together, and that the different species of fireflies can be recognized by the characteristic length of the flash and interval between the flashes. On the other hand, who can suggest the use of light to a luminous bacterium, an organism $\frac{1}{25,000}$ in. in diameter with no nervous reactions of a higher form, or the use to a protozoan who lives on the surface of the sea and is blown hither and thither by the wind? The logical conclusion seems to be that in these cases the light is fortuitous, a chance phenomenon that accompanies some necessary organic chemical change occurring in the organism.

Chemistry of Bioluminescence.—Knowledge about the chemical nature of bioluminescence has accumulated in four steps:

1. R. Boyle (1667) showed that fungi and bacteria require air (oxygen) for luminescence, becoming dark under an air pump and luminescing again when air is readmitted. He drew an interesting comparison between a glowing coal and phosphorescent wood, although oxygen was not known and combustion was not understood at that time.

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FIG. 5.—GLOWING DEEP-SEA SHRIMP (SERGESTES PREHENSILIS)

2. R. de Réaumur (1733) showed that water is necessary, that luminous cells can be dried and preserved, and can then be made to produce light by being moistened. This proves also that bioluminescence is not a process involving definite structural peculiarities of the cell, as is the contraction of a muscle or the conduction of a nerve impulse, which will not occur after drying and moistening. Excellent material for chemical studies of bioluminescence is the dried ostracod *Cypridina,* which gives a bright luminescence in water after being dried for 40 years.

3. R. Dubois, in 1887, found that the photogenic material of *Pyrophorus* and of *Pholas* can be separated into two constituents, luciferin and luciferase, because of their marked difference in chemical behaviour. The latter is destroyed on boiling and behaves like an enzyme or catalyst; the former resists heat and can be oxidized. These substances can be precipitated by certain reagents and redissolved in appropriate solvents.

4. E. N. Harvey (1918), working with extracts of dried *Cypridina,* showed that after the luminescence had disappeared, due to the oxidation of luciferin in the presence of oxygen, addition of various reducing agents that can add hydrogen to the molecule would reform luciferin. Partial reversibility of the reaction was established, since light again appeared if the newly formed luciferin were reoxidized by luciferase and oxygen. Continued oxidation appears to result in an irreversible oxidation product.

It has been observed that luciferin of one luminous species (*Cypridina*) will not react with luciferase of another unrelated luminous species (*e.g.,* the lampyrid firefly) or vice versa, but there is interaction between luciferin and luciferase of two different genera of ostracods or of two different genera of lampyrids. Only rarely does the luciferin of *Cypridina* react with a distantly related species such as a fish (*Apogon*) and vice versa. Quite a few different luciferins and luciferases appear to have evolved in different phyla of the animal kingdom, so that these words now stand for groups of unrelated substances rather than for a single compound. Three totally different luciferins are now fairly well known—luciferin of bacteria, of the firefly and of *Cypridina.*

In luminous bacteria, the chemical structure of luciferin is a combination of reduced flavin mononucleotide and a long chain (greater than six carbon atoms) aldehyde. When these substances in aqueous solution are mixed with bacterial luciferase in oxygen-containing water, light appears, even though no cells or cell fragments are present. Both firefly luciferin and *Cypridina* luciferin have been crystallized. The empirical formulas have been given as $C_{13}H_{12}N_2S_2O_3$ for the former and $C_{21}H_{28\text{-}30}N_6O_2Cl_2$ for the latter. Firefly luciferase has also been crystallized, but its relationship to other enzymes is not known. The luciferins and luciferases of some other groups of luminous animals are undoubtedly different, but not enough research has been carried out to determine their chemical structure. It seems fairly certain that among luminous bacteria the luminescent reactions have evolved in connection with the cell respiratory mechanism. In other forms also, the luciferins probably represent a slight change in a group of compounds important in the life of the cell.

In luminescence some molecules must absorb energy, thereby attaining the excited or energy-rich state. On return to normal this excess energy appears as a light quantum. The luminescence intensity is determined by the number of quanta emitted per unit of time. In a fluorescent lamp, molecules of fluorescent powder on the glass walls of the tube are excited by the energy of incident radiation; with many organic substances the energy of chemical reaction may lead to excitation of molecules, giving such a brilliant bluish chemiluminescence as that of 5-amino-2, 3-dihydro-1, 4-phthalazinedione (luminol) or the yellow chemiluminescence of dimethylbisacridinium nitrate (lucigenin). Many other organic compounds capable of oxidation emit light, such as pyrogallol, lophine, esculin, and various essential oils. In fact, the whole process of light production by luminous organisms can be so perfectly imitated by such purely chemical reactions that bioluminescence can no longer be considered a mysterious or unusual phenomenon.

Efficiency of Light Production.—Bioluminescence is often spoken of as "cold light." This does not mean that no heat is produced but only that very little appears as compared with the ordinary methods of illumination, which depend on the incandescence of carbon particles in flames or of wires through which a current is passing. The rise of temperature in some luminous animals is less than 0.001° C.

The luminescence spectra of luminous animals consist of bands of different widths and in different positions in the visible region of the spectrum; hence the variation of colour of different luminous animals, which may be reddish, yellow, green, blue or violet. The light is no different, physically, from any other kind of light—it will affect a photographic plate, can induce chemical reactions and can be polarized, although it is never polarized as produced by the animal. No infrared or ultraviolet radiations and no penetrating radiations are produced. Hence the luminous efficiency, *i.e.,* the percentage of the radiant energy which is visible, is very high, nearly 100%. This does not tell, however, what the radiant efficiency is, *i.e.,* the percentage of the energy (chemical) of the oxidation process that appears as a radiant energy; nor does it tell the over-all efficiency, *i.e.,* the energy (chemical) in the food of the animal that appears as visible radiant energy. This is the efficiency in which an illuminating engineer is interested, and studies on luminous bacteria have shown that the over-all efficiency of these forms is at least slightly and probably considerably greater than that of a nitrogen-filled incandescent lamp, when calculated from the energy of the coal necessary to run the dynamo that supplies current to the lamp. Neither the radiant efficiency nor the over-all efficiency of the firefly is known.

It has often been suggested that firefly light, or living light, might someday be used for residential lighting. The intensity is sufficiently great, provided large enough areas are covered. In fact, the modern trend in lighting has been toward larger surfaces of less intrinsic brilliance, as in the fluorescent lamp. Although no chemiluminescence had been used in commercial lighting by the early 1960s, the fluorescent tube, perfected around 1938, seemed destined to replace the electric filament because of higher efficiency, little heat and diffuse illumination. By this change mankind has adopted the principle if not the actual light of the firefly.

See also LUMINESCENCE: *Bioluminescence and Chemiluminescence;* MARINE BIOLOGY.

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(E. N. H.)

BIOMETRY. The word "biometry" comes from the Greek words *bios,* "life," and *metron,* "measure." Thus, etymologically, it means measurements of living phenomena. The word was apparently coined by Karl Pearson, together with the name "Biometrika" as the title for a periodical on biometry, the word initially appearing in print in the first issue of the periodical in 1901.

The etymological meaning of the word is too vague. A much too narrow meaning, now only of historical interest, was given to it by some of its founders: the study of heredity by statistical methods, specifically by the use of correlation coefficients. Francis Galton wrote somewhat vaguely in *Biometrika* (1901) that "the primary object of biometry is to afford material which shall be exact enough for the discovery of incipient changes in evolution which are too small to be otherwise apparent." However, he also stated that "biometry is . . . the application to biology of the

modern methods of statistics." At that time modern methods of statistics meant the use of correlation coefficients. More precisely, biometry is the ensemble of experimental techniques and of conclusions that involve living phenomena and require statistical methods. It pertains to populations of living beings as opposed to individuals.

The experimental techniques range over the whole field of biology, biochemistry and biophysics. The statistical methods range over the whole field of statistics. In fact, most of the basic concepts and methods of modern statistics are due to biological investigations, and the names of Galton, William Sealy Gosset (who wrote under the pen name "Student"), Pearson and R. A. Fisher are indissolubly linked to modern statistics as well as to biometry. (*See* STATISTICS for statistical methods, and articles on biological sciences for experimental techniques.)

There are many branches of biometry. Description, classification, regulation and changes, interactions, responses, etc., of living populations form the main part. The populations may be of animals (including humans), plants, bacteria, etc. Their description involves statistical estimation; for instance, forest inventories, estimating mobile populations such as those of fish, insects, etc.

Determination of biological response is a new branch of biometry. For example, in the early 1960s techniques, designs and conclusions for vitamin tests, comparison of toxicities and animal feeding were well developed and in everyday use. Yet physiological biometry as well as biochemical biometry, while common, were in their scientific infancy. For example, the so-called normal ranges were too frequently ill defined and obtained by inadequate experimental and statistical techniques.

Biometry plays an ever increasing role in taxonomy. Populations of the same species may differ according to habitat, or two populations may overlap in some characters, or a population may be a mixture of species. In any of these cases, the investigations and the conclusions must be of a statistical nature.

Studies of competition or, more generally, interactions between species were first based on theoretical models of a deterministic character. It was only at mid-20th century that probabilistic models were introduced. Thus these studies became statistical by the very nature of the phenomena as well as by the unavoidably statistical nature of observations.

The study of heredity was founded by Galton and his followers on correlation analysis, but this basis was soon abandoned in favour of the Mendelian theory. Genetics became a continuously interacting combination of probabilistic models and of biometrical methods; the experimental techniques and the results—for example, estimation of gene frequencies, investigation and changes of breeding structures of populations, or of effects of radiations on body cells or on viruses—are part of biometry.

Although biometry is a young science, by the mid-20th century it was playing a basic role in life sciences and their applications, and giving rise constantly to new experimental and statistical problems and techniques. (ML. LE.)

BION (fl. *c.* 100 B.C.), one of the Greek bucolic poets, was born at Phlossa, near Smyrna, and is stated by the author of the *Lament for Bion* (wrongly attributed in some manuscripts to Moschus) to have lived in Sicily. Seventeen extracts from his *Bucolica* have been preserved, all but one by Stobaeus. They vary in length from a single line to 16 lines; some seem complete, but others may come from longer poems. The pastoral colouring is superficial, but Bion wrote simply and gracefully about love and sometimes about mortality. A very different poem, the *Lament for Adonis*, in 98 hexameters, was first attributed to Bion by the German scholar Camerarius (1500–74), chiefly on the ground that the *Lament for Bion* contains clear references to the earlier *Lament*. An Adonis-song forms the conclusion of Idyll xv of Theocritus, but the *Lament* attributed to Bion owes more to Callimachus' technique as shown in some of his *Hymns*. The treatment is emotional and in its way effective. A fragmentary *Epithalamius* for Achilles and Deidameia in a bucolic setting, which is sometimes attributed to Bion, is probably not by him.

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BIONICS, a hybrid science, offspring of biology and electronics, the primary aim of which is to investigate the sensory routes through which animals gather information and to incorporate this biological engineering in the design of synthetic systems. The study of living organisms as prototypes for man-made devices grew out of a need to resolve the physical and mechanical limitations of machines. Nature can show man how to simplify information system circuitry, how to miniaturize electronic components, how to eliminate static (nonrelevant information) from data-processing operations, and how to construct machines that may evaluate concepts.

Aspects being studied by bionicists include the extreme sensitivity of receptor organs (eye, ear, etc.), the retrieval capability of the central nervous system, the high order of integration of sensor and effector organs by even the simplest living brains, and the tremendous information storage potential of chromosomes. The study of decision-making circuits in many lower animals shows promise for solving many critical problems of the space age; *e.g.*, in weather satellites, computors, and guidance systems.

While the chief concern of bionics has been the mode of operation of the senses, interest has also arisen in other natural features of animals, such as the remarkably tenacious adhesive produced by the starfish, the artfully designed holdfast structures of birds, and the efficient multijointed limbs of arthropods. Analysis of these features may provide man with an array of new hardware.

The term bionics was coined in 1960 by J. E. Steele of the U.S. Air Force's Aerospace Medical Laboratories; he used it as the title of a symposium that brought together scientists of widely diverse interests (biologists, physicists, mathematicians, electrical engineers, etc.) to discuss the proposition that ideas gained from the analysis of biological systems could be applied to the design of artificial information processing systems. The imaginative roots of this new discipline can be traced to the nature-miming designs of Da Vinci; but the theoretical and philosophical bases took shape in the information theory concepts of the 1940s and in the cybernetics (*q.v.*) of Norbert Wiener (1948).

Computer and space technology stands to gain the most from bionics. The frog's eye is a natural computer of high precision. How the eye draws in the surrounding scene, screens out irrelevant background details, and transmits to the frog's rather simple brain only the germane—perhaps that a fly is in tongue range—may help man design a mechanism that will scan space and warn future astronauts to change course to avoid a field of meteorites. The bee and the beetle, experts in flight; the bat, an expert in radar; the dolphin in sonar; and the homing pigeon in navigation may all contribute clues that will enable man to further refine his data-gathering and processing machines.

See also INFORMATION THEORY; SERVOMECHANISM.

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BIONOMICS, the study of an organism in relation to its environment. *See* ZOOLOGY; ECOLOGY, ANIMAL; PLANTS AND PLANT SCIENCE: *Plant Ecology*.

BIOPHYSICS, in a broad sense, is the physics of living things; that is, it comprises all physical knowledge of the structure and activities of organisms or groups of organisms. In a narrower, more practical and commoner sense, the word is restricted to that scientific specialty which deals with those aspects of organisms that require, for their understanding and investigation, a specialist's competence in contemporary physics or physical chemistry. This is the sense in which the word will be used in this article.

Relations to Other Sciences.—Some persons regard biophysics as part of physics, others as part of biology. Choice of viewpoint is largely a matter of convenience. Clearly, biophysical research or teaching requires competence in both physics and

biology, as these broad fields are usually defined.

Biophysics, in its physical aspect, is primarily concerned with the organization and activities of living matter in relation to space, time and mass energy. Accordingly, it is complementary to biochemistry, which deals primarily with the atomic and molecular composition of organisms and especially with the changes in composition that occur in the course of the organism's activities. The two fields overlap and cannot be sharply separated, particularly in their concern with energy transformations, just as is the case with the physics and chemistry of inanimate objects. Their overlap and complementarity are particularly prominent in molecular biology, which is primarily concerned with the biological significance of polymeric macromolecules, notably the proteins and nucleic acids. (*See* also BIOCHEMISTRY: *Scope.*)

In its biological aspect, biophysics may contribute to scientific understanding of practically any structure or activity pertaining to any organism, part of an organism or group of organisms. It has made fundamental additions to botany, zoology, microbiology and virology; to morphology and physiology, in their broadest senses. The informational content of biophysics, as defined above, increases continually through research, as does that of any other scholarly specialty. However, it also decreases through research, because certain phenomena or certain methods, originally comprehensible only to a specialist in physics, may become so adequately elucidated that the information can be wholly or partly assimilated into the conventional subdivisions of biology that do not demand specialization in physics.

This is illustrated by the history of visible-light microscopy. The great pioneer microscopists of the 17th century had to engage in biophysics. Many of them built their own instruments, and all of them, in order to improve their microscopes and get maximum information from them, used a specialist's understanding of contemporary optics. In the 20th century, tens of thousands of persons use microscopes daily and routinely. They see with little effort much more detail than did the pioneers, but the overwhelming majority, because of the confidence they can place in the physical design and constructional adequacy of modern microscopes, give no thought to (and indeed have little or no knowledge of) the physics involved in the instrument or in the interpretation of what they see. The microscopy done by such persons is obviously not biophysics. On the other hand, there is always a comparative handful of persons who are continually pushing the microscopy of organisms to new levels of achievement, for instance in such fields as ultraviolet micrography and microspectrophotometry, polarization microscopy, phase-contrast and interference microscopy. Here the resources of contemporary physics are brought to bear not only on the improvement of instruments with respect to their use on biological objects, but also in the interpretation of the spatial and other physical properties that the instruments reveal or measure. Thus, although the total factual content of microscopy is enormously greater in the 20th than in the 17th century and the biophysical portion of this collection of facts has changed through the years, the biophysics of microscopy continues to consist of those aspects of biological microscopy that demand, for their understanding and investigation, a specialist's knowledge of the physics of the times.

Illustrative Contributions of Biophysics.—The ultimate goal of biology is a thorough understanding of all types of living things. Chemical analysis of organisms reveals that they contain the same kinds of atoms as are found in the inanimate universe, and that from these are derived a great many kinds of ions and molecules, some of which are encountered also in inanimate objects and some not. The properties and behaviour of these chemical species are the concern of physics and chemistry. It is the task of biophysics and biochemistry to determine how these building blocks are put together into successively larger and more complexly functioning aggregations until ultimately living cells and organisms are produced. In this stupendous undertaking, biochemistry and biophysics must complement each other. The variety and significance of biophysics' contribution toward an understanding of the ultimate structure and workings of living things can be indicated by citing a few examples.

Most cells have dimensions of the order of microns or tens of microns (abbr. μ; $1\ \mu = 1/10{,}000$ cm.), and the limit of resolution for the visible-light microscope is in tenths of a micron under the most favourable conditions. The ultimate building blocks of cells (atoms, inorganic ions and small molecules such as water, amino acids, fatty acids, sugars, pyrimidine and purine bases, etc.) have dimensions of the order of angstroms (abbr. Å; $1\ \text{Å} = 1/10{,}000\ \mu$). It is thus clear that techniques much more delicate than those of light microscopy must be used to reveal the detailed structure of living things. Of many such techniques, two will be briefly discussed: electron microscopy and X-ray diffraction.

The electron microscope is in principle analogous to the light microscope, except that the wave lengths of the electrons are so short that the limit of resolution is theoretically a small fraction of an angstrom, provided that a perfect machine could be built. In current practice a resolution of several angstroms is achieved under favourable conditions, and prospects for improvement are good. Thus, electron microscopy takes the investigator a long way from the dimensions of cells toward those of atoms. It has furnished, for instance, copious information about the sizes and shapes of many kinds of viruses, those replicating entities which, in functional capabilities, lie between inanimate things and undoubtedly living beings and which are measured in hundredths or tenths of a micron.

Perhaps even more important has been electron microscopy's contribution to our knowledge of the structure of cells of conventional size. Extremely thin sectioning (slicing) was introduced in the late 1940s. This procedure, along with other progressively improved techniques for preparing the cells for examination, has enabled electron microscopists to reveal organized cell parts previously undreamed of; *e.g.*, the ribosomes, which are now known to be functional in the synthesis of proteins. Other cell parts, large enough to be detectable with the light microscope but too small for that instrument to reveal their internal structures, are shown by the electron microscope to be meticulously organized systems. For instance, the mitochondria—which appear in the light microscope only as fine granules or threads—display a striking internal "bookcase" arrangement, the "shelves" of which provide a relatively extensive total surface. In many if not all mitochondria, there is attached to this surface a monolayer of mushroom-shaped particles that have dimensions of a few hundredths of a micron. These particles—and indeed the entire, beautifully organized mitochondrion—are specialized functional units that are involved in many of the subtle catalytic processes that biochemists have long known to be of primary importance in the cell's energy transformations. Although present-day electron microscopes can be used only on killed material, they make unique and continuing contributions to an understanding of living things. In the application of this class of instruments to progressively exacting tasks, biophysics in the most sophisticated sense must play a leading role.

X-ray diffraction is a powerful tool that reveals the spatial relations among atoms or groups of atoms when their arrangement is such that those of a certain sort repeat at definite intervals in definite directions. This technique has been extremely successful in elucidating the atomic configurations in inanimate crystals, including those of comparatively simple cell constituents, such as sugars and amino acids. Although its application to the more complex structural elements of cells yields much less elegant results, the information gained is usually unobtainable in any other way. In the 1920s the method first began to play a leading part in working out the spatial arrangements of the glucose (sugar) molecules that are chemically linked together to form the greatly elongated molecule of cellulose, which is the basic component of typical plant cell walls and therefore of wood. Applied to proteins, the method yielded astonishing results. Biochemistry built up a formidable store of information about the composition of these numerous, complex and characteristically "biological" substances, including the fact that all of them are composed of a class of molecular building blocks called amino acids, of which only about 20 kinds are found in nature. Chemical procedures yield, more or less routinely, the relative numbers of molecules of the different

amino acids that compose a given protein; and for several comparatively small protein molecules, such as insulin (a hormone) and ribonuclease (an enzyme), biochemistry has brilliantly determined the precise order in which hundreds of individual amino-acid molecules of the approximately 20 different kinds are linked together in a polypeptide chain to assemble the molecule of protein.

However, chemical procedures are not of a nature to yield information about the exact spatial configuration of the polypeptide chain. On the other hand, the physical approach, featuring X-ray diffraction data, has made stimulating contributions in certain favourable cases, for instance that of α keratin, a protein that is the main constituent of certain relatively stable biological structures, such as hair, nails and feathers. This work, started in the 1920s, advanced to the point that in the early 1960s it could be concluded with a high degree of probability that in α keratin the chain of amino-acid residues forms a helix that has about 3.6 residues per turn and a pitch of about 5.4 Å, the helical form being maintained largely by hydrogen bonds between adjacent turns of the spiral. Many protein species, notably enzymes, have properties which show that the molecule cannot be simply an extended polypeptide chain, helical or otherwise, but must be folded in a completely characteristic way so as to produce an approximately isodiametric body. During the 1950s and early 1960s this three-dimensional (tertiary) structure was thoroughly worked out for the relatively small molecule of myoglobin and, to an advanced degree, for the larger molecule of hemoglobin. These achievements represent a triumph for X-ray diffraction techniques. Moreover, diffraction data figured prominently in the formulation of the celebrated double-helix model for the molecule of deoxyribonucleic acid (DNA) in the early 1950s. X-ray diffraction studies, incidentally, furnish a good example of a research area that is likely to remain for a long time as sophisticated biophysics. One does not obtain directly, as for instance with the electron microscope, a fairly undistorted, highly magnified picture of the object studied. Instead one gets, on photographic film, patterns of spots, arcs, rings, etc., whose dimensions, intensities and relative positions must be subjected to highly mathematical interpretation in order that the actual structures may be deduced. Thus, a critical understanding of these matters is accessible only to those thoroughly trained in the pertinent physics.

Innumerable problems arise in attempts to understand how the nervous system correlates the functionings of the various parts of a many-celled organism, such as a man. Among the most basic of these problems is that of how a "message" is transmitted along a single nerve fibre, which is a long cylindrical protruding portion of a single cell (neuron) and usually has a diameter of a few microns. In rare instances, however, fortunately for the investigator, this dimension may be in hundreds of microns. Like all other cells, the unstimulated neuron maintains a potential difference (resting potential) across the cell membrane, the inside of the cell being negative with respect to the outside. About 1930, through an ingenious combination of electrical techniques with a functional isolation of single fibres by patient and skilful microdissection, it was clearly demonstrated that each "message" transmitted along a fibre is characterized by a series of electrical disturbances (impulses) that are propagated at uniform speed. At each point along the length of the fibre, each impulse is manifested by a transitory change in the magnitude, and even in the sign of the potential difference between the inside and the outside of the fibre. Each impulse passes a given point in a matter of milliseconds.

In any given fibre the change in potential difference is of the same magnitude for all impulses, regardless of the nature and magnitude of stimulus used to produce them. The frequency of the impulses within a series (volley) does, however, vary with the stimulus, so that information about the magnitude of the latter can be included in the message. These and similar basic biophysical facts revolutionized the concept of nerve function and laid the groundwork for a field of investigation so far-reaching that it is in itself a major scientific specialty devoted to answering such questions as: How, in terms of atoms, molecules and ions, does the stimulus initiate the impulse? How does the impulse propagate itself? What is the ultimate basis of the observed transitory change in potential difference from the resting value for an unstimulated fibre? Among numerous interesting partial answers was the demonstration, about 1950, that the impulse is intimately correlated with migration of potassium ions across the cell membrane, this movement being meticulously correlated with an opposite migration of sodium ions.

Progress.—The foregoing examples, although few, amply illustrate the fundamental nature and significance of the contributions that biophysics, by virtue of its characteristic methods and points of view, has made and is making to an understanding of organisms.

Biophysics demands an unusual versatility. Effective biophysical research on any aspect of an organism demands not only competence in contemporary physics but a broad grasp of general biological principles and a detailed mastery of the available information about the specific object under investigation.

Since such versatility is difficult to achieve, even at the doctoral level of formal education, unless the training of the student is planned and integrated from the baccalaureate stage or earlier, it is not surprising that biophysics has mostly been practised by persons whose initial professional training was not specifically directed to that purpose. There have been many instances in which a professional physicist and a professional biologist have formed a productive team. The chief drawback here is in communication. One or each must learn considerable about the other's basic field if the work is to be effectively planned and executed. There have also been numerous instances in which a professional physicist or biologist has achieved adequate versatility by intensive postdoctoral training in the field of his deficiency. The chief difficulty here is that this late training, usually informal and largely self-supervised, is likely to be relatively narrow. Nevertheless, the results are frequently surprisingly good.

Naturally the persons best qualified to advance biophysics are those specifically trained for it. Despite the versatility demanded, doctoral training can be achieved in a reasonable time if it is planned well and is started not later than the baccalaureate stage. Starting about 1930, both students and university authorities became increasingly aware of this fact and acted in such fashion that, by 1965, most major universities, especially in the U.S., had established either departments of biophysics or less formal academic groups to perform substantially the same functions.

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BIOPSY, a medical diagnostic procedure in which cells or tissues are removed from a patient and examined visually, usually with a microscope. The material for the biopsy may be obtained by several methods and with various instruments, including aspiration through a needle, swabbing with a sponge, scraping with a curette, trephining a bone, or excision with a forceps or electric snare. The biopsy is a standard step in the diagnosis of malignant and benign tumours. *See* CANCER: *Diagnosis;* TUMOUR: *Diagnosis of Tumours.*

BIOT, JEAN BAPTISTE (1774–1862), French physicist, best known for his work in polarization of light, was born in Paris on April 21, 1774. In 1800 he became professor of physics at the Collège de France, through the influence of Laplace, from whom he had sought and obtained the favour of reading the proof sheets of the *Mécanique céleste*. In 1804 he accompanied Gay-Lussac on the first balloon ascent undertaken for scientific purposes. In 1806 he was associated with D. F. J. Arago (*q.v.*), with whom he had already carried out investigations on the refractive properties of different gases, in the measurement of an arc of the meridian in Spain, and in subsequent years he was engaged in various other geodetic determinations. In 1820, with Felix Savart, he discovered the law known as "Biot and Savart's law" (*see* ELECTRICITY: *Magnetic Fields of Direct Currents*). He died in Paris on Feb. 3, 1862. He was especially interested in questions relating to the polarization of light.

BIOTITE is an important rock-forming mineral belonging to

the mica group. The name was given in honour of the French physicist J. B. Biot. Biotite, a hydrous silicate of potassium, magnesium, iron and aluminum, with small amounts of other elements, is a common constituent of many igneous and metamorphic rocks; it is stable over a large range of geological conditions. Sometimes called black mica, it is found in both deep and shallow intrusive rocks and persists in some lava flows. It may be abundant in dikes, veins and in pegmatites, where crystals may grow to exceptional size. One crystal 14 ft. in diameter and 33 ft. long has been found. Biotite appears in the lower grades of regional metamorphism of the clayey sediments, and in many of the contact metamorphic aureoles developed in sediments around igneous masses. Some varieties of biotite have been synthesized. The iron-free synthetic and natural varieties are useful in the electrical and electronics industries.

The biotites possess a perfect basal cleavage and two partings. The crystals are usually lamellar or six-sided prisms. The colour is usually black, brown, green or yellow, but some varieties are colourless. The biotites exhibit several polymorphic forms based on the stacking of the simple, layered, crystal structure. Common biotite usually has a one-layer monoclinic structure; however, several polymorphs may be found in the same hand specimen. The hardness ranges from 2.5 to 3, the specific gravity from 2.8 to 3.4, and the indices of refraction from 1.535 to 1.690. Birefringence (or double refraction) and pleochroism (or the appearance of different colours under polarized light) are strong. Inclusions are common and may give rise to the appearance of starlike rays. The biotites are decomposed by sulfuric acid, leaving a silica residue. They alter readily to chlorite; other products may include potash feldspar, rutile, magnetite, quartz and hematite. Weathering reduces biotite to vermiculite, or to a clay, quartz and hematite. Biotite is complex in composition and may be expressed by the general formula $XY_{2-3}Z_4O_{10}(OH, F)_2$, where X is K, Na and small amounts of Rb, Cs and Ba; Y is mainly Mg and Fe^{2+}, with Al and Fe^{3+} and small portions of Mn and Ti; and Z is Si and Al, usually in the ratio of 3:1 but extending to about 2:1 in some varieties.

For further discussion of crystal structure, polymorphism, composition and mineralogical properties *see* MICA. *See* also GEOCHEMISTRY: *Geochemistry of the Lithosphere;* MUSCOVITE; PHLOGOPITE. (H. S. Y.)

BIQUADRATIC, an adjective used in mathematics to refer to the fourth power of a quantity; that is, to the square of a square. It is used in connection with equations or algebraic functions. The equation $ax^4 + bx^3 + cx^2 + dx + e = 0$ is a biquadratic equation, since the highest power of the unknown quantity (x) is the fourth; that is, x^4 is the square of x^2, or the square of the square of x (the *bi,* "two" + *quadratus,* "square"). The general biquadratic equation was first solved by Lodovico Ferrari (1522–1565) and was published by Geronima Cardano in his *Ars Magna* (1545). *See* EQUATIONS, THEORY OF: *Formulas for Solving Equations of Low Degree;* FERRARI, LODOVICO.

BIRBHUM, the northernmost district of the Burdwan division of West Bengal, India. Pop. (1961) 1,446,158. Area 1,757 sq.mi. The western half of the district is an undulating upland rising to 3,000 ft., its surface being diversified by hot springs and hills of granite and basalt, while the eastern half is a flat, densely populated alluvial plain. The Ajay, Mayurakshi, Bakreswar and Dwaraka are the principal rivers. The Mayurakshi project provides water for irrigating about 600,000 ac. of arable land, and 2,000 kw. of power throughout the year for electrifying towns and countryside. Rice is the main crop. There are stone quarries at Dubrajpur and Nalhati. Silk and shellac are the principal industries. Suri (pop. 22,841), the district headquarters, has a beautiful carved brick temple. Rampur Hat (pop. 19,897) is a market town and contains a college and a hospital. Bolpur (pop. 23,355) is the chief rice-exporting town, and the nearest railway station for Santiniketan, the seat of Visva-Bharati university, founded by Rabindranath Tagore (*q.v.*). Dubrajpur and Sainthia are small market centres. (S. P. C.)

BIRCH, THOMAS (1705–1766), English historian and biographer, whose numerous works are valuable source-books for 17th-century history, was born at Clerkenwell on Nov. 23, 1705. A priest in the Church of England, he held a succession of country benefices, and from 1744 until his death was rector of St. Margaret Pattens, London. In 1735 he was elected fellow of the Society of Antiquaries and of the Royal society. From 1752 to 1765 he was secretary to the Royal society, of which he wrote the *History* (1756–57). He was killed by a fall from his horse in London on Jan. 9, 1766. He left his books and manuscripts to the British museum.

Birch's output was enormous. He invariably consulted original sources, and although he was derided for his pedestrian style by such contemporaries as Samuel Johnson and Horace Walpole, the value of his work is increasingly recognized. His *Collection of the State Papers of John Thurloe* (1742) is the chief source for the political history of the Protectorate. He contributed 618 lives to *A General Dictionary* (1734–41), of which he was the main editor.

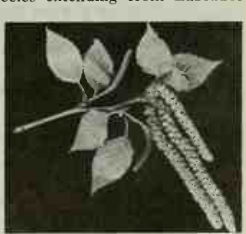
See A. Kippis, *Biographia Britannica* (1778–93); J. M. Osborn in *Modern Philology,* vol. xxxvi (1938).

BIRCH, the name applied to about 40 species of trees and shrubs belonging to the genus *Betula* of the Betulaceae. Widely scattered through the cooler regions of the northern hemisphere, the birches are readily distinguishable from their forest associates. Their alternately disposed, simple, deciduous, ovate, oblong or triangular leaves feature toothed margins, while their inconspicuous unisexual flowers, borne in unisexual catkins (monoecious), appear before leaf emergence in the spring. The fruit is a multiple of tiny, one-seeded, winged nutlets borne in conelike clusters that disintegrate at maturity. A wintergreenlike aroma emanates from the bruised twigs of several species. The bark, especially on most young trees, peels off horizontally into thin sheets of varying hues and texture.

There are at least eight birches indigenous to North American forests, three of which are timber trees of primary importance. The foremost, the yellow birch (*B. lutea*), with yellow-bronze bark, is a tree 60 to 80 ft. tall and 24 to 36 in. in diameter (maximum 100 ft. by 48 in.). Ranging from Newfoundland to western Minnesota and over the Appalachian highlands to northern Georgia, it contributes about 75% of the American harvest of birch timber, the bulk of which is produced in New York, the Great Lakes states and southern Canada.

The hard, strong, reddish-brown wood is manufactured into furniture, flooring, millwork and plywood. In finishing, it is often stained to simulate either walnut or mahogany. The wing, fuselage and *empennage* skins of the renowned British Mosquito bombers used in World War II were molded with yellow birch plywood. Sweet birch (*B. lenta*), also called cherry birch in allusion to its cherrylike bark, attains neither the stature nor the broad distribution of yellow birch. Lumber production of this species is centred in Pennsylvania and West Virginia. The woods of both species are similar and are used for essentially the same purposes. Commercial birch oil, marketed as oil of wintergreen and now made synthetically, was originally derived from the bark and twigs of sweet birch.

Paper birch (*B. papyrifera*), including its western varieties, is a widespread transcontinental species extending from Labrador to 70° N. in Alaska and south to New England, New York, Nebraska and Washington. Rarely exceeding a height of 60 ft. or a diameter of 20 in., the tree is easily distinguished by its creamy-white bark, once universally used by northern American Indians as a skin for their canoes. The wood of paper birch is white, moderately hard, and is largely consumed in production of spools, shoe findings, dowel rods, toothpicks, swab sticks and tongue depressors. River birch (*B. nigra*), the only birch in southern United



BY COURTESY OF U.S. DEPARTMENT OF AGRICULTURE

PAPER BIRCH (BETULA PAPYRIFERA) LEAVES AND (LEFT) FEMALE AND (RIGHT) MALE CATKINS

States at low elevations, and gray birch (*B. populifolia*), of the northeast, are trees of secondary commercial importance.

White birch (*B. pendula*) is indigenous to the greater part of Europe and abounds in Asia Minor and Siberia. Comparatively short lived and seldom exceeding a height of 50 ft. or a diameter of 12 in., it flourishes on light soils and is one of the few trees that will grow with heather. It is one of the most useful trees in the U.S.S.R., where the wood is employed for many purposes. The water-impervious bark is fashioned into several kinds of liquid and food containers and is the principal roofing material in many villages. The bark is used in general tanning, and an empyreumatic oil extractive, also from the bark, is employed in making Russian leather. Several horticultural varieties of white birch are prized ornamentals. Included among them are var. *purpurea*, with purple leaves; var. *dalecarlica*, with deeply lobed leaves; var. *tristis*, with slender pendulous branchlets; var. *fastigiata*, with closely appressed, ascending branches forming a narrow columnar crown; and var. *gracilis*, with pendulous branchlets and finely dissected leaves.

Two Japanese birches, *B. maximowicziana* and *B. grossa*, are productive of timbers the equal of the yellow and sweet birches; both are important to the Japanese plywood industry. *B. alnoides* is the common birch of northern India.

A few unrelated species bearing superficial resemblances to *Betula* are also known locally as birch. Among these are the West Indies birch (*Bursera simaruba*); the bog birch (*Rhamnus caroliniana*), a small tree in southeastern United States; and four Australian species, known respectively as cherry birch (*Schizomeria ovata*), ivory birch (*Baloghia lucida*), golden birch (*Endiandra compressa*) and streaked birch (*Strychnos arborea*).

(E. S. Hr.)

BIRD, the name for any animal of the class Aves, which comprises 10,000 to 12,000 living species. Birds are most easily distinguished from their nearest relatives, the reptiles, and their more distant relatives, the mammals, by being clothed in feathers, without exception.

A more elaborate definition is as follows: A bird is a warm-blooded vertebrate animal with a four-chambered heart (shared with all mammals); with forelimbs modified into wings (shared with some mammals; *i.e.*, bats); with a body covered with feathers (unique); with reproduction by calcareous-shelled eggs; and with keen vision—the major sense relied upon by the bird for information about its environment.

The historical development of the study of birds is traced in the article Ornithology; the present article, dealing with the animal itself, is divided into the following sections:

I. Birds and Man
  A. Birds in Literature and Legend
    1. Early Interest
    2. Contemporary Interest
  B. Uses of Birds
    1. Food
    2. Domesticated Birds
    3. Feathers in Clothing and Ornamentation
    4. Pets and Ornamentals
    5. Sport
    6. Guano Fertilizer
    7. Messengers
    8. Values, Pro and Con
II. Natural History and Habits
  A. Locomotion
    1. Flight
    2. Flightlessness
    3. Walking, Hopping and Swimming
  B. Preening and Resting
    1. Bathing with Water, Dust, etc.
    2. Resting, Sleeping and Hibernating
  C. Food and Feeding
    1. Food getting
    2. Ways of Feeding
    3. Water and Salt Requirements
  D. Enemies and Diseases
    1. Predators
    2. Parasites
III. Form and Function
  A. External Features
    1. Topology of the Body
    2. Skin and Feathers
    3. Coloration
  B. Internal Systems
    1. Circulatory System
    2. Respiratory System
    3. Digestive and Excretory Systems
    4. Reproductive and Endocrine Systems
  C. Senses
    1. Sight
    2. Hearing
    3. Other Senses
IV. Breeding
  A. Reproduction
    1. Breeding Seasons
    2. Territory and Pairing
    3. Display and Song
    4. Nests and Nest Building
    5. Eggs and Egg Laying
    6. Incubation
  B. The Young
    1. Hatching and Development
    2. Parental Care
    3. Leaving the Nest
    4. Social Parasites (Cuckoos, etc.)
V. Behaviour
    1. Instinct and Learning
    2. Play, Flocking, Dominance, etc.
    3. Migration
    4. Summary
VI. Types of Living Birds
    1. Land Forms
    2. Water Forms
    3. Night Flyers
VII. Geographic Distribution
VIII. Vital Statistics
    1. Populations and Numbers
    2. Ages and Sex Ratios
    3. Extinction
IX. Origin and Evolution
    1. Bird Ancestry
    2. Fossil Birds
X. Classification

I. BIRDS AND MAN

Since earliest times birds have helped to satisfy man's material needs and to provide him with recreation. They have also been sources of inspiration and have been used as symbols. This close association between man and birds can be traced back through recorded history and its earlier existence can be inferred from the activities and beliefs of present-day primitive peoples.

A. Birds in Literature and Legend

1. Early Interest.—Birds as objects of general interest have always been woven into the writings and art of man. There are a few bird figures on the walls of the Lascaux cave (France), relics of the work of Old Stone Age man. Long before ornithology emerged as such, man's interest in birds and his knowledge of them found expression in the general conversation and stories of the people which crystallized into the records of their general culture. Bird figures are found in ancient Egyptian hieroglyphs and paintings. The Bible also is rich in references to birds, including Noah's use of the raven and then the dove to bring him information about the state of the flood. Aesop's fables abound in bird characters. The *Physiologus* and its descendants, the bestiaries of the middle ages, although considered serious natural history by some, read more like moralistic writings using birds as symbols for conveying ideas; they indicate little knowledge of birds themselves.

Supernatural beliefs in regard to birds probably took hold on the mind of primitive man as early as did recognition of the fact that birds are good to eat. The Australian aborigine still drives a black and white flycatcher from his camp lest it overhear his conversations and carry tales to his enemies; peoples of the Pacific islands use figures of frigate birds in their carvings, as the Pacific coast Indians use the raven and the Indians of Central America worshiped the quetzal.

2. Contemporary Interest.—With increasing leisure and education in the 20th century, more people have become interested in their environment. As birds are one of the most attractive features of animate nature, a tremendous amount of writing and reading about birds is done each year, and many people watch birds, band birds and study birds as a hobby.

It is not possible to separate all that is written about birds into scientific writings and popular writings. Ornithology more than any other science, except anthropology, has had the help of the nonspecialist. Important data on birds are contained in many papers written for the general reader, and many specialists have imparted literary style to their writings. It is in this great middle ground that students of birds have been successful in putting the knowledge of their science before the general public. James Fisher estimated that more than 100,000 persons in Great Britain and 250,000 in North America own at least one bird book, and in Great Britain one bird book is published each week. The leading American bird journal, the *Auk*, has a circulation of about 3,000, and the *Audubon Magazine*, originally a bird journal, but now one that embraces all popular natural history, reaches 30,000. *See* also Bird Watching; Migration, Bird: *Bird Banding*.

B. Uses of Birds

1. Food.—Many birds have tasty flesh and palatable eggs, which probably were eaten by most primitive people when opportunity offered. But it was only where birds were especially plentiful, as at nesting colonies of sea birds, or where there were species of considerable size, such as the rhea of South America and the emu of Australia, that they were important as food. Birds are economically important today in some parts of the world. In Greenland, the Eskimos take quantities of eider ducks and dovekies in the summer and store them for the winter, when they are an important part of the food supply. The Faeroe islanders annually take one-half million puffins in addition to other birds and eggs for food, salting the birds in brine and preserving the eggs in water glass, and the islanders of Tristan da Cunha make annual trips to bird colonies for supplies of the meat, fat and eggs of penguins and petrels.

In the orient certain swifts that nest in great numbers in caves use in making their nests a salivary gland secretion that hardens into a solid. A soup made from these nests is prized and the packaged nests are even available in markets in occidental cities (*see* Bird's Nest, Edible). On the islands off southern Australia an industry in muttonbirds, or shearwaters, has been carried on for over a century. In a good season about 750,000 young birds are captured, and their carcasses are either salted in barrels or canned (squab in aspic) for the commercial trade.

In Europe, where wild birds are not really essential as food, many small songbirds are killed and eaten each year. In North America an abundance of ducks, geese, shore birds and passenger pigeons was exploited relentlessly by hunters shooting for the market until the early part of the 20th century, when such practices were outlawed (*see* Wildlife Conservation). In most places, domesticated birds, or poultry, rather than wild birds, make the chief bird contribution to man's diet, either as flesh or as eggs.

2. Domesticated Birds.—There are four major domesticated birds, or poultry: domestic fowl (chickens), ducks, geese and turkeys.

Chicken.—The chicken provides the greatest contribution to man's larder, and its eggs are probably more important than its flesh. Although many different-looking breeds have been developed under domestication, all are descended from the red jungle fowl, *Gallus gallus*, one of the four species of jungle fowl, in southern Asia. Domestication probably took place in India or Siam before 2500 B.C., and the birds were brought to central Europe by about 1500 B.C.. Chickens are raised in most parts of the civilized world and also by many primitive peoples in Africa, South America and the Pacific islands.

Duck.—Most domestic ducks—even such widely different breeds as the Indian Runner and the Pekin—are descendants of the common mallard of northern Europe. Although it has been suggested that ducks were domesticated even before chickens, they have never become so important as a source of food. The muscovy duck of tropical America also has been domesticated and has been carried by man to many parts of the world. Except for white or piebald varieties the muscovy duck has changed little in appearance from its wild progenitor.

Goose.—The graylag goose of Europe and Asia was the ancestor of all the common geese of the barnyard except for those called Chinese or African, including the white breed with a knob on its bill; the latter's ancestor was the swan goose of China. Geese, it is suggested, were the first domesticated poultry.

Turkey.—This American contribution to the poultry yard was domesticated in Mexico before the coming of the white man. The Spaniards carried it to Europe, from where it was introduced into the United States.

Others.—A few other birds have been domesticated on a lesser scale, among them the pigeons, descendants of the rock dove of Europe, with many much modified varieties; and the guinea fowl, little modified from its African ancestor. Ostriches have been raised on ostrich farms for their plumage. Peacocks and other ornamental pheasants, swans and waterfowl are better classed as ornamentals (*see* below).

3. Feathers in Clothing and Ornamentation.—Although the feather coat of a bird may be warm, the skin is usually fragile, so the use of bird skins for clothing has never assumed much importance. Eskimos, however, do make warm undergarments of some duck and auk skins.

The down of the eider ducks of the North Atlantic provides a light, resilient, warm material for the padding of quilts, sleeping bags and outdoor jackets. Eider down, gathered from the nest of the duck, is the down the female has plucked from her breast and put into the nest to form a blanket for her eggs. The harvesting of these feathers has been put on a continual-yield basis in such countries as Iceland through legislation regulating the amount harvested each year. The feather cloaks worn by people in the more temperate regions, such as the cloaks of feathers of some of the original Hawaiian islanders, were apparently emblems of rank rather than useful articles of wear.

Parts of the whole bird are worn by primitive man in many regions of the world: a necklace of parrot feathers by a South American Indian; a war bonnet of eagle plumes by a North American Indian; a hat decorated with bird feathers by an African tribesman; a hornbill or cassowary head ornament or an elaborate bird of paradise dance ornament by a New Guinea native. In some cases these bird parts may be simple ornaments, comparable to the hibiscus flower worn behind a Papuan's ear; in others they may be fancy dress; and in still others an indication of rank or achievement by the wearer.

4. Pets and Ornamentals.—The cage bird, used like the potted plant in enlivening a dwelling, has been much more popular in Europe and Asia than in North America, and many species of birds of bright colour, cheerful voice or engaging habits have been caged. The most widely popular songbird is the canary, a yellowish descendant of the wild, more sparrowlike bird of the Canary Islands, and many varieties of it have been developed. Parrots are often kept in captivity, either in cages or, as with some of the larger species, chained to a perch, indoors or out. The three most commonly tamed parrots are the African gray; the green and yellow Amazons of various species; and the small budgereegah (budgerigar) of Australia, all of which add to their other interesting habits by having the capacity, in varying degrees, of imitating human speech. In the orient various starlings called mynas are popular cage birds, and these, especially the wattled myna, which may speak a few words, have some vogue in the western world.

Swans, living on ponds in city parks, are the best known of the ornamental birds, but many other species of waterfowl—especially the males with the brightest colours—also are used, and colourful pheasants such as the golden and the Lady Amherst are kept to add interest to estate grounds. The peacock, a semidomesticated bird, is probably the best known of the pheasant group. In more tropical climates flocks of flamingos are sometimes kept to ornament race tracks, and macaws and cockatoos are perched on balconies or in gardens for decoration.

Birds as decorations have been popular in modern societies, too, especially as adornments for women's hats. This use reached its peak about the beginning of the 20th century, and plumes and whole birds of many species from all parts of the world appeared in the millinery trade. This fashion was responsible for a worldwide trade in feathers and bird skins, a traffic that subsequently

dwindled almost to nothing. Although feathers are still used in women's hats, they are more likely to be the feathers of domesticated birds, chicken, pheasant, guinea fowl and turkey, rather than those of wild birds.

5. Sport.—Before the days of firearms, hawks, falcons and eagles were used in capturing other birds and smaller mammals. The hawks were tamed rather than domesticated: when the prey was sighted, the hawk was loosed; it followed and struck down the prey and stayed with it until the huntsman came up. Falconry was very popular in Europe in the middle ages, and an elaborate social code and special vocabulary grew up about it. The sport continues to be popular in Arabia and India, where it has flourished for centuries, and it has experienced a modern revival in the United States and Europe (*see* FALCONRY). Netting of waterfowl was carried on in ancient Egypt, as shown by pictures decorating the tombs, and in a different form has been carried on in present-day Japan.

With the advent of shotguns, the hunting of birds for sport changed in the western world, where people could afford firearms and ammunition. Hunting with a shotgun was abused for a time in North America and degraded into market shooting and in competitions to kill as many birds as possible. But by the mid-1900s the size of a sportsman's bag ceased to be regarded as the mark of his skill. Small bags and a short open season are the rule and are compatible with the continued existence of waterfowl. Nonmigratory game birds such as quail and grouse present other problems of management which state and federal governments attempt to solve by restocking and by providing controlled public shooting grounds (*see* WILDLIFE CONSERVATION). Locally, commercial preserves are stocked with birds that are available to the public at a fee. Trapshooting and skeet shooting, in which clay disks called clay pigeons are thrown into the air as targets, have nearly but not completely replaced an earlier practice of releasing live pigeons as targets.

Just as literature and science grade imperceptibly into each other in some writings on bird watching, so do sport and science in some bird listings. In 1955 a national magazine in the United States, reporting on the annual co-operative Christmas day bird census in North America, classified the account under "sport." This census, instituted in 1900 by the American naturalist Frank M. Chapman as a substitute for the then popular Christmas day shoot, provides a record of bird abundance over a 50-year period, which is of considerable scientific importance.

6. Guano Fertilizer.—Great bird rookeries, or colonies, found in some dry regions bordering the sea, become incrusted with piles of excreta of birds. This dried excrement, called guano, provides a fertilizer rich in phosphates and nitrogen. The deposits are exploited commercially in Australia, Republic of South Africa and, most important, by Peru. The birds that build up the deposits vary with the locality, but various species of cormorant and booby (gannet in England) are usually most important. (*See* GUANO.)

7. Messengers.—Before the days of radio and telephone, birds were of some importance in transporting messages quickly. Some South sea islanders used frigate birds as messengers. Patrons of sporting events in early Rome took swallows from their nests to the arena, attached coloured threads to them and then released them to fly home and announce the winners of various events. The pigeon, however, was the chief bird messenger of the western world, being used in wartime as early as the beginning of the Christian era, according to Pliny, and commonly for a long time afterward. The outcome of the battle of Waterloo, in 1815, was brought to the Rothschilds by pigeon messenger. Pigeons are no longer commonly so used, but they continue to have some value as quick, secret conveyors of messages; they were used extensively by the German, British and American forces in World Wars I and II, and by the United States in the Korean conflict. In the latter action, pigeons were used by seven groups of agents parachuted behind enemy lines, and during a four-month period not a single message was lost.

8. Values, Pro and Con.—The influence of birds in maintaining the balance of nature is hard to weigh. They eat both harmful and beneficial insects, and seeds and fruits. To try to assess the value of any single element in the whole web of life is impracticable. It may be demonstrated perhaps that a certain flower is pollinated by a certain nectar feeding bird, and that the numbers of one type of insect are checked by the predation of certain birds; these situations, however, are not viewed from the vantage point of evolution —they may or may not be significant in the long run.

With man's cultivated crops and domesticated animals, the case is different. When a hawk takes a chicken, or a heron or a kingfisher takes to living on the fry in a fish hatchery, or a flock of birds descends on a field of grain, the damage is immediately apparent to the man involved and steps are usually taken locally to prevent such loss. Notable cases of this include the invasion of emus into the wheat fields of western Australia and the appearance of great swarms of queleas (weaverbirds) in the grain fields of Africa. But some outcries against birds, such as those against the fish-eating cormorants thought to be harming the commercial fisheries in such widely separated localities as Canada and Australia, prove to be unfounded upon investigation.

II. NATURAL HISTORY AND HABITS

A. Locomotion

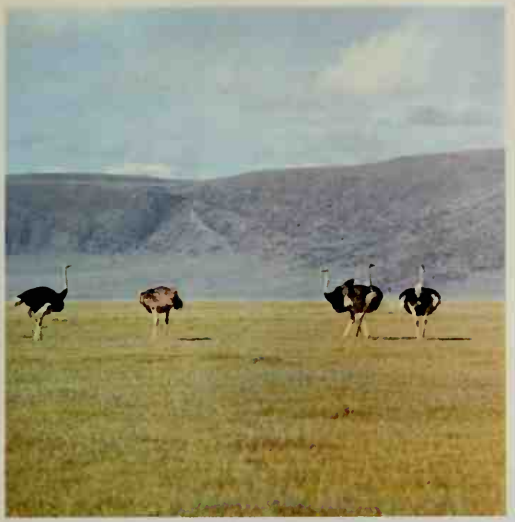
Because of their body structure and their feathery body covering, birds are the best fliers among animals, better than the insects and the flying mammals, the bats. There are, however, considerable differences in flying ability among various birds. Penguins cannot fly, but spend much of their time in the water swimming with their paddlelike wings; such birds as ostriches and kiwis have rudimentary wings and are permanently afoot. At the other extreme are the long-winged swifts and frigate birds that move from their perches only to fly, never to walk. Most birds alternate some walking or swimming with their flying.

Birds usually fly when they have any considerable distance to travel; there are exceptions, however. The mountain quail of California make their annual migrations up and down the mountains by foot. The murres, or guillemots, of the Greenland coast migrate southward by swimming; they begin their journey before the young have grown their flight feathers and before some of the adults at least have regrown their recently molted ones. The Adélie penguins may ride northward on drifting ice floes; at the approach of nesting time they swim back to the antarctic continent and then walk over the ice to their breeding grounds many miles inland.

1. Flight.—Birds fly by flapping their wings, steering mainly with their tails. A goshawk, pursuing its prey through the forest, uses its long tail in making quick turns, and the barn swallow uses its deeply forked tail in making the involved patterns of its graceful flight. Ducks with their short tails have a swift but direct flight. There is, however, such great diversity in birds' tails that the precise size and shape probably is not of critical importance.

Comparing a bird to an airplane, a bird's wing is both wing and propeller. The basal part of the wing supplies most of the supporting surface, the wing tip most of the propelling force. A bird's wing has many adjustable features: it can be shortened or lengthened by flection; the feathers of the tip can be spread or closed; the angle of the whole wing or its parts, on one side or the other or on both sides, can be altered. All these adjustments make the aerodynamics of a bird's wing much more complicated than those of the airplane; consequently, the flight of a bird is much more varied and adaptable.

Flying ability varies widely among birds, and different types of wings correlate with different types of flight. Many songbirds use their short, rounded wings mostly to move with quick wing beats from perch to perch or from ground to perch. Ducks have pointed wings that, beaten at high speed, provide rapid flight for long distances. Swallows, terns and frigate birds have long, pointed wings that enable these birds to fly and maneuver gracefully for hours with leisurely wing beats. Large herons with long, broad wings travel far with slow, measured wing beats, while buzzards soar high in the sky on their long, broad wings. Gulls and albatrosses with long, narrow wings sail along the beaches or over the waves with infrequent wing strokes. A hummingbird can whir



Ostrich, a two-toed African bird, largest living bird, may attain a height of eight feet and a weight of 300 lb. Order Struthioniformes

Kiwi, of New Zealand, with rudimentary wings, stout legs, and nostrils at the tip of its bill. Order Apterygiformes

LARGE FLIGHTLESS BIRDS

In spite of the wide variety of forms among the more than 10,000 species of birds, the class Aves is bound together by a feature unique among animals: feathers. In many species the feathers constitute a plumage of bright colour and striking pattern; in most, they serve to enhance the power of flight, while in others, grounded, they provide scarcely more than a protective mantle. Flightlessness is a characteristic of some of the more primitive orders of birds, such as those shown on this page. These birds, called ratites, lack the keeled breastbone of the fliers; unlike most fliers, they are strong runners and grow to great size

Emu, of Australia, second only to the ostrich in size, sometimes reaches a height of five feet and a weight of 120 lb. Order Casuariiformes

Rhea, sometimes called the South American ostrich, is smaller than the ostrich and has three toes. Order Rheiformes

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BIRD

Emperor penguins, flightless birds that may reach a height of four feet, live in large colonies in the far Southern Hemisphere

The smaller Magellan penguins, found in Chile, Tierra del Fuego, and the Falkland Islands, swim in the Strait of Magellan

TINAMOU; AQUATIC BIRDS

Some of the more primitive orders of birds comprise a single family. The order Sphenisciformes comprises the family of penguins. The ordinal name, which means "small wedge," refers to a characteristic common to all: narrow, flipperlike wings, useless for flight but well suited for swimming. The Tinamiformes contains the family of tinamous, which superficially resemble partridges but are related to the ratites. The Gaviiformes comprises the loon family and the Podicipediformes the grebe family

Horned grebe, a lobe-footed marsh bird, has a distinctive crest of reddish-brown feathers. The grebe's toes form propellerlike blades used in swimming and diving

Common loon in breeding plumage. Barely capable of walking, loons nest near water. They are keen divers; submerged or afloat, they are strong swimmers, with powerful legs set far back on their bodies

Tinamou, a primitive, three-toed, ground-dwelling bird of the New World, is protectively coloured. It can fly swiftly for short distances

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White pelican, a large, gregarious water bird that breeds on inland lakes and sometimes winters on seacoasts

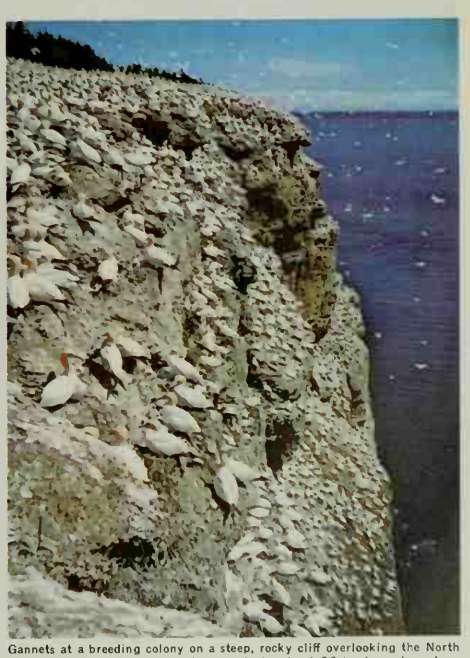
Red-footed booby, a seabird that nests on low marshland bushes, is shown here defending its nestlings. It has a powerful beak and feeds by diving into the sea for fish

PROCELLARIIFORMES AND PELECANIFORMES

The order Procellariiformes includes, among others, the albatrosses, shearwaters, and diving birds. Birds of this order differ sharply in appearance but all have nostrils that extend onto the bill in short tubes. The pelicans, order Pelecaniformes, have four toes connected by webs, a characteristic that distinguishes them from other orders. They are particularly noted for their distinctive throat pouches

Laysan albatrosses, masters of soaring flight, can glide on ocean air currents for hours without beating their wings; on land they waddle about awkwardly

Frigate bird, sometimes called man-o'-war bird, with its orange air sac distended in courtship display. A large seabird with wingspan attaining seven and one-half feet, the frigate bird breeds on islands and seldom flies out of sight of land



Gannets at a breeding colony on a steep, rocky cliff overlooking the North Atlantic Ocean. Adult gannets grow to be about 36 in. long, have long and narrow, tapering wings with a spread of about 6 ft.

PHOTOGRAPHS, (TOP LEFT) HELEN CRUICKSHANK FROM NATIONAL AUDUBON SOCIETY, (TOP RIGHT) ROBERT GOODMAN FROM BLACK STAR, (CENTRE LEFT) KARL W. KENYON FROM NATIONAL AUDUBON SOCIETY, (BOTTOM LEFT) PHILIPPA SCOTT—PHOTO RESEARCHERS, INC., (BOTTOM RIGHT) DAVID O. HILL—PHOTO RESEARCHERS, INC.

BIRD

Painted storks, of southern Asia, nesting in a tree

Flamingos, which live in large groups, are among the most specialized of all wading birds, obtaining food by scooping mud into their bills and straining the inedible portion out again through their fringed lips

Scarlet ibis, of South America, is one of the few ibises with brightly coloured plumage

Least bittern. At a distance the bird blends into the tall marsh grass and reeds in which it lives

WADERS: CICONIIFORMES

This order includes the heron, ibis, stork, and flamingo, long-legged wading birds that feed on fish and other aquatic life

Boat-billed heron, a stocky wading bird that ranges from Mexico to Brazil, is named for its broad, keel-shaped bill

PHOTOGRAPHS, (TOP LEFT) CHRISTINA LOPE—PHOTO RESEARCHERS, INC., (TOP RIGHT) RON ABSTING—PHOTO RESEARCHERS, INC., (CENTRE LEFT) ROGER TORY PETERSON—PHOTO RESEARCHERS, INC., (OTHERS) E. A. BAUMBACH

Pair of North American wood ducks, the male of which is one of the most strikingly coloured waterfowls

A swan brooding its young, which, though able to swim and feed themselves soon after they are hatched, stay with adults for several months

As its name implies, the horned screamer is noted for its slender, threadlike frontal horn and its loud, shrill call. It inhabits the swamps of tropical South America

WATERFOWL; BIRDS OF PREY

The waterfowl of the world, such as ducks, geese, and swans, are grouped with South American screamer in the order Anseriformes. Dissimilar in appearance, the two groups of birds nonetheless are closely related. The birds of prey, Falconiformes, are commonly recognized by the hooked bill and long-clawed powerful feet

Prairie falcon, a diurnal bird of prey that feeds primarily on rodents, inhabits the dry, open country of the western United States

The raptorial secretary bird feeds on snakes and rodents that it batters to death on the ground. The name derives from the quills on the back of the bird's head

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BIRD

Crowned crane, with its distinctive crest, is a 35-in.-long African marsh bird

Common peacock, displaying its tail coverts, is native to India and Ceylon but has been widely introduced as an ornamental bird

Great bustard may exceed three and one-half feet in length and 30 lb. in weight. In recent years these birds have become rarer in their Eurasian range because of hunting and the encroachment of mechanized farming

GALLIFORMES AND GRUIFORMES

Galliformes are fowllike birds with strong feet used for scratching. Included in the order are domestic poultry, pheasant, grouse, and guinea fowl. The Gruiformes are the cranes and their relatives, a diverse order whose members inhabit swamps and marshes

Ruffed grouse in courtship display "drums" with its wings

Golden pheasant of eastern Asian highlands is chiefly terrestrial, but takes short, rapid flights when alarmed

PHOTOGRAPHS: (TOP LEFT) R. C. HERMES—PHOTO RESEARCHERS, INC. (TOP RIGHT) RUHE-ROTH FROM NATIONAL AUDUBON SOCIETY. (CENTRE LEFT) WOLFGANG GEWALT. (BOTTOM LEFT) DAVID [illegible] (BOTTOM RIGHT) ROSS KINNE—PHOTO RESEARCHERS, INC.

Heermann's gulls are found from Vancouver Island to Mexico. Their usual length is about 20 in.

Avocets, long-legged waders, are 18 in. long. The avocet's bill has an upward curve, and the bird feeds by sweeping its bill back and forth in shallow water in quest of marine life

SHOREBIRDS AND PIGEONS

Charadriiformes, shorebirds, gulls, and auks, are found practically everywhere. Most are inhabitants of coastal waters, beaches, and marshes, but some stay well inland. The Columbiformes, pigeons and allies, are land birds. They are the only birds able to suck up and swallow water without raising their heads

Common murre resembles a penguin but differs in two respects: the murre can fly and it lives in northern seas. It is the size of a small duck

White-faced quail dove, of Mexico, feeding its squab with a curdy, milk-like fluid prepared in the parent's crop

The Queen Victoria crowned pigeon, a native of New Guinea, is noted for its intricate lacelike headdress

PHOTOGRAPHS, (TOP) ROGER TORY PETERSON—PHOTO RESEARCHERS, INC., (CENTRE LEFT) PAT BAILEY WITHERSPOON FROM NATIONAL AUDUBON SOCIETY, (CENTRE RIGHT) FRED BALDWIN—PHOTO RESEARCHERS, INC., (BOTTOM LEFT) WALTER DAWN, (BOTTOM RIGHT) WOLFGANG LUMMER

BIRD

Leadbeater's cockatoos, 15-in.-long Australian birds, have a crest of long, pointed feathers, which they can raise and lower at will

Senegal parrot

Derbyan parakeet

PARROTS AND ALLIES

The birds in parrot order, Psittaciformes, vary in shape from the plump African lovebirds to the slender lories of Malaya. All have zygodactyl feet: two toes directed forward, two directed backward; thus a "hand" for gripping. The range in plumage colour is wide. Their natural habitat is the tropics

Aymara parakeets

Blue-and-yellow macaw is native to forests of Central and South America

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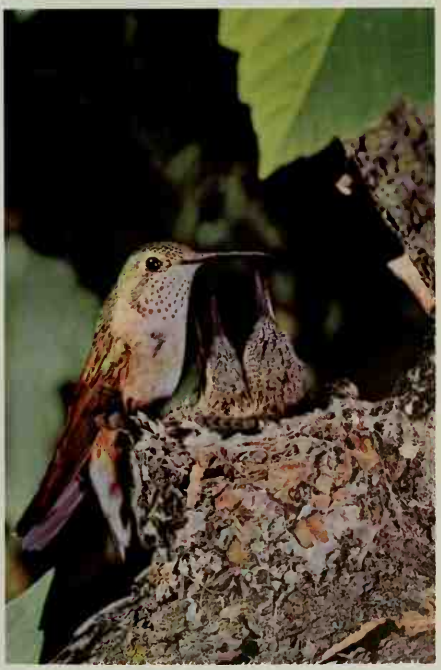
Crested touraco is found in Africa south of the Sahara

Cuckoo, a parasitic bird, is fed by its smaller foster parent, a dunnock or hedge sparrow

Tawny frogmouth, a sluggish, nocturnal bird, feeds on insects

CUCULIFORMES, STRIGIFORMES, CAPRIMULGIFORMES, AND APODIFORMES

The cuckoos and the touracos, constituting the order Cuculiformes, resemble perching birds. The Strigiformes, or owls, are nocturnal birds of prey similar in some respects to the Falconiformes. The Caprimulgiformes, nightjars and frogmouths, are nocturnal birds with large gapes and small weak feet. The Apodiformes include renowned fliers like the hummingbirds and the swifts



Broad-tailed hummingbird of the southwestern United States

Horned owl, a nocturnal raptor, is shown here with a mouse in its beak

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BIRD

Field sparrow, five to six inches long, nests in brush

Meadowlark in tall grass, its preferred surroundings, often reaches a length of 11 in.

PERCHING BIRDS: PASSERIFORMES

The order Passeriformes contains the most highly developed and the largest number of species of bird. Commonly referred to as the perching birds, the Passeriformes are small to medium in size, have stout and conical bills

American robin, probably the best known of all U.S. birds, is a member of the thrush family

Kentucky warbler is one of the many species of wood warblers, family Parulidae, found in the New World

Cedar waxwing, named for the waxy red tips of the wing feathers, feeds chiefly on berries but also catches insects

PHOTOGRAPHS, (TOP LEFT) JOHN H. GERARD, (TOP RIGHT) ALLAN D. CRUICKSHANK FROM NATIONAL AUDUBON SOCIETY, (CENTRE) WILLIS PETERSON, (OTHERS) KARL MASLOWSKI—PHOTO RESEARCHERS, INC.

Great bird of paradise, among the largest of the colourful birds in the family Paradisaeidae, is found in New Guinea

Purple finch ranges from Canada to Lower California in the west to New Jersey in the east

Woven nests of African weaverbirds provide excellent protection against snakes and marauding monkeys

Western tanager ranges from Canada to Brazil

Hooded pitta, often called jewel thrush, is a plump-bodied Old World bird

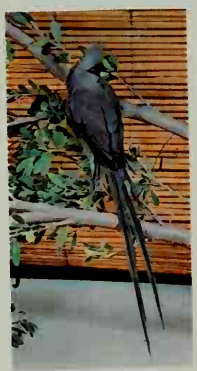
PHOTOGRAPHS, (TOP LEFT) E.-A. BAUMBACH, (TOP RIGHT) KARL MASLOWSKI—PHOTO RESEARCHERS, INC., (CENTRE) CHRISTINA LOKE—PHOTO RESEARCHERS, INC., (BOTTOM LEFT) WILLIS PETERSON, (BOTTOM RIGHT) WOLFGANG LUMMER

Quetzal, a Central American bird, has caudal tail plumes that may reach a length of three and one-half feet

Blue-crowned motmot, a soft-feathered bird, ranges from Mexico in the north to Chile and Argentina in the south

CORACIIFORMES, PICIFORMES, TROGONIFORMES, AND COLIIFORMES

Birds classified in the order Coraciiformes (motmots, kingfishers, etc.) have three toes, bright plumage, and large, distinctive bills. The Piciformes (woodpeckers, toucans, barbets, etc.) share with trogons (order Trogoniformes), parrots, and cuckoos, zygodactyl feet but have a distinctive thigh musculature found in no other order of birds. The Coliiformes, or colies, closely related to the hummingbirds and trogons, were earlier grouped with the latter under Coraciiformes



Coly, sometimes called mousebird because of its dun colour, seldom flies because of its short, weak wings

Toucan, native to South America, has a thin-walled, bulky beak used to feed on fruit and leaves

Green barbet, its beak full of berries, shown dropping from its perch an instant before spreading its wings

Red-headed woodpecker, native to eastern and central U.S., extracts its food from the bark of trees but also feeds on berries and fruit

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its tiny wings so rapidly that it can hover as it thrusts its long bill into a blossom; it can even fly backward as it leaves the bloom.

Speed.—The speed with which birds fly varies greatly from species to species, and of course individual birds can vary their speed. The data on the speed of birds' flight are difficult to evaluate. One of the complicating factors is that a bird's speed in relation to the ground may depend on the force of the wind. A bird flying at 40 m.p.h. with a 60-m.p.h. wind behind it would travel at 100 m.p.h. The same bird flying into a 60-m.p.h. wind would be losing ground at the rate of 20 m.p.h. Despite the variables involved in determining a bird's speed of flight, the following generalized speeds, based on level flight in calm air, appear to be sound:

10–20 m.p.h.—many small songbirds such as sparrows and wrens
20–30 m.p.h.—many medium-sized birds such as thrushes and grackles, and larger, long-winged birds such as herons, pelicans and gulls
20–40 m.p.h.—many small- and medium-sized birds such as starlings, chimney swifts and mourning doves
40–60 m.p.h.—the faster-flying birds such as falcons, ducks, geese and domestic pigeons

There are many faster records, often disputed, such as that of 200 m.p.h. for an Indian spine-tailed swift in level flight, and 570 m.p.h. for a golden eagle in a dive. A homing pigeon has been timed at 94.3 m.p.h.

Range.—The record long-range flight of a bird species in a single season is undoubtedly held by the arctic terns that migrate from a summering ground in the arctic to a wintering ground in the antarctic, traveling more than 7,200 mi. one way. Some long-range flights are made very quickly: a blue-winged teal banded in Canada was recovered 3,800 mi. away in Venezuela only 30 days later; a Manx shearwater, trapped at its nest in Wales and transported 3,200 mi. to Massachusetts and released, returned home in 12½ days. Some very small birds regularly make long water crossings in a single flight. Ruby-throated hummingbirds fly across the over 500-mi.-wide Gulf of Mexico, and many warblers fly from the American coast to Bermuda, a journey of about the same distance. (*See* also FLIGHT [NATURAL].)

2. Flightlessness.—Flight, so characteristic of birds, is maintained during the molt in most species by a gradual replacement of the flight feathers. However, ducks and geese, some rails and loons (divers) and auks shed all of their flight feathers at one time, immediately after the nesting season. Not until these feathers are replaced are the birds able to fly again. Most of these are birds that find their food by walking or swimming, as would be expected. Some ducks living in the marshes become very shy and retiring at this season, skulking in the reeds, but geese nesting in the arctic barrens continue to walk about over the tundra, feeding. In another group of birds, however, the hornbills of Africa and Asia, only the females lose both flight and tail feathers at once; they stay in the nest until the feathers grow out again, being fed during this period by the males.

Some birds have completely lost the power of flight during the course of evolution. The close similarity in basic structure of both flightless and flying birds indicates, however, that they all had a common flying ancestor. The rudimentary wings and the flightless condition of the ostrichlike birds and the penguins is a secondary, specialized condition. That flightlessness is a secondary condition is made still more apparent in other flightless birds that belong to families most of whose members are capable of flight. The extinct great auk of the North Atlantic is one of the best-known examples of such a flightless bird; the rail family also is noted for having many flightless species living on islands in the Pacific and the South Atlantic. Loss of flight seems to occur most often on isolated islands where there are no mammal predators. In New Zealand, where there are no native land mammals, not only are there many species of extinct flightless moas but also flightless kiwis, penguins and rails and a duck, an owl and several songbirds that are nearly flightless.

The ostrichlike birds of continental distribution present an apparent contradiction to this correlation of mammal-free island habitats with bird flightlessness. Another adaptation, however, their great size, has enabled these forms to escape the predation of mammals.

3. Walking, Hopping and Swimming.—Terrestrial birds such as pheasants tend to walk; arboreal songbirds tend to hop as they travel from branch to branch. Parrots often walk along branches, and house sparrows hop when they come to the ground, while palm warblers walk on the ground and some songbirds, such as American robins and European blackbirds, may both walk and hop. Some birds with small feet, such as swifts, hummingbirds, bee eaters and many hornbills, use their feet only for perching and rarely walk at all. Other birds with robust feet, such as guinea fowl and rails, do most of their moving about on foot. Jaçanas with their greatly elongated toes and nails walk over floating waterweeds, and herons with long legs wade in shallow water. The ostrich is probably the fastest running bird; some investigators have credited it with a speed of 50 m.p.h. at which time the length of its stride was about 25 ft.

The usual position of a bird's body in walking is more or less horizontal to the ground. But the penguins, with their feet far to the rear of their bodies, stand upright as they waddle along. When the Adélie penguin, however, makes its trek of many miles over the snow-covered ice to its breeding grounds, it may vary its awkward waddle with periods of tobogganing; *i.e.*, sliding along on its breast and propelling itself with thrusts of its feet.

Some water birds have become so adapted to swimming that they are practically helpless on land. In this class are loons, which shuffle awkwardly the few feet from the water to their nests. Swimming in birds is usually correlated with webbed feet, but coots and grebes, with only lobes on their toes, also swim and dive, and gallinules, without either webs or lobes on their toes, commonly swim. On the other hand, frigate birds, with partly webbed feet, never swim. Penguins swim through the water with their wings and use their webbed feet only for steering. Auks use their wings and webbed feet in swimming underwater.

Some birds such as the mallard usually swim at the surface, feeding only as far underwater as they can reach by dipping their heads. Other ducks, such as scoters and pochards, commonly dive to the bottom for their food, and cormorants, auks and loons pursue fish underwater. Sometimes loons are taken at remarkable depths in fishermen's nets and on set lines, indicating that they may dive as deep as 200 ft.

Pond ducks, such as mallards and teals, spring straight up from the water's surface into the air in flight, but many swimming birds —for example, coots, grebes, cormorants and diving ducks—take off with a long spattering run along the surface.

B. Preening and Resting

To serve their function, a bird's feathers must lie smooth and neat. The grooming or preening of the plumage starts as the nestling's feathers are breaking out of the sheaths. The young birds spend a great deal of time combing the feathers with the bill, and freeing them from bits of sheath. Similar behaviour continues throughout adult life. Oil glands, or preen glands, located on the back, just in front of the tail, are present in many birds. It is probable that the oily secretion of these glands helps keep the plumage in good condition; indeed, many birds nibble at these glands and rub their heads against them as though spreading the secretion on their feathers. It has also been suggested that this oil, after exposure to the sun, may be accidentally swallowed by the bird in preening and hence a source of vitamin D. Some birds, however, such as some pigeons and parrots, have no oil glands but do not seem to suffer from vitamin D deficiency.

1. Bathing With Water, Dust, etc.—To aid its preening, a bird often bathes. A land bird may thoroughly soak itself by crouching down in water and ducking and flicking its wings. Ducks and gulls, with their waterproofed plumage, may bathe also, often when swimming. Sometimes birds bathe on wet grass or in a fine rain or under a garden spray; in tropical forests where predators lurk in the waters, birds may bathe by fluttering among the wet leaves of the trees.

Dust serves instead of water for some birds, such as the domestic fowl and larks. They crouch down on the dry soil and scratch and fluff and shake their feathers until they are full of dust, then they stand up and preen themselves. This is not always an

efficient cleaning process; nevertheless, the dust may help groom a bird's feathers as the furrier's sawdust helps recondition a fur piece. A few birds, including the house sparrow, both water bathe and dust bathe.

In sun bathing a bird may rest on the ground, spread out its feathers and remain still as though it were enjoying the warmth of the sun on its body. Possibly related either to sun or dust bathing is anting. In this process the bird places living ants among its feathers. It may substitute for the ants such things as bits of orange peel or a moth ball, substances that the bird rubs on its wings or the posterior part of its body. What purpose this toilet serves is unknown, but perhaps the bird likes the feeling of some ant secretion or a substitute on its skin.

2. Resting, Sleeping and Hibernating.—*Resting.*—Many small birds are active throughout most of the daylight hours, birds such as the titmice that flit and hop through the branches and the swifts that keep moving on the wing, but some small birds perch quietly for considerable periods, for example, the hummingbirds. Some large birds may sit quietly for hours—a hawk on its perch, a heron on the edge of a pond and a duck on the water.

Many birds have such poor night vision that they sit quietly all through the hours of darkness. Exceptions are many owls, nightjars and some herons, which sleep by day and hunt by night. Some ducks visit grain fields to feed by night in order to avoid hunters. Cormorants swim and dive for fish to eat, but as their plumage is imperfectly waterproofed these birds come ashore periodically to spread their wings and dry out their feathers. Scoters, which feed on mussels along salt-water coasts, may time their feeding and resting activities to take advantage of optimum tidal conditions.

Sleeping.—The habitat in which a bird feeds during the day may serve as its resting place at night: a cover of grasses for a sparrow, twigs of a tree for a warbler and the surface of the ocean for a petrel. A bird may sleep where it perches during the day, a hawk or crow in a treetop and a tern on a beach. Some ground-frequenting quail, however, sleep in trees, and American blackbirds and starlings that have wandered all day, feeding on the ground and perching in trees, may swarm into a cattail marsh to sleep. Some ducks and geese escape hunters by seeking out a habitat they would not otherwise use—for instance, one far out on broad stretches of open water.

Some birds seek a roosting place at night that is similar to that in which they were hatched or raised. Thus chimney swifts on migration sleep in chimneys, but in their winter home in the tropics they undoubtedly revert to the ancestral use of a hollow tree for sleeping. Woodpeckers sleep in holes in trees, some of them freshly chiseled out by the birds as winter approaches. Wrens may make dormitory nests. The roosting behaviour of a species is not always consistent. While starlings may roost in great numbers in a cattail swamp at one time, at another they may roost in trees and even on buildings. The ruffed grouse often roosts in trees, but, especially in stormy weather, it may roost on the ground or in the shelter of a log, and in winter it may burrow into the snow.

In sleep a bird commonly bends its head over its back with its bill nestled among its feathers, but some birds, such as storks, sink their bills among their breast feathers. Water birds, sleeping afloat, retain a swimming pose except that they, too, hold their heads over their backs and tuck their bills among their back feathers. Ducks ashore may rest on their breasts, pulling up their legs into their feathers, an obvious advantage when the birds are resting on an ice floe. Many birds commonly rest on one leg; this posture is especially noticeable in such long-legged birds as shore birds and storks. Sometimes a stork may vary its pose and instead of standing on its toes in the usual fashion may rest on its heels with the shank (tarsus) stretched out in front.

A bird on a branch retains its grip without effort, for the bending of the leg automatically tightens certain tendons that strengthen the grip; rather, there must be an effort to straighten the leg and loosen the grip. Small-footed nightjars may perch lengthwise on a large branch, instead of crosswise, grasping a twig, and hat lorikeets of the orient sleep not by perching on a branch but by hanging below it, as bats do.

Sociability may be more pronounced at sleeping time than during waking hours. The flocks of American blackbirds streaming into a marsh to sleep, the herons congregating at a roost, and the morning and evening flights of flocks of parakeets to and from their roosts may be conspicuous features of a landscape. Even birds that are largely solitary by day may gather together at night, as when a dozen or so creepers sleep in a single crevice in winter. Bat lorikeets of the orient, colies of Africa and wood swallows of Australia may gather so closely together at night that they form tight bunches. As the colies also do this during the day in cold or wet weather, this habit may actually be an adaptation for keeping warm.

Hibernating.—The question as to whether birds hibernate as mammals do has been debated for many years. In the middle ages it was commonly thought that swallows and other birds hibernated in the mud at the bottom of ponds when winter approached, but advancing knowledge showed that the birds' annual disappearance was due to their migration. A few birds, *e.g.*, swifts, hummingbirds and colies, have long been known to sink into a torpid state during the night when the weather is cold.

In 1948, however, it was discovered that one of the American nightjars, the poorwill, really does hibernate. One of these birds was found in a cavity in the wall of a canyon in the Colorado desert in a torpid condition. In subsequent years additional observations definitely established that this species does hibernate, one poorwill having been observed in hibernation over a period of 80 days.

C. Food and Feeding

1. Food Getting.—Food getting has been a major factor, in the course of evolution, in shaping bird structures and habits to fit the environments into which birds have spread. The habitats used by birds are not so many or so varied as those occupied by other vertebrates: no birds burrow in the ground for their food as do some mammals, nor do any birds live in the great depths of the oceans as do some fishes. But birds do feed in the air, in the water and on the land.

Types of Food.—Birds, like other animals, ultimately depend on plants to synthesize inorganic material into organic compounds they can use as food. Some birds eat plant material directly: seeds and fruits are the staple foods of many species, and bulbs, roots, grass, leaves, the nectar of flowers and the sap of trees are eaten by others. The ptarmigan of the arctic even eats lichens; a parrot in New Guinea eats fungi; and flamingos eat tiny plants and animals living in the mud. Many birds, however, eat other animals that have fed on plants. Insects supply food for many birds, including many songbirds; fishes of fresh and salt water also supply food for many more. Worms, mollusks, crustaceans, spiders, squids, amphibians, reptiles and mammals and other birds are the specialized food of still others.

The food items may be small, such as the algae sieved from the mud by ducks and the flying midges snapped up by swallows; or bite-sized, such as many insects, seeds or berries eaten by many songbirds; or large enough to need breaking or tearing into pieces, such as the monkeys eaten by a certain Philippine eagle; or very large, such as the whale carcass over which scavenging petrels quarrel.

While many birds take a variety of foods, both plant and animal, some have a very specialized diet, such as the everglade kite that eats only fresh-water snails of a particular genus; and others specialize within wider limits, such as the sharp-shinned hawks that typically eat birds. Some larger insectivorous birds eat tree frogs and lizards as readily as they do insects of a similar size. Doves that ordinarily eat seeds have been found with their crops filled with small snails. Domestic chickens picking up seeds and grasshoppers will also eagerly gobble down small frogs from a drying pond, and a hungry heron or marsh hawk (harrier) does not distinguish between a crayfish, a grasshopper, a frog or a mouse, taking whichever appears.

Availability seems an important factor in determining diet. Within limits a bird eats what is available. This may underlie certain seasonal shifts in food shown by the American robin for

example. During the spring robins are often seen on lawns catching earthworms; later they come into gardens and eat cherries; and on their wintering grounds in Florida they may live on palmetto berries. Crows, which feed on cutworms in the spring, may turn to grasshoppers in late summer and eat waste grain in the winter.

Certain adaptations of wings and feet fit different birds to seek their food in certain habitats: the graceful swifts catch insects on the wing; cormorants, auks and ducks dive for food underwater; quail grub for food on the ground; songbirds snatch food in shrubbery. But the bill, the grasping organ of the birds, is most closely linked with food gathering, and has been modified in many ways for catching, holding and manipulating food. There are often remarkably precise correlations between bill structure and the type of food taken.

Bill and Food.—Extremes in bill shape are many. The bill of a crow or jay may be considered a good example of an all-round tool; it is stout and of fair size, strong enough to use in killing small mammals and in opening nuts but fine enough at the tip for picking up small insects. Some songbirds have slender bills for picking insects off leaves or out of cracks; others have broad, flat bills for catching flies; and still others have strong, thick bills for cracking the shells of seeds. (The force exerted by a hawfinch in breaking open an olive pit with its bill has been estimated at 100 lb.) Woodpeckers, which search for wood-boring insects, have chisellike bills for cutting holes in tree trunks. The hooked bills of birds of prey are for tearing flesh; this kind of bill finds its counterpart in the bill of the shrike, which eats large insects and mice, and in the bills of the cormorant and frigate bird, which catch fish. Parrots also have strong, hooked bills, which are usually used for eating fruits and cracking seeds—though some parrots eat flowers. Sandpipers, and especially woodcocks and snipes, have long, probelike bills for probing worms and other invertebrates out of mud. The long daggerlike bills of terns, herons and kingfishers are used for catching fish and frogs.

Another adaptation is shown by the broad, flat bill of the duck, which has a sievelike fringe along the sides. When a mouthful of water is taken and the mouth closed, the water and fine mud are forced out through the fringe and the small food items—snails, insects, seeds, etc.—are retained and swallowed. Certain petrels, the prions or whalebirds, have a similar arrangement for sieving small crustaceans from sea water, and one of their names is derived from the resemblance of its food-straining apparatus to that of the whale-bone whales. The flamingo also has in its bill a sieving apparatus much like that of a duck, but the bill of the long-legged bird is sharply bent in the middle so that it is actually upside down when in use in the mud around the flamingo's feet.

Yet another extreme in bill design is seen in the nightjars, swifts and swallows, which catch insects on the wing. In these birds a great reduction of the horny bill is concomitant with a great increase in the size of the gape. A similar wide gape is seen in trogons and oilbirds, which may pick the fruit they eat by hovering in front of the twig on which it grows and seizing the fruit in their mouths. On the other hand, the greatly enlarged and lengthened bills of the toucans and hornbills may, in extending the reach of these birds, help them get the fruit they eat.

The tongue of some birds is a horny flap with taste buds at its base. It seems to be of minor importance in many species. It may serve a sparrow as a scoop in getting kernels out of seeds, or a jay as an aid in swallowing. The tongue is of major importance, however, in some birds. The fleshy tongue of ducks and flamingos helps force water out of the mouth through the strainers on the edge of the bill. The woodpecker's long tongue, barbed at the tip and capable of great extension beyond the bill, is a great aid in extracting grubs out of burrows. The hummingbirds, sunbirds and honey eaters have tubular tongues, brushy at the tips, which aid in getting nectar out of flowers. The brush-tongued lories have fleshy tongues that open into a brush when extended—an adaptation that helps the birds collect nectar and gather various flower parts.

2. Ways of Feeding.—Despite the apparently fine adjustments between food and structure the same structure is sometimes used for surprisingly different purposes. The tree swallow that has caught insects all summer by flying back and forth and snapping them up in its wide gape may be found in the autumn clinging to twigs and eating berries. Most vultures, because of special adaptations, usually feed on carrion, but a west African species feeds largely on oil palm fruit.

On the other hand, birds of quite different structure may feed on the same types of food; *e.g.*, an African vulture, a West Indian tree duck and the South American oilbird all feed on the fruit of palm trees.

Snails and clams, with their succulent parts enclosed within hard shells, seem well protected from predation by birds, but many different kinds of birds have solved the problem of using them for food. Some ducks simply swallow shellfish whole and grind them up in their gizzards; oyster catchers wait until the bivalve gapes open, then stab and cut the strong hinge muscles, exposing the animal; crows drop clams on hard ground to break them open; a European thrush and a Philippine kingfisher smash open a snail's shell by holding the snail in the bill and pounding it on a rock; a South American hawk holds a snail in its foot and waits for the snail to open up, then jabs its bill into the exposed animal and shakes it out of its shell.

Along a stretch of stream a kingfisher watches from a branch, waiting to plunge headfirst into the water and seize a fish in its long, pointed bill; a heron, with a similar bill, stands on long legs in the water and uses its long neck like the shaft of a spear to jab its daggerlike bill into a fish. A passing osprey or fish hawk hovers, then drops feet first to catch a fish in its talons, while a merganser duck swims underwater in pursuit of a fish which it seizes between the serrate margins of its bill. The cormorant gets its fish underwater with a snap of its hook-tipped bill.

Along the coast, terns in graceful flight plunge headfirst into the water to seize fish in their slender bills; pelicans also dive from flight to scoop up fish in their pouched bills; and the frigate bird, with its swallowlike shape and long hook-tipped bill, either hovers over the water and snatches up its fish without getting its plumage wet or robs the terns of their fish. Most unusual is the fishing of the skimmer. This bird, which has a long, bladelike lower mandible and a much shorter upper one, flies over the water with the lower mandible submerged. When the mandible hits a fish, the bird's head is thrust down so that the upper mandible is engaged in seizing the prey.

Change of Habits.—Although birds' feeding habits tend to be stereotyped, they often change with the season and with temporary changes in environment. The black parrots that raid a Madagascar corn (maize) patch certainly did not do this before corn was introduced from the Americas. The kea parrot of New Zealand is a familiar example of a vegetarian turned carnivore after the introduction of sheep to the islands. Some of these parrots, after having learned to feed on the flesh of recently dead sheep, finally learned to kill them as well. Titmice in England have learned to open milk bottles to get at the milk.

Preparation of Food.—Food is swallowed whole or piecemeal. A jay may break off the legs of a grasshopper and discard them before swallowing the body. A hawk may pluck off the feathers of a bird before bearing off chunks of the flesh to swallow. A bee eater may hammer an insect against a hard surface, perhaps to quiet the captive or to break up the exoskeleton before swallowing the insect. Secretary birds are said to drop a snake from aloft to kill it. Nuthatches may wedge a nut into a crevice to shell it, while a jay may do the same with a nut held under one foot. Like the birds that smash shellfish on rocks, the lammergeiers of Europe are said to drop bones from a height to break them in order to get at the marrow. Gulls in the Falkland Islands are said to drop eggs to get at the contents, while in Australia a hawk is said to drop a stone in an emu's nest to break the eggs.

A cormorant has been known to swallow a fish too big to fit into its stomach all at once. When this happens the bird sits quietly until the head end of the fish is digested, and then swallows the rest of the fish. This lack of preparation of food to be swallowed can be dangerous, however, and a heron has been recorded as dying when a catfish with erect spines lodged in its gullet. Mice and insects, swallowed whole, carry much indigestible material into

the bird's stomach. This roughage is cast up in the form of pellets. Under an owl's perch one can find such pellets containing fur and bones. In late summer crows feeding on grasshoppers commonly cast up pellets composed of the exoskeletons of those insects.

Storage of Food.—The most striking case of food storage is that of the acorn woodpecker of California, which chisels holes in the bark of a tree and fits an acorn in each hole. Another American woodpecker, the redheaded, not only puts an acorn in a hole but tamps it in with a piece of soft rotten wood. Many jays and crows store seeds. The nutcracker in Europe buries nuts in the forest floor during the autumn, as a provision for the winter.

The shrikes of northern countries and of east Africa impale insects, mice and smaller birds on thorns; the butcherbirds of Australia do the same thing. Undoubtedly this is a way of storing food, but just as surely it is also a part of food preparation, for the birds that lack a firm grip with their feet often impale their prey so that it is firmly held as they pull it to pieces with the bill.

The ground squirrels and rabbits strewed about an eagle's nest, or the mice about an owl's, could be considered stored food, but perhaps the carcasses are simply a surfeit of food. Relatively few birds store food; for the most part they live from day to day.

3. Water and Salt Requirements.—The frequency with which garden birds visit a birdbath leaves no doubt that birds enjoy water, which is important to most species in the care of their plumage. Physiologically, birds are essentially less dependent than mammals on drinking water, because they need less in voiding their nitrogenous waste in the form of insoluble uric acid. Birds may not need bodies of water, but may drink droplets of rain or dew from leaves or grass, or may get what they need from moist foods without any source of free water. However, two modes of life do pose the problem of water supply in acute forms: grain eating in deserts and life at sea.

Some animals, such as the desert kangaroo rats, have been able to escape the need of taking in water, and this they have done by adjusting their metabolic processes so as to manufacture needed water from dry food stuffs. Birds, however, need to take in water at frequent intervals. It is probable that drinking water is a factor in determining the local distribution of quail in the American deserts, and a supply of water is especially important for the young. In the arid regions of Africa and southern Asia sand grouse are able to live and breed in deserts by making long flights to water daily, morning and evening. On their return they bring water to their young. One opinion is that they carry it in the gullet and regurgitate it for the young; another, that they wet their breast feathers and the young get water from these feathers. Perhaps both methods are used.

Although drinking sea water may prove fatal to man, it has long been known that sea birds drink sea water with impunity. In the 1950s a series of experiments showed that sea birds can drink sea water without dangerously raising the level of salts in the body because the excess salts are rapidly excreted by large nasal glands as well as by the kidneys.

Many herbivorous mammals visit salt licks for the mineral content in the soil, but only a few birds are known to do this. The fruit-eating colies of Africa eat soil that is rich in salts. The habit of eating salt is especially well known for some northern finches such as the crossbills.

D. Enemies and Diseases

1. Predators.—Some of the animals that eat birds are other birds, the most persistent predators on small birds being certain species of hawks. The peregrine falcon, or duck hawk, is a good example; it can overtake and catch on the wing even such fast-flying birds as the teal. Some short-winged hawks, such as the goshawk, prefer to capture birds by surprise dashes from concealment. Many other hawks, those that are slower or clumsier in flight, and owls, which ordinarily feed on mammals, lizards or insects, sometimes take small birds when the opportunity offers. Birds of other groups, such as cuckoos, shrikes and frogmouths, occasionally eat other birds; and some, such as jays and crows, sometimes rob other birds' nests for the eggs and young.

Carnivorous mammals, such as foxes and weasels, are more likely to be predators on eggs or young birds. It is probably the predation pressure of such mammals that has confined sea bird nesting colonies in the north to islets or cliffs. Similarly, in warm climates, herons nest on islets or on tall trees because such sites are relatively immune from ground predators such as raccoons or civets. Continental land birds that nest on the ground do so singly, trusting to concealment as protection against predation; the colony nesters among land birds build their homes in reeds over water or high in trees.

Reptiles, such as snakes, sometimes take birds' eggs, and certain species of snakes of the old world tropics have even developed special processes in the throat for puncturing the eggshell. Crocodiles may occasionally take a swimming duck or cormorant, and alligators are said to wait about heron rookeries, snapping up unwary young that fall into the water. Among the amphibians, bullfrogs have been known to snap up small birds. Aquatic birds are occasionally taken by large fish, and surface feeding fish, such as bass and pike, may take young ducks or even songbirds flitting low over the water.

2. Parasites.—The parasites that occur in birds are best illustrated by those found on the pigeon, or rock dove, of city parks and dovecots. There have been reported about 70 species of plants and animals living on (as exoparasites) or in (as endoparasites) a pigeon. These include species of ticks and mites, a fly, a bug, lice, roundworms, tapeworms, flukes, protozoans, fungi, bacteria and viruses. Doubtless many more pigeon parasites remain to be found. Ignoring the smallest microscopic animals and plants, the number of individuals of some of the larger animals (the flies and ticks that may be as large as houseflies and the tapeworms that are several feet long) is impressive. A single pigeon has been found to have 1,000 tapeworms in its intestines, 30 flies among its feathers and as many as 20 bird lice on a single feather.

The food of the different members of the community of parasites is as various as their form. Flies, ticks, some mites and some lice may suck blood; some lice may eat downy parts of feathers; some mites may feed on the pith within quills, others may eat skin debris; intestinal worms absorb partly digested food; some roundworms (filaria) and protozoans may feed on blood.

Probably all birds support sizable groups of parasites. Some, like lice, undoubtedly are passed from one bird to another through contact. The antiquity of some of these parasites may be judged by the fact that a certain species of louse may be found on only one species of bird. The passenger pigeon, for example, had an endemic louse, and when the last passenger pigeon died, the last of this species of louse presumably died with it.

Among the illnesses suffered by birds are psittacosis (ornithosis), coccidiosis, a form of botulism called western duck sickness, cholera and several respiratory diseases of unproved cause. Poultry and other domesticated birds are, of course, more susceptible to disease because of the more or less unnatural conditions under which they live. Although man may contract some of these diseases from his domesticated birds, rarely does he do so from wild birds. In any event the incidence of bird-borne diseases in man is so low that it represents only a minor public health problem. *See* Psittacosis; Coccidiosis; Poultry and Poultry Farming: *Diseases and Parasites.*

III. FORM AND FUNCTION

A. External Features

To understand how birds cope with their environment it is necessary to have an outline of the structural modification that fits the bird for this. The bird's head is of moderate or small size; the neck slender; the forelimbs modified into wings for flight; the body oval and large; the hind limbs modified for bipedal movement; the tail, short or long, with most of its length consisting of a few feathers (and hence light); and the body clothed in feathers that smooth body contours into a streamlined shape, conserve body heat and also provide protection.

1. Topology of the Body.—*Head.*—The bill, composed of upper and lower jaws, or mandibles, serves in seizing, carrying and manipulating food and nest material; in fighting; and in grooming and preening. The jaws are covered with horny sheaths. There

may be teethlike projections, or notches, on the edges of the mandibles but never true teeth, except in some ancient fossil birds (see *Origin and Evolution* below). A few birds, such as hawks and parrots, use their feet to supplement their bills in handling objects.

The eyeballs of birds are relatively large as befit animals that depend almost completely on vision. In many birds binocular vision is limited since the eyes are on the sides of the head and the eyeballs have little mobility. Most birds, therefore, see a considerably different view with each eye. In some birds, however, such as owls, the eyes are in the front of the head, and the bird looks forward. Although the owl's eyes are immovable in bony sockets, these birds have considerable binocular vision. Some other birds, such as bitterns and starlings, can turn their eyes down or forward to increase binocular vision, some of which is imperative in judging distance—especially when the bird is attacking prey or alighting on branches.

The ear is represented externally by an opening on the side of the head just behind the eye; it is covered by a special patch of feathers, sometimes distinctively coloured, called ear coverts, or auriculars. There is no fleshy ear flap, or pinna; the so-called ears or horns of some owls are really tufts of feathers having nothing to do with hearing.

Neck.—A bird has more neck vertebrae than the usual seven of mammals; as a result its neck is more flexible. The long-necked swans may have as many as 25 vertebrae, and some perching birds, *e.g.,* cuckoos and parrots, may have as few as 13. Additional neck flexibility is afforded by the saddle-shaped articulating surfaces of the vertebrae. A striking example of this flexibility is the owl's ability to turn its head through about 270°, or three-fourths of a circle.

Wings.—In the course of avian evolution the primitive vertebrate forelimb has become an airfoil, a wing: the humerus of the upper arm, and the radius and ulna of the forearm have been retained, but the many bones of wrist, hand and fingers have been fused into a few elements for rigidity. The single line of large, overlapping flight feathers that form the surface of the spread wing are attached to the posterior edge of the ulna and to the fused wrist-finger bones.

Breast.—Whereas flexibility is important in the neck, rigidity is necessary in the chest to withstand the strain of the powerful wing strokes. The rib cage, which joins the backbone to the breastbone (sternum), is strengthened by a tonguelike process extending backward from each rib to overlap the next. The breastbone in strong flying birds is broad and bears a deep keel to which the great flying muscles (the white meat on the breast of a chicken) are attached. These muscles (the pectorals) may be as much as 15% of the total weight in a mourning dove. The wishbone (fused clavicles) and the adjacent coracoids that brace the front of the sternum add to the rigidity.

Legs.—The legs, used in bipedal locomotion, have four toes at most—usually three directed forward and one backward. Some birds, however, such as some woodpeckers and cuckoos, have two in front and two behind. A reduction to three toes is not uncommon, as in some woodpeckers and kingfishers, though only one bird, the ostrich, has as few as two toes.

The bird's shank, or tarsus, is usually covered, as are the toes, with scales rather than feathers. The tarsal bone is compound, formed by the fusion of ankle and foot bones. This is in effect a running foot, designed for speed, and is more comparable to the hind foot of a deer or a horse than to that of a man or a bear. The joint at the upper end of the shank is comparable to the ankle rather than the knee joint.

Above the tarsus is the shin (the drumstick of poultry), composed of the tibia and the much reduced fibula. This section of the leg is more or less feathered. Above the shin is the thigh, or femur. Both the thigh and the knee joint are usually completely concealed under the flank feathers.

Hips.—The hip, or pelvic girdle, on which the legs articulate, is noted for its rigidity, the lower back being nearly one solid piece, with the sacral vertebrae, paired ilium, and ischium and pubis all fused together. This extensive fusion with the vertebrae is perhaps necessary because the pubic bones, which in mammals and reptiles may unite in front to form a solid ring, do not unite in birds, but are separate in front. This nonunion of pubic bones may be an adaptation for egg laying: the ends of these bones can spring apart and allow passage of relatively large and inflexible eggs.

Tail.—The tail of a modern bird is considerably shorter than that of the ancient *Archaeopteryx,* a Jurassic ancestor, and the tail bones are fused rather than separate. In modern birds there are only a few caudal vertebrae (usually six or seven) and a terminal plowshare bone, or pygostyle, the latter formed by the fusion in the embryo of a number of vertebrae. It is to the plowshare bone that the main tail feathers are attached.

2. Skin and Feathers.—The skin of a bird is soft, flexible and usually thin and tender. Most of it is thickly overlaid with feathers, but in some birds, such as vultures, there are areas of bare skin on the head and neck. This bare skin is sometimes brightly coloured, and in some birds—pheasants, cassowaries and some songbirds—forms fleshy wattles.

Oil Glands.—The only skin glands of birds are the oil, or preen, glands. These consist of a pair of glands just above the tail that secrete an oily substance used in grooming the feathers. Although present in many birds and best developed in water birds, oil glands are absent in some species, such as some parrots and some pigeons (see *Preening and Resting* above).

Feathers.—The coat of feathers, or the plumage, that covers a bird is this animal's single most distinctive feature. Feathers are horny epidermal structures derived in the course of evolution from the scales of reptiles, from which birds are descended.

A bird's overlapping feathers smooth its contours, and are important in making the bird an efficient flying machine. Long flight feathers form the main supporting surface of the wing. No less important is the insulating value of the feathers, one of the fundamental adaptations by which the body temperature is held high and constant.

Feathers show diversity in size and structure, but typically a feather has a slender tapering shaft with a vane or web on either side. The short, basal part of the shaft, the calamus, or quill, has no vanes and is round and hollow. The distal part of the shaft, the rachis, bears the vanes and is solid and angular in cross section. Each vane is composed of a close set series of parallel barbs; each barb has two rows of branches called barbules; and each barbule, in turn, bears two rows of still smaller branches, the barbicels, some of which end in tiny hooks. The barbicels overlap and hook together to form a strong but light vane.

There are several kinds of feathers, each modified to serve a special use. The ordinary feathers that cover the bird are called contour feathers, of which the flight quills are especially large and stiff. The downy feathers are those with a very short calamus, no rachis and with fluffy barbs; they are usually hidden beneath the contour feathers, and afford additional insulation. Filoplumes are hairlike feathers scattered among the contour feathers. Bristles are vaneless feathers; they occur about the mouth of many insect catchers, in the eyelashes of the hornbill, and elsewhere in other birds. Some contour feathers have a part of the basal web downy.

Arrangement and Number of Feathers.—A few birds such as penguins have the feathers uniformly distributed over their bodies. But in most birds the contour feathers are distributed in well-defined feather tracts that occupy restricted areas (pterylae) on the surface of the bird. From these pterylae the contour feathers fluff out and cover the naked areas (apteria).

The long flight feathers (remiges), which edge the posterior portion of the wing and overlap to provide most of the wing's surface, have a definite number that varies among the different groups of birds. The primaries (remiges attached to the digits) vary from 9 in such groups as the new world sparrows and the tanagers to 10 in most songbirds and 12 in the grebes and storks. The secondaries (remiges attached to the ulna) vary from 9 in most songbirds to as many as 32 in the long-winged albatross. Smaller feathers called coverts overlap the bases of the remiges above and below to give the wing a smooth contour.

Most of the length of the tail is formed by long tail feathers (rectrices), of which in most groups there also is a definite num-

ber. In most birds there are 6 pairs of rectrices, but some have as few as 4 pairs, as in some rails and cuckoos, and others have as many as 16 pairs, as in some pheasants.

Counts of total number of feathers have been made for some birds. The smallest count was 940 feathers, on a hummingbird. Many songbirds have between 1,500 and 3,000 feathers, and a whistling swan has about 25,000. Birds of the arctic regions probably have a larger number of feathers than do their relatives of comparable size in the tropics, an obvious adaptation against the cold.

Molt.—Feathers push out of the skin as dark blue, blood-rich pin feathers with a scaly covering. As they grow they burst the sheath, and the vane expands. Once the feather is full grown and dry, it is a dead structure, unable to repair damage caused by wearing or fading; to compensate for this, feathers are molted and replaced periodically. This replacement, in which old feathers are pushed out by new ones, usually takes place once a year, just after the breeding season. There are, however, many notable exceptions to the usual one molt a year. Many songbirds have an additional partial molt in the spring, and ducks have two complete molts of the body feathers yearly.

Molting is usually a gradual process, only a few feathers at a time being shed and replaced by new ones. Thus most birds are always adequately covered with feathers and can fly even in the middle of the molt. On the other hand, ducks and a few other birds that molt all their flight feathers at once, usually after the young are hatched, are flightless for a short time during the molt. (*See* also FEATHER.)

3. Coloration.—The colour of bill, feet and eyes may harmonize with that of the feathers or may contrast sharply with it. The colour of feathers is caused mostly by two factors: pigment in the feather and the microscopic structure of the feather. The latter factor, responsible for the scattering and reflecting of light, modifies the underlying pigmentary colour.

The common pigments in most birds' feathers are the melanins, ranging from yellow-brown to black, and the carotenoids (lipochromes), ranging from yellow to red. The white colour of feathers is structural, the result of the reflection of all the light. Blue results from structure and the presence of the underlying pigment melanin; pure green is usually the result of the same structure that produces blue, but a yellow pigment underlies it. A different structure produces iridescence.

Occasionally among birds that normally produce coloured offspring a white, or albino (*q.v.*), individual may appear, owing to the lack of any pigment. In other cases a bird may be conspicuous among its fellows by showing an excessive red or yellow coloration, the result of abnormally large amounts of such pigments. So-called adventitious colours may be found in birds of certain localities or under special conditions: sparrows living in cities acquire a dark, sooty plumage not seen in country sparrows; some white snow geese acquire a reddish stain as a result of contact with iron-rich water.

Colour Change.—A feather on completion of its growth is a dead structure like hair, unable to add to or subtract from its pigmentation. Certain colour changes, however, do occur. These changes are the result of fading, well illustrated by the gradual loss of the salmon pink colour of the breast of the freshly molted merganser. The brown of the desert thrasher becomes paler as the season advances; this may be caused not only by fading but also by the wearing away of some of the feathers. The effects of wear are much more evident in a bird such as the snow bunting. In the autumn the bird is buffy brown; by spring the brownish tips of the feathers have been worn away, revealing the black and white main parts of the feathers. Most of the pronounced colour changes, *e.g.*, that of the scarlet tanager, which is red in the summer and green in winter, are the result of molt; the feathers of one colour replace those of another.

Range of Colours.—Coloration in birds ranges from all white to all black; from predominantly bright shades—red, yellow, green, blue, etc.—to pale and drab ones—buff, brown, olive, purplish, ochre, etc. Some birds are solidly coloured, whereas others are patterned in various ways. There would seem to be an endless variety in colour arrangements, but the same ones tend to repeat themselves. This similarity in colour markings occurs not only in birds that are closely related, as is shown by the streaked pattern in many sparrows, but also in birds that are more distantly related, as is shown by the black chin patch of house sparrows and chickadees (titmice or tits) and the white rumps of some woodpeckers and some sandpipers. Resemblances of eyebrow stripes, wing bars, neck rings and white outer tail feathers also occur in many unrelated species.

Although a particular type of plumage colour characterizes each species, this generalization needs qualification. Most species have colour variations based upon sex, age, season and climate.

In some species the sexes are alike; in others they are quite different. The brown wrens are birds in which both sexes are the same dull colour. Some parrots have both sexes bright green marked with red or yellow; in the eclectus parrot the male is mostly bright green and the female bright red. In many ducks and pheasants the male is brightly coloured, the female dull; in the button quail (*Turnix*) and the phalaropes the females are brighter. Some of these colour differences are correlated with the different parts the sexes play in reproduction, as will be discussed below.

When both parents are dull coloured, the young usually resemble them, as in wrens; when one sex is bright and the other dull, the young usually resemble the dull parent, as in the American red-winged blackbird; and when both parents are bright, the young may show a slightly duller plumage. In the American robin, in which adults of both sexes have a reddish breast, the duller spotted breast of the young is reminiscent of the adult pattern common in many thrushes.

Many young birds, when they are only one year old, resemble their parents, but some take several years to acquire the adult plumage. The bald eagle takes about ten years to acquire the pure white head and tail characteristic of the adult bird.

Some birds look much the same the year round, as, for example, crows and jays. Others change their appearance considerably from summer to winter; the common starling of North America and western Europe, for example, is black with many pale spots on the tips of the feathers in winter, but by spring is completely glossy black, the spots having worn off. The scarlet tanager changes from a red summer plumage to a green winter one and back again, and the arctic ptarmigan molts alternately to white in winter and brown in summer.

Within a species, birds that live in arid regions tend to be pale; those that live in regions with high rainfall tend to be dark. The song sparrow of North America is a classical example of this. The birds from the dry country in the central part of the continent are light brown; those from the humid, foggy islands of the Bering sea are almost blackish brown.

Adaptive Coloration.—Certain colours and patterns seem to be an advantage to the bird in concealing it from its enemies, or in enhancing the male's courtship displays. A bittern standing among dead reeds on the edge of a marsh harmonizes so well with his background that he is all but invisible to a predator's eye. Such protective coloration involves several principles. Countershading is one of them: the bird's under parts, in shadow when the bird is on the ground, are paler than the upper parts, which are in bright light. This countershading gives the bird a more uniform appearance and greatly lessens the shadows that would define the bird's body.

The brown-streaked plumage of the bittern matches, both in colour and pattern, the reedy habitat in which the bird lives. A similar matching of background is seen in the brown-streaked plumage of some sparrows, snipe and quail that live among the grass, and in the mottled browns and grays of the owls that perch among the branches of trees.

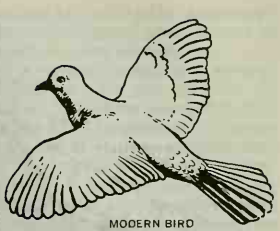
In some birds disruptive coloration, the presence of large markings of contrasting colour, breaks up the animal's outline; an example of such coloration is seen in the white and black markings on the necks of some small plovers.

Shape and pose of the bird adds to the effectiveness of matching colour, as shown by the tall thin bittern that stands upright against the vertical patterns of the reeds, and the "eared" owl that stands motionless on a branch, its ear tufts giving the im-

HAWK

PETREL

SHOVELER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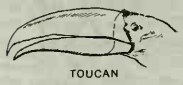
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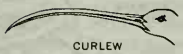
GROSBEAK

AMERICAN ROBIN

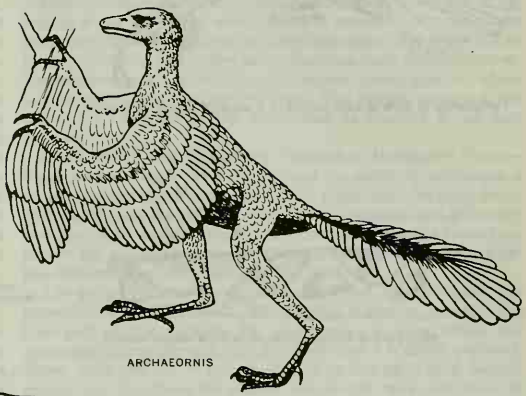
GOOSANDER

COCKATOO

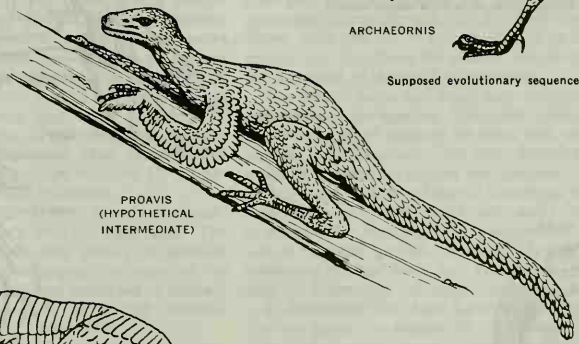

CURLEW

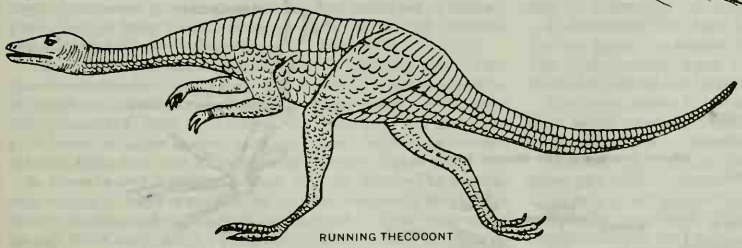
SPOONBILL

Types of bills indicating adaptations to feeding

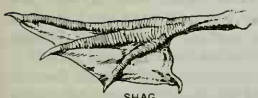

ARCHAEORNIS

Supposed evolutionary sequence from reptile to bird

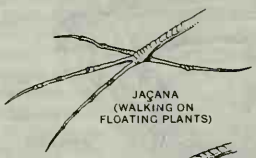

PROAVIS
(HYPOTHETICAL
INTERMEDIATE)


RUNNING THECODONT

Types of feet indicating adaptations for locomotion and predation


SHAG
(SWIMMING)

JUNGLE FOWL
(WALKING, SCRAPING)


JAÇANA
(WALKING ON
FLOATING PLANTS)

CROW
(PERCHING, LIFTING)

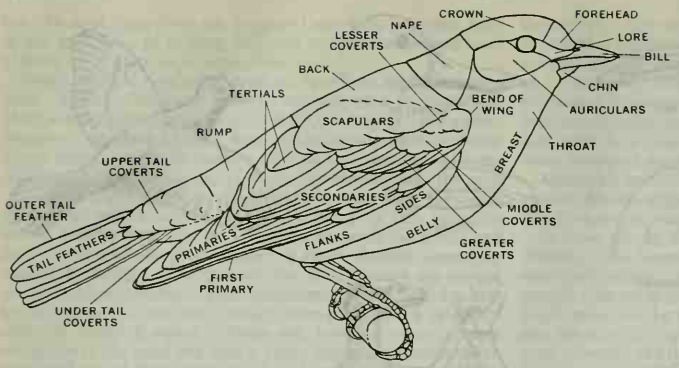
COOT
(SWIMMING)

SEA EAGLE
(RAPTORIAL)

PTARMIGAN
(FEATHERED)

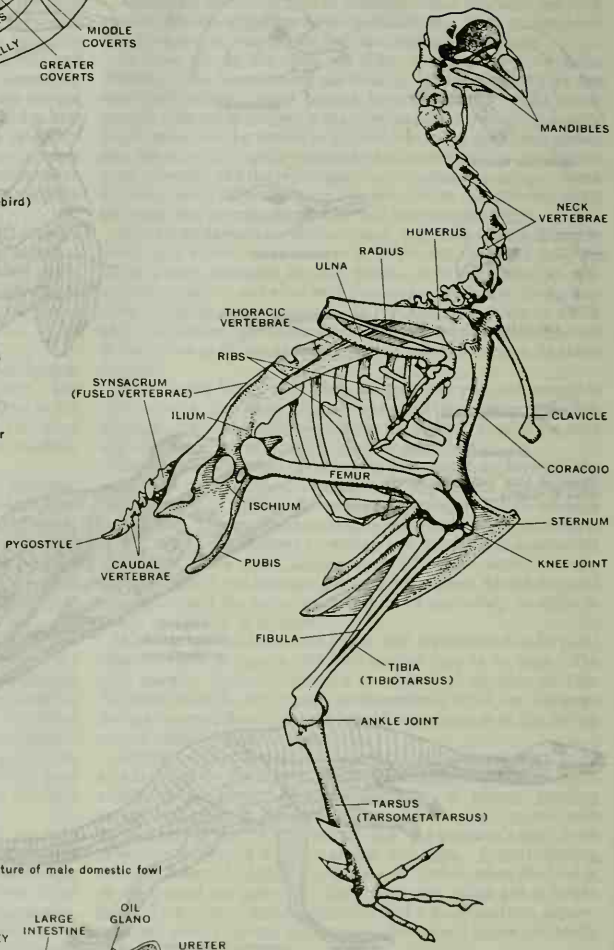
BY COURTESY OF (CENTRE) AMERICAN MUSEUM OF NATURAL HISTORY; (TOP AND BOTTOM) FROM ARTHUR J. THOMSON, "THE BIOLOGY OF BIRDS"

BIRD

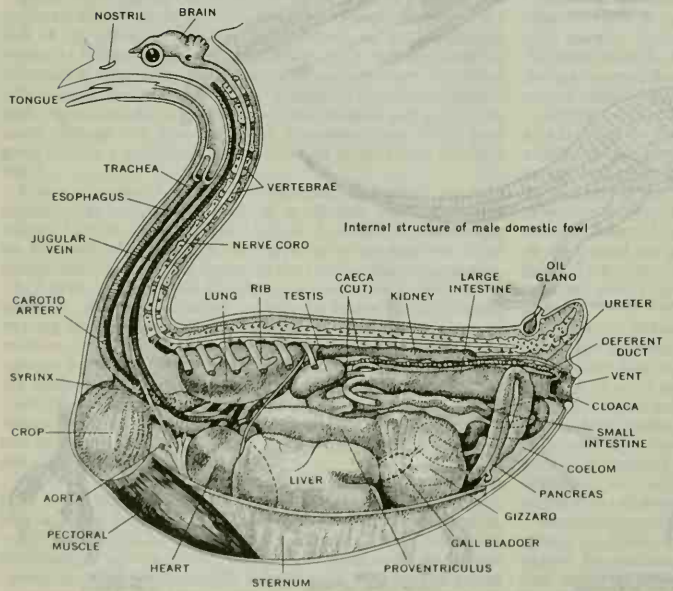


Terminology of parts of body surface of a songbird (based on bluebird)

Wing bone of vulture sectioned to show hollow interior



Skeleton of domestic fowl



Internal structure of male domestic fowl

(TOP) FROM F. M. CHAPMAN, "BIRDS OF EASTERN NORTH AMERICA," APPLETON-CENTURY, PUBLISHER; (CENTRE LEFT) FROM J. Z. YOUNG, "THE LIFE OF VERTEBRATES"; (CENTRE RIGHT) FROM E. E. POTTER, "TEXTBOOK OF ZOOLOGY"; (BOTTOM) FROM T. STOHLER AND R. USINGER "GENERAL ZOOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL

pression of the jagged end of a broken stub.

The many species of birds that live in desert regions often are pale in colour, corresponding to the general colour of their background. This coloration is carried still further in some larks of the arid parts of Africa and Asia; these birds even have the tint of the soil on which they live.

Some conspicuously coloured birds have flesh that is less palatable than that of duller coloured ones. Possibly, these conspicuous markings, such as the black and white plumage of some desert thrushes of Asia, are actually labels warning predators of the bird's disagreeable taste.

Some bold patterns are displayed only in flight, like the white rump of the flicker and the black and white pattern of the turnstone; these markings may serve to confuse a marauding hawk. The hawk follows a turnstone only to find that on alighting the boldly marked bird changes to a more plainly coloured one; the resulting confusion of the hawk may make the difference between escape and capture of the turnstone.

Colours and patterns undoubtedly aid birds in recognizing others of their own species. Further, the white outer tail feathers of a vesper sparrow, the white wing bars of some crossbills and the bold back pattern of the turnstone may make the birds' movements conspicuous to others of the same species, thus conveying information, as when one bird flees from danger and warns the others.

Bright colours, sometimes in patches or on special plumes, such as the elaborate flank plumes of the birds of paradise and the bizarre ornamentation of the pheasants and manakins, are displayed at mating times and in fighting.

B. Internal Systems

1. Circulatory System.—*Blood.*—The blood, which distributes food and oxygen to all parts of the bird's body and carries waste products to the kidneys, is notable for the red corpuscles being oval and, unlike those of mammals, possessing nuclei. Blood is carried by tubular blood vessels through which it is pumped by a four-chambered heart (as in mammals). The oxygenated blood leaves the heart by a right aortic arch (instead of the left as in mammals), the only one that remains of the primitive six pairs of aortic arches. Birds are warm-blooded, their temperatures ranging from about 105° to 111° F., which is 2° to 14° higher than the normal range of temperature in mammals.

Heart.—The heart is relatively larger in birds than in mammals, and is relatively larger in smaller birds than in larger ones. The exact weights published by anatomists vary greatly in absolute values, presumably due to different techniques, but some of the most often quoted percentage weights of bird hearts are as follows: goose 0.8% of body weight; pheasant 4.7%; raven 10%; sparrow and starling 13%–14%; hummingbird 19.8%–22%.

The normal heartbeat of a resting bird is generally higher than that of a mammal of similar size. The following are some examples of heartbeats per minute of adult birds at rest: sparrow 460; robin 570; pigeon 218; crow 342; turkey 43. In general the rate tends to be lower for larger species; of course, many factors can increase the individual rate, and strenuous exercise may double it.

2. Respiratory System.—*Lungs and Air Sacs.*—The respiratory system of birds is notable for its relatively small lungs, with little expansion and contraction, and a series of large thin-walled air sacs in the body cavity. The air sacs have pouches (diverticula) that commonly extend into the femur, humerus and vertebrae, but in some species may extend into almost any part of the skeleton, even the toes. Birds, unlike mammals, have no diaphragm to assist in breathing; they rely instead on the expansion and contraction of muscles of the body wall.

During inspiration air enters through mouth or nostrils, passes through the windpipe (trachea) and the two bronchial tubes and enters the lungs, much of the air going beyond into the air sacs. Some students believe that during expiration much of the air in the air sacs passes through the lungs again; others think that the air bypasses the lung tissue via the bronchial tubes and goes directly to the mouth.

The precise course of the air in the lungs during inhalation and exhalation, and just when most exchange of oxygen and carbon dioxide occurs, has been the subject of considerable experimentation and much conjecture. The only undisputed point seems to be that the bird's system of breathing is a very effective one.

The breathing rate of a bird is variable, depending on activity, excitement and environmental factors. The rate given for the domestic fowl is 12 to 37 per minute, and for the canary 96 to 120; this rate varies, however, with the bird's temperature. A pigeon has been shown to breathe at the rate of 46 times a minute when its body temperature was 107° F., and 510 times a minute when its temperature was raised to 110°. It has been postulated that air sacs, in addition to their function in gaseous exchange, are also important as cooling devices (birds cannot cool themselves by sweating).

Voice Producing Organs.—These organs, in birds, are not in the larynx, at the top of the windpipe, as in mammals, but are at the junction of the windpipe and the bronchial tubes. The voice box of birds is the syrinx; it consists of cartilaginous rings and membranes. The membranes are moved by certain special paired muscles, whose number varies with the type of bird. The passing stream of air causes the vibration of the membranes to produce sound (*see* Songbird).

3. Digestive and Excretory Systems.—*Alimentary Tract.*—Food passes through the gape and into the gullet, or esophagus, a structure often capable of considerable expansion. In some birds, such as pelicans, the gullet is permanently expanded as a gular sac; in others, such as domesticated fowl and sparrows, the lower portion of the gullet is enlarged as the crop. In both cases these expansions serve for carrying or storing food.

The gullet leads to the stomach, of which the fore part, the proventriculus, is glandular and secretes digestive juices. The hind part of the stomach, the ventriculus, is thick walled and sometimes extremely muscular, in which case it is called a gizzard. There, with the aid of grit swallowed by the bird, hard food is ground up. In effect, the gizzard and its grit take over some of the functions of the teeth in mammals.

The liver is large, and there may or may not be a gall bladder, depending on the species. The coiled small intestine may or may not have a pair of caeca at its lower end, where it joins the short, straight large intestine. The large intestine ends in a cloaca into which the urogenital system also empties.

Excretory System.—There is no urinary bladder in birds; therefore the waste matter (chiefly uric acid) from the kidneys passes as a semisolid into the cloaca, where it is mixed with the feces and is excreted through the vent. A pair of nasal glands, well developed in some birds, *e.g.,* cormorants, that live on salt water, aids the kidneys in excreting surplus salt taken into the body.

4. Reproductive and Endocrine Systems.—*Sex Glands.*—The sex glands, or gonads, lie in the body cavity on the forward edge of the kidneys: a pair of oval testes in the male, a single ovary on the left side in the female.

The sperm passes from the testes to the cloaca via the deferent ducts and is transferred from the male to the female by contact of the birds' cloacae. Sometimes a penis is present in the male.

The true egg, a single, giant, yolk-filled cell, is fertilized in the upper part of the oviduct of the female; as it passes down the duct it receives its protective coats of albumen and membranes, its shell and finally its colours. When it arrives at the cloaca, the egg is expelled through the vent.

Hormonal System.—The importance of the ductless, or endocrine, glands to the biology of the bird is out of all proportion to the small size of these glands. They secrete hormones that are carried, via the blood stream, to various parts of the body. Among the important effects of these hormones are influences on growth, physiology and seasonal behaviour. The ductless glands may affect each other, and their secretions may have multiple effects.

The pituitary, located below the floor of the brain, is called the master gland, for its secretions, in addition to influencing directly many bodily functions on its own, also regulate other glands. Since the pituitary may be affected by seasonal variations in light intensity, it may act as a timing mechanism in controlling cyclic activities such as reproduction and migration.

The thyroid gland, in the neck, can be influenced by diet: a

deficiency in iodine causes goitre, or enlarged thyroid, in chickens as well as in man. The thyroid secretion regulates feather growth, colour deposition and other bodily processes.

The parathyroid, also in the neck, affects various physiological processes. The function of the adrenals, paired glands situated on the kidneys, is little known in birds.

In addition to the four endocrine glands listed above, there are several other organs that secrete hormones in addition to performing their other functions. These organs include the pancreas, in the first loop of the intestines, which produces insulin, and whose secretions influence metabolism; and the gonads, situated on the kidneys, whose secretions control such secondary sexual characters as the type of plumage (male, female or neutral).

C. Senses

Birds, together with anthropoid mammals, are the only animals that combine excellent eyesight and hearing with a poor sense of smell. Knowledge of the presence and importance of a bird's senses depends on the interpretation of bird structure and behaviour.

1. Sight.—The faculty of sight in birds is comparable to that in man. There are two main differences, however. The first is that most birds have predominantly monocular vision because their eyes are on the sides of their heads. These birds receive a visual picture that is flat, two-dimensional and without perspective, in contrast with the three-dimensional visual picture of man and of a few birds such as owls. Such a bird must move its head to obtain depth of vision. For example, a robin, in cocking its head to look at a worm from two angles, is unwittingly using parallax to judge distance. Even in those birds with chiefly monocular vision, however, a small field directly in front of the bird may be viewed binocularly. Binocular vision, however limited, is of considerable advantage to birds that pursue prey.

The other notable difference is that the bird's visual picture, judging by the structure of the bird's eye, is clear and detailed throughout, in contrast with the condition in man in which only a small part of the visual field is seen in detail at one time.

Some birds, especially diurnal ones, see the whole range of the spectrum of colours much as man does. It has been suggested that night birds actually see their prey as self-luminous sources of infrared light, but this seems to be without foundation. Owls do catch prey in complete darkness, but they do this by using their acute sense of hearing (*see* below). The owl's night vision has been estimated to be about 10 to 100 times better than that of man, which is the equivalent of saying that owls probably can see by starlight what a man can see by full moonlight. This night vision presumably enables an owl to find its way about and to avoid trees and branches, but is hardly enough to enable it to find its prey. Diurnal birds may have very poor night vision.

The visual acuity of birds with the keenest vision is probably two or three times that of man. It is also probable that colour sense plays a more emphatic part in the vision of diurnal birds than it does in man (judging by the density of colour-sensitive cones in the peripheral retina of the bird's eye). In detecting motion, too, birds seem to be much more successful than man.

2. Hearing.—Hearing is also keen in birds, and usually second to sight in importance. Birds probably hear a range of sounds equal to that of bird vocalization, that is, from 200 cycles per second to 10 or more kilocycles per second. Experiments have shown that a hen can locate a hidden, peeping chick with the same degree of accuracy shown by a dog or a cat.

Still more interesting are the experiments showing that barn owls can catch mice in complete darkness by locating them by ear, listening to the faint noises that the mice make.

It has also been shown that the South American oilbird, which nests in the darkness of deep caves, guides its flight in caves by uttering audible calls and listening to the echoes from the surrounding obstacles. This compares with the better-known echolocation of bats in which, however, supersonic frequencies are used.

3. Other Senses.—The sense of smell is not well developed in most birds. The flightless kiwis, however, with nostrils uniquely placed near the tip of the bill, are said to locate worms by scent rather than by sight. The sense of taste, located in the base of the tongue and in the oral cavity, is developed to different degrees in various birds. Some birds show a definite preference for a certain kind of food; for instance, a barred owl that eats frogs may reject a toad.

Apparently there is some use of the bill as an organ of touch; this is especially evident in snipe, which probe for worms in the mud. The feet are rather insensitive to touch.

The inner ear, which has large connections with the cerebellar portion of the brain, provides a mechanism for balance and for orientation to gravity.

Other senses that have been postulated for birds include those of direction, time and magnetism. These senses must await more experimental evidence before they can be accepted.

IV. BREEDING

A. Reproduction

Reproduction is as important to the species as food getting is to the individual. Except for the primary sex characters, the gonads and gonaducts, the physical adaptations for reproduction are largely those used in courtship and display. Most other adaptations for breeding are those of behaviour; they include such complicated behaviour patterns as those concerned with the building of elaborate nests.

The cycle of reproduction involves the laying and incubating of eggs and the raising of the young to maturity. This cycle may take only several weeks in many songbirds, but it may take nearly a year in some birds such as albatrosses. Some songbirds may raise two or three broods in quick succession and then rest for months. The albatross may let a year or more elapse between each breeding cycle.

1. Breeding Seasons.—Birds have a definite breeding season followed by a resting period, an alternation that provides a natural rhythm of activity. Each species has its own particular time of year for breeding, but an annual cycle with one breeding season every 12 months is the rule. A notable exception, however, is the sooty tern on Ascension Island that breeds every nine months.

The onset of the breeding season is apparently governed by external factors, foremost among them being light. In temperate climates, breeding usually starts with the advancing spring, at a time when food is becoming more abundant. This timing assures that when the young are ready to fend for themselves, food is readily available.

Experiments have shown that the changing amount of daylight in the spring can start the growth of the bird's gonads, which growth is accompanied by other physiological changes. But in many places in the tropics the breeding seasons may correlate with the end of the dry season and the beginning of the wet one, when the vegetation begins to grow and insects begin to be plentiful.

Even when some external factors are favourable for breeding, other factors may delay or even prevent breeding that year. This is particularly apparent in the arctic, where food supply is an important consideration: snowy owls and skuas, which depend on the hamsterlike lemmings for food, do not breed during certain years when their prey is scarce.

Some birds breed at any time of the year, even in a northern winter, as the crossbills do when the conifers have a good crop of seeds, or as birds in the Australian interior do after rain at any season. In the humid tropics, where conditions are always favourable, some birds may breed the year round—but in general the breeding seasons are surprisingly well marked.

2. Territory and Pairing.—As the time for breeding approaches, birds that are permanent residents, *i.e.*, nonmigrant birds, begin to select their special breeding areas called territories; migrant songbirds return to temperate climates from the tropics and establish their territories; and far-ranging sea gulls and albatrosses gather at their breeding colonies to begin their annual breeding cycle.

The establishment of a territory is the preliminary step in the breeding cycle of many songbirds. A territory is an area defended against competing members of the same species. It is an acre or more in extent for many songbirds, and may serve for

courtship, nesting and all food getting. However, in colonially nesting sea birds and herons and in solitary doves, it may enclose scarcely more than the nest itself. In polygamous birds, such as the black grouse and ruff of Europe and many birds of paradise, there is no enduring pair formation and the territory is no more than a display and mating station. The territory is defended primarily by giving highly specific warning signals, such as the song of songbirds, but seldom by actual fighting. The male commonly establishes and defends the territory, in which he is later joined by the female, but the female of some species chooses the territory and may help in defending it.

The primary significance of territory seems to be social, that is, to reduce disturbance of the breeding pair during reproduction. But it may have secondary effects, such as providing exclusive feeding areas among some songbirds, and it certainly helps to spread out the breeding population in species with well-defined large territories. The importance of these secondary effects is doubtful, for certainly the size of a territory can vary considerably for any one species. In some places the populations may be dense and the defended territory small, while in others the population of the same species may be sparse and the territories large.

There are still other types of loosely defined areas, and other ways of pair formation. For instance, in the canvasback ducks many of the birds may already be paired before they reach their breeding grounds on the prairie marshes, pairing having taken place while the birds were in the winter flocks much farther south; a few canvasbacks, however, pair after the flocks have arrived on the prairie marshes.

When the canvasback pair is ready to nest it takes possession of a small area of water as its territory. This has been chosen by the female and is defended by the drake. The nest usually is outside this territory, and when the female makes a nest and begins laying, the male may accompany her and wait nearby until she rejoins him. The male usually abandons the territory and leaves his mate while she is incubating to go off with others of his kind.

3. Display and Song.—Both display and song are very important in the early mating activities. Song is widely used by dull-coloured species, while it is of lesser importance in birds that have elaborate displays. Displays may include the use of bright patches of coloured plumage; elongated, ornamental tail feathers; flank tufts, or other feathers; wattles; bare gular skin; and bright coloured feet.

Display and song are usually, but not always, the function of the male. In many songbirds a simple display, consisting of partly spread wings and raised head feathers, may be used along with song to defend the boundaries of a territory. There the display may replace actual fighting, and thus the birds are spared the dangers of physical combat. A male's song may serve to attract the female to the territory and to influence her to make a union that will last for one breeding cycle. In cases in which the male, however, is highly ornamented and gives an elaborate display, and the female is dull, the male often has little to do with the female after mating or egg laying; the display has most to do with attracting the female and stimulating her to mate. Voice may be used in this case, also, but it takes a simple form as compared with the elaborate songs given by some birds that make little or no display.

Among the more elaborate displays are those of the birds of paradise (*q.v.*), some of which clear a solitary display area. These birds call frequently and display occasionally in isolation; when a female arrives, however, the male displays violently, exhibiting all his bright plumes. If the female approaches and indicates her readiness by posturing herself, mating takes place, after which a further display is given before she leaves. Other birds of paradise dance in groups, recalling the performances of manakins in the forests of tropical America; and those of black grouse, prairie chickens and ruffs on their communal display areas.

Even though a pair of birds has already established a bond that will last at least one breeding season, a display is sometimes given during actual copulation. This may include precopulatory and postcopulatory display and courtship feeding. An instance of courtship feeding may be seen among the road runners, a species in which male and female are very similar. The male, with a lizard dangling from his bill, approaches the female who is crouched down, fluttering her wings. After the male mounts the female and copulation takes place, the female seizes the lizard and eats it while the male runs quickly around her several times and then runs off. Sometimes in such ceremonies the male may carry nesting materials such as grass in his bill.

Some grebes with elaborate head ornaments in both sexes may pair for the duration of the breeding cycle and periodically display to each other in a variety of poses during the early part of the cycle. This pairing seems to serve to hold the birds together, to reinforce the bond between them until the care of the young directs their activity elsewhere.

In some species, such as herons for instance, in which both sexes have ornamental plumes, nest relief is accompanied by an elaborate mutual display ceremony. (*See* also COURTSHIP, ANIMAL: *The Courtship of Birds.*)

4. Nests and Nest Building.—*Form and Placement.*—A bird's nest is a cradle for the eggs and often a nursery for the young. The basic plan for a nest is a saucer- or cup-shaped hollow, but even this sort of nest may be rudimentary or even absent in some species, whereas very elaborate nests may be made by others.

The nest site chosen by a particular species varies according to geographical location. This is well illustrated by certain herons that make their nests in tall trees in Florida, but on the ground on islands off the Texas coast. There are even differences in sociability from place to place. In eastern Canada the osprey is a solitary bird that places its nest on the top of a lofty dead tree. But farther south, on islands off the coast, the osprey may nest on the ground and in loose colonies.

As a result of man's interference there have been marked changes in the nesting sites chosen by some birds. The use of bird houses for hole-nesting birds such as wrens, titmice, swallows and martins is commonplace. Chimney swifts now nest almost exclusively in chimneys instead of in hollow trees; many cliff swallows now nest on buildings instead of on cliffs; and the peregrine falcon even nests on ledges of city buildings.

Ordinarily birds select a fixed site for a nest, with movement limited to the swaying of a branch in the wind. But there are a number of records of birds that have nested on moving objects. Tree swallows have nested on the ferry boats that ply the St. Lawrence between Ogdensburg, N.Y., and Prescott, Ont., a distance of more than a mile. The nests were tucked into suitable openings on the ferries, and the frequent trips across the river and the docking at different piers did not seem to disturb the birds. A somewhat similar example has been reported from northern British Columbia, where a pair of barn swallows nested in a freight car used on short runs.

As related earlier, in many songbirds the female of the pair selects the actual site of the nest, as in the yellow wagtail of England. But in some species, as the phainopepla of western North America, the male chooses the site and has already started the nest before the female comes to join him. She then adds the lining to the nest that he has started. Among other groups of birds the female canvasback also chooses her nest site, but in the mourning doves both birds try out likely looking places in the branches of trees.

Many birds make their nests in or near their normal feeding habitat; warblers make a nest among the branches through which they flit in search of insects, and terns and many auks and loons make their nests close beside the water where they feed. Grebes even make floating nests on the water.

In some cases the habitat of the nest site may be quite different from that normally used by the bird in feeding. This is well illustrated by the large herons that feed by wading in shallow water, but nest in the tops of tall trees, and by some auklets of the North Pacific that feed in salt water, but fly far inland in Alaska to nest on the mountain slopes above timber line.

Nest Building.—In species in which the sexes meet only for mating, as the hummingbirds and some birds of paradise, the female has charge of all the nesting duties. Even in cases in which a monogamous, enduring pair is formed, the female may do all of

the nest building, as in the red-eyed vireo; but in such cases the male often accompanies the female on her trips for building materials, and sometimes assists her. In the mourning dove the female does all the building, using the material that the male may bring her. In some African weaverbirds and in phainopepla the male builds the framework of the nest, even before he gets a mate, and the female provides the lining. The members of a pair of woodpeckers may share equally in excavating a nest site.

The male long-billed marsh wren builds extra dummy nests without linings; these seem to serve no useful purpose unless some of them are used for sleeping. Some weaverbirds, however, make additional nests after the first has been accepted by a female; these attract other potential mates.

The time that it takes a bird to make a nest varies considerably even among members of a single species. Early in the season a songbird may take several weeks to complete a nest, but later in the season, a pair of the same species nearly ready to lay may make a nest in as many days. Work on the nest does not always cease completely with the laying of the eggs. Occasionally, an incubating bird may add to or rearrange nesting material. A Madagascan weaverbird usually continues to add more fresh grass around the entrance to its retort-shaped nest. Purple martins and some hawks often bring twigs with fresh green leaves to their nests. (*See* NEST.)

5. Eggs and Egg Laying.—*Development of Egg.*—The new chick actually begins its existence when the egg cell, or oöcyte, enormously swollen with yolk, is released from its follicle in the ovary, and fertilized by the sperm that has swum up the oviduct. As the fertilized egg cell descends the oviduct the following materials are added to it, in order: layers of albumen, enclosing parchmentlike membranes and finally the hard, calcareous shell and its coloration. At this time the living portion of the egg cell has developed into a many-celled, minute disc or blastoderm that lies on the side of the yolk. The blastoderm gives rise to the chick embryo. During its life in the egg the embryo will draw its food from the yolk and albumen. There is no air cell in the warm, newly laid egg, but it appears at one end of the egg as the contents cool and contract and increases in size as evaporation of the moisture through the shell causes the egg's contents to decrease in volume.

Size and Shape.—Although the size of the eggs does not correlate exactly with the size of the birds that lay them, the largest eggs are certainly laid by larger birds and the smallest eggs by smaller birds. They vary from the hummingbird's tiny pea-sized egg, less than ½ in. long and weighing less than ½ g., to the ostrich's large egg, about 6½ in. long and weighing about 1,500 g. For comparison, a common leghorn hen's egg may measure about 2½ in. and weigh about 60 g.

In general, smaller birds lay relatively larger eggs than do larger birds. But other correlations exist, too. Birds whose young hatch in a well-developed state (precocial) lay relatively larger eggs than do those whose young hatch in a less developed state (altricial). This is illustrated by a spotted sandpiper, with precocial young, that lays an egg averaging 1.25 × .95 in.; while the American robin, about the same size but with altricial young, lays an egg averaging only 1.1 × .8 in.

For shape, a hen's egg is taken as standard, and is called ovoid. Its longitudinal outline is a distorted ellipse with one end more pointed than the other. This is a very common shape for birds' eggs, but some eggs are much more pointed at the small end than are others; some are really elliptical or long elliptical; and a few, such as those of owls, are round.

The auks and shore birds lay eggs that taper quickly to the small end, eggs that will roll in a small circle. This may be an advantage to auks that lay their eggs on sea-cliff ledges since it tends to reduce the chances that an egg may roll over the edge. This shape also enables four relatively large eggs (the usual clutch of northern shore birds) to fit snugly together, small end in, thus facilitating incubation by the parent.

Colour.—Commonly, the surface of the eggshell has only a slight gloss, but the eggs of the tinamous of South America have a highly glossy, porcelainlike surface, and those of cormorants have a white, chalky outer layer that flakes off to show the blue shell colour underneath. Other variations include the coarsely granulated shell of the cassowary's egg and the pitted surface of the ostrich's egg.

The range in colour of birds' eggs is not as great as that of birds' plumage, but many eggs are beautifully coloured and marked. Depending on the species, the eggs may be white or pale bluish, greenish, buffy, olive or brown; uniform in coloration or spotted, speckled, blotched or scrawled with dark brown or rusty brown. Some colour spots are pale gray or lavender—actually brownish spots beneath the surface of the egg and overlaid with the colour of the shell itself.

The eggs of many songbirds have a wreath of spots around one end. If the shell is white, the newly laid egg may have a rosy tinge from the yellow yolk within. Sometimes, as in the ptarmigan, the markings may cover more of the shell than the ground colour does. The guira cuckoo's egg is a strikingly different one: dark blue with white lines on it. The highly glossed tinamou eggs, which are uniformly green, blue, yellow or chocolate, are also striking.

Although each species of bird tends to lay one type of egg, there may be considerable individual variation. The Atlantic murre, or guillemot, provides one of the extreme examples of this. Its eggs may have a ground colour of white, green or blue, and the shell may vary from nearly unmarked to heavily mottled.

Birds that nest in holes—kingfishers, barbets, woodpeckers and the like—usually lay immaculate white eggs, whereas birds that nest in the open often lay coloured or spotted eggs—most songbirds, gulls, grouse and many others. This generalization suggests that the shell pigmentation may serve a function; perhaps to shield the contents of the egg from the adverse effects of light as well as to make them less conspicuous to a predator's eyes. But it is also true that some birds that do not nest in holes, such as pigeons, lay white eggs, and some hole-nesting birds, such as starlings and nuthatches, lay coloured eggs, so the generalization does not always hold.

Number of Eggs Laid.—The number of eggs a bird lays is more or less constant for each species in a particular area. Some birds, such as albatrosses and shearwaters, some penguins and some tropical pigeons, typically lay but a single egg. Two eggs is the normal clutch for the mourning dove, ruby-throated hummingbird and nighthawk. Northern shore birds commonly lay four eggs. Many ducks, grouse, rails and quail lay larger clutches, up to 20 or more in some quail.

The birds that live in the tropics often lay fewer eggs than do their nearest relatives in more northern latitudes. Thus many tropical songbirds lay only two eggs but most northern songbirds lay four or five. This may apply within a single wide-ranging species. Thus clutches of the European robin vary rather regularly with latitude, from an average of 3.5 eggs in the Canary Islands (30° N.) to 6.3 in Scandinavia (60° N.).

Pattern of Egg Laying.—The usual pattern of egg laying is for a bird to lay an egg each morning until the clutch is complete, but this is not invariable. Some birds customarily lay eggs every other day, or several days apart, and if incubation starts with the first egg, this results in the young hatching on different days. Because of this a brood of young marsh hawks, barn owls or road runners, for instance, may contain individuals of considerably different sizes and ages. This may be a disadvantage to the smallest young, who, being incapable of competing with their hardier kin for food brought by the parents, may suffer from malnutrition.

Some birds apparently lay a specific number of eggs and then stop, regardless of whether some eggs have been taken from or added to the nest, thus disturbing the normal number of eggs in the clutch. The herring gull is such a species. On the other hand, some birds will replace an egg that has been removed from the nest during laying. The yellow-shafted flicker that was induced to lay 71 eggs in a 73-day period has become a classical example of this.

6. Incubation.—Heat must be applied to the egg so that the embryo within will develop. The heat is normally provided by the parent sitting on the eggs and holding her warm breast against

them. To facilitate this warming of the eggs, incubation or brood patches may develop on the parent's skin at the proper season. These are areas of skin with increased blood supply, and from which feathers have been shed.

The incubation period, or time it takes an egg to hatch, varies widely, from 11 days to nearly 3 months, depending on the species.

In many songbirds the incubation period is 11 to 15 days, but in some it may approach 3 weeks. Woodpeckers, cuckoos and pigeons have about the same incubation period as songbirds, whereas hummingbirds, swifts and nightjars have 16 to 20 days. A 3–4 week incubation period is usual for plovers, sandpipers, grouse, pheasants, grebes, cormorants and herons; a 6 week period for ducks, geese and swans; a 4–8 week period for hawks and eagles; and a 9–11 week period for albatrosses.

As might be expected, the shortest incubation periods generally are shown by small birds; the longest by large birds. These differences are not attributable to size alone, for small hummingbirds have a relatively long incubation period of 16 to 18 days; the thrush-sized storm petrels, a period of as much as 7 weeks; and the ostrich, a period of only about 6 weeks.

Usually the female incubates, and the male may or may not share this duty with her. But in some groups, such as the button quails (*Turnix*), some ostrichlike birds and the phalaropes, the male does all the incubating.

When the male and the female share incubating, alternating on the nest, the eggs may only rarely be left uncovered. When the female does all or most of the incubating her mate may bring her food. Short periods of cooling do no appreciable harm to the eggs except in very cold weather, and they are often left uncovered while the female goes to feed. In some groups, such as some ducks, the female is deserted by her mate early in the incubation period, and she then carries on alone; in most grouse and pheasants, the female is deserted by the cock even earlier, immediately after the eggs are laid.

In some species when the eggs are periodically left untended by the bird they are camouflaged in various ways. The female eider duck pulls the edges of the downy lining of the nest over the eggs when she leaves, and the grebe covers its eggs with material from the side of the nest. This covering is apparently only for the concealment of the eggs.

A most unusual case is that of the Egyptian plover, or courser. It nests on sand bars and normally buries its eggs in the sand. The bird has been seen to sit on the sand above the buried eggs and to regurgitate water on the nest. Since she is nesting under a tropical sun, without shade, she may do this in part to protect the eggs from excessive heat.

The megapode's eggs, buried in the ground, hatch by the heat of decaying vegetation or of sunwarmed or volcanic sands, depending on the location, and neither sex incubates.

The time that individual birds of different species spend continuously on the nest, incubating eggs, may vary greatly. Some extremes are as follows: in many small, active songbirds the incubating birds may leave the nest twice an hour or even oftener; in many hawks, periods of continuous incubation may last for hours; in some gallinaceous birds the bird may leave the nest only once a day. In some pigeons the two parents may alternate incubating, the male incubating during the midday hours, the female the rest of the time. In albatrosses the attentive periods of each parent may last several days, during which time the setting bird fasts completely. In some parrots the female incubates almost continuously, being fed by the male. In some hornbills the female walls herself in the nest and is fed throughout incubation by the male. In the emperor penguin the male alone incubates, and continuously, for the whole 60-day period, and eats nothing the while.

B. The Young

1. Hatching and Development.—As the time for emerging from the egg approaches, the chick makes small movements and utters little chirps or calls within the egg. The young bird, using the egg tooth, a little protuberance on top of the end of the upper bill, pips the shell as it moves its head and rotates its body within the egg. From the time the first puncture appears in the shell until the young struggles out may take nearly a day, even in small songbirds; in some larger birds several days may be needed.

A young songbird at hatching is naked (or nearly so) and blind, and for some days its activities are limited to gaping for food, which the parents thrust into its mouth, and resting quietly in the nest. Young hatched in this helpless condition are termed altricial, or nidicolous. Among the larger birds cormorants and birds of prey are altricial.

A young quail, duck or killdeer, on the other hand, is covered with down when it hatches, and as soon as it is dry is able to walk about, follow its parent and pick up its own food. Birds hatched in such an advanced state are called precocial, or nidifugous. Included among them are grouse and pheasant. Young megapodes show the extreme of precocial development. They burrow out on hatching and fly as soon as their plumage dries. Between these two extremes, the altricial and the precocial, are many birds whose young hatch in intermediate stages. For instance, young nightjars, terns and gulls at hatching are downcovered and soon are able to move a little but depend on their parents to bring them food.

The development of precocial young at hatching is so far advanced, both physically and in behaviour, that it is equivalent to that of young altricial birds when they leave the nest. This, of course, leads to great differences in the infancy of the two types.

2. Parental Care.—The period of dependency in the nest for a young songbird may be as short as two weeks. During this time a coat of feathers appears, the eyes open and an awareness of the environment develops. The young may sit up and look about, beg vociferously when it sees the parent approaching with food, preen its feathers, flap its wings and when alarmed crouch down into the bottom of the nest. For the first few days the parents brood them, *i.e.*, cover and warm them, most of the time. After that they are brooded only at night.

Among the birds with altricial young, many songbirds bring food in the bill and simply stuff it into the gaping maw of the young bird. The young of hawks and owls nibble bits of meat held in the parents' bills, but they soon learn to tear to pieces the whole carcasses of small animals that the parent brings to the nest. Gulls regurgitate food in front of their young, which help themselves to it. Cormorants and pelicans bring fish in their gullets, but in these groups the young puts its head into the throat of the parent and rummages about for the stored and largely undigested fish. Hummingbirds reverse this process: the female inserts her long bill into the throat of the young bird and injects nectar and tiny insects into its gullet.

More completely processed food is provided by pigeons, which, in the early days of the nestling period, provide "pigeon milk," a secretion of the crop. The young puts its bill in that of the parent which pumps the food into the gullet of the young. The petrels feed their young in a similar manner but on a diet of semiliquid, partly digested material from the stomach.

Small, active songbirds are busy all day carrying food to their young, a mouthful at a time. The two parents of a group, or brood, of swallows may make as many as 40 trips per hour with food. In the phainopepla, in which the adults carry as many as seven berries in the throat at once, and regurgitate them for the young, the feeding rate may be as low as two or three trips an hour. The American robin brings worms in its bill six or seven times an hour. In some hawks food may be brought only a few times a day, and often there is an abundance of food lying on the top of the nest. The European sparrow hawk may make only two or three trips a day for food when the young are small, but make trips more often when the young are well along in growth, and need more food. Gulls may make several trips per hour; cormorants, one per hour; tropic birds, only two or three trips per day; whereas albatrosses may make trips several days apart.

To prevent the nest from becoming foul with excrement, two methods of nest sanitation are used. One is well illustrated by those songbirds in which the young, after being fed, raises the rear part of its body and voids the excrement in a gelatinous sac. The parent bird waits for this sac and either eats it or carries it away and drops it. The other way is illustrated by young hawks and

other birds that turn and void forcibly over the edge of the nest so that the excrement falls clear of it. Although the immediate vicinity of the nests of some birds, such as kingfishers and hoopoes, that lay their eggs in holes may become much fouled, the young birds remain clean. The odour of rotting fish and excrement, present in the colonies of such birds as herons and cormorants, seems to have no effect on these birds, for, like most birds, they have little or no sense of smell.

3. Leaving the Nest.—The altricial young of most songbirds leave the nest before they can fly well. For several days they sit quietly in trees, shrubbery or grass, and the parents bring them food. When they are able to fly better they may follow the parent, and it is no uncommon sight in the spring to see a full-grown young robin begging food from an older bird. Even young swallows that are able to fly well when they leave the nest sit on perches, and the parents feed them for a while.

The situation with some auks and shearwaters is very different. The young have a long period in the nest, during which time the parents care for them. Then, long before the young can fly, the parents desert them and may even start off on migration. The young stay in the nest and complete their growth by using the fat they have accumulated; then, without parental care or guidance, they set out into the world by themselves.

In such precocial birds as the pheasants, quail, shore birds and ducks, the downy young leave the nest on hatching and accompany their parents, who lead them into suitable habitats; the parents call them to come to food that has been found, break up food for the young, call an alarm when a predator appears and may even brood the young at night. Young grouse and quail grow their feathers quickly, and in a few days are able to fly short distances. Young ducks, however, delay the development of their wings until they are nearly full grown. The young of the megapodes, as described earlier, are down-covered at hatching and go their independent way without ever knowing a parent's care.

4. Social Parasites (Cuckoos, etc.).—One of the most aberrant types of nesting behaviour is that of the social parasites, birds that lay their eggs in the nests of other birds and leave them to be incubated and the young reared by the foster parents. This habit is best known in the European cuckoo and in the North American cowbird (a new world icterid blackbird), but some other cuckoos and cowbirds, honey guides, some African weaverbirds and a South American duck also have this habit.

Remarkably enough, in the European cuckoo, for which about 50 different birds have served as foster parents, some individual females are said to lay their eggs in the nests of only a single species of foster parents; moreover, the eggs of this female cuckoo bear a close resemblance to the eggs of the special foster parent. Instinctively, when the cuckoo lays her own egg, she completes the deception by removing one of those already in the nest. The young cuckoo, upon hatching, ejects the other occupants of the nest, eggs or small young, by backing them to the rim of the nest and letting them roll out. Thus, the young cuckoo becomes the sole recipient of the attention of the foster parents.

The cowbird, for which 160 host species and subspecies have been recorded, has none of the cuckoo's methods of getting rid of eggs or young in the nest. Instead, the young cowbird grows so rapidly that it soon surpasses its nest mates in size and strength; thus it usually takes so large a share of the food that the other young birds may starve to death.

Not all chosen foster parents of the cowbird accept the role selected for them. Some may desert the nest when a strange egg is placed there, and some may build a new floor on the nest, thus burying the cowbird egg. The yellow warbler has been known to do this several times in succession. Other birds, such as the American robin and the catbird, may throw out a cowbird egg.

Many birds, however, are obviously unaware that the cowbird's egg is not their own, and these foster parents raise the strange young even though, in some cases, their charges greatly outsize them. It is remarkable that the young of these social parasites develop all the traits of their own species; they are completely uninfluenced by the very different voice and habits of their foster parents.

V. BEHAVIOUR

The behaviour of birds is caused by both instinct and learning. There no doubt is a broad range of bird activities the patterns of which are inherited. But just where and how the bird uses these activities may be greatly modified by the individual bird's experience. Each bird gains some of this experience through direct contact with its environment, some through association with its parents or its fellows.

1. Instinct and Learning.—*Instinctive Behaviour.*—Those habits or behaviour patterns that are as rigidly inherited and as inflexible as is the bird's structure are termed instinctive. Individual variations and aberrations in habits occur, just as they do in structure, but aside from these the behaviour pattern is constant for each species. This rigidity of behaviour is nowhere better illustrated than in nest building activities: the nest is considered as the concrete record of an elaborate pattern of behaviour, for each species has its own type of nest.

The instinctive control of elaborate behaviour patterns is apparently particularly strong in activities regarding reproduction. Rigid, built-in behaviour patterns that assure the continuance of species are obviously of considerable survival value to animals that have short average life spans and rapid turnovers in population. (*See* also INSTINCT.)

In matters of enemy recognition and in feeding, behaviour is apparently less rigidly controlled by instinct and more affected by learning. The enemy-recognition response is generalized: the young bird flees from any large object, a response that more or less assures that the inexperienced young will escape when a predator approaches it. The method of picking up food is instinctive; however, response to types of food is not so rigidly controlled, for it might well be a disadvantage should one type of food become scarce.

The study of bird behaviour has been given much impetus since the development of ethology, an interdisciplinary science that focuses its attention on instinctive behaviour patterns, the elaborate specific patterns of action. (*See* ANIMAL BEHAVIOUR for a discussion of the concepts involved in instinct.) The original outline of the sequence of events involved in an instinctive action, formulated by K. Lorenz in the 1930s, was beautiful in its simplicity and its avoidance of certain undesirable psychological implications. Lorenz' concept of instinct, particularly under the stimulus given it by N. Tinbergen, has been the basis of modern comparative ethology; however, it has been greatly modified, particularly in that drives feature more prominently in the study and in that learning is incorporated into appetitive behaviour.

Learning.—In the first quarter of the 20th century it was commonplace to read that birds were creatures of instinct, with very limited intelligence. By mid-century it had been demonstrated that the learning ability of birds may be as great as that of any animals except the highest mammals. Research continues, and another quarter century probably will see drastic revision of many of the mid-century concepts. (*See* also LEARNING.)

Maturation.—Care must be taken not to confuse the maturation of a behaviour pattern with learning. It is commonly said that the flapping of the wings of a young bird in the nest is connected with the bird's learning to fly. But young birds experimentally prevented from flapping their wings during their infancy flew just as well the first time as did those that had been allowed freedom to flap.

Trial-and-Error Learning.—A young bird, without experience of water, often goes through the motions of bathing outside the water; it is only by accident that it learns to associate these movements with bathing in water. Similarly, a young bird pecks at all sorts of things in its environment and finds that only some of them are edible; finally it learns to prefer only the edible objects. The actions themselves are instinctive, but their application is modified by experience. Similar trial-and-error learning surely plays an important part in other adjustments to everyday living, even in those birds that instinctively restrict their activities to a narrow section of possible habitats.

Puzzle boxes and mazes have been used to demonstrate this type of learning. Siskins have learned, by trial and error, which one

of a row of similar boxes to open for food. Mazes like those used in testing rats are less suitable for testing birds because of the very different habits of the two animals. Pigeons and sparrows, however, have shown considerable skill in learning a route through a maze.

Habituation.—Learning not to respond when a response is unnecessary is termed habituation. A good example of habituation is seen in enemy recognition. While a few types of enemies may be instinctively recognized and responded to, there is a more widespread, generalized response to danger. Gradually, however, a bird learns that certain things initially feared are not dangerous. This is well seen in the birds that come to a winter feeding station just outside a window. At first they flee at the slightest movement within the house, but as winter progresses they become bold and tame and come to disregard such activity.

Insight or Latent Learning.—In this type of learning, the experience gained earlier is used in a delayed response. Perhaps the simplest case is that in which a bird has become familiar with its territory and travels back and forth through it easily. It can go directly to the nest even though it cannot see the nest until close to it. The nutcrackers of Europe that bury nuts in the autumn and dig them up in the winter are good examples of birds using a long-delayed response.

Detour Problems.—Comparatively little has been done in studying detour behaviour (*i.e.*, going around an obstacle) in birds, though the domestic hen has demonstrated a lack of it: the hens peck at a piece of glass covering food without attempting to get around the glass.

Tool Using.—Tool using, as exemplified by the Galapagos finch that uses a stick or spine to get insects from cracks, can be attributed to either instinct or insight. But the string pulling of some birds, such as chickadees and jays that quickly pull up a string to get food attached to the end of it, perhaps qualifies as a better example of tool using.

Counting.—There is also good evidence that birds have some concept of quantity or number. Counting of course is done only by human beings, who have names for the numbers, but the recognition of numbers of things, such as marks on a paper, without counting, is possible. This is a prelinguistic number sense. Although individual performance varies, birds can recognize, without counting, up to eight units, though some reach only five. (Interestingly, this is about the same as a man does.) A raven was shown to recognize up to six spots by matching the number of spots on a card with the same number of spots on a box containing food and choosing it from among other boxes without food and with different numbers of spots.

Imitation.—That a bird can learn to solve a problem by seeing another bird solve it has not been demonstrated (though the manner in which the ability to tear the tops from milk bottles spread through British populations of blue and great tits suggests it). True visual imitation in learning, therefore, is not accepted as playing a part in bird behaviour. Birds, however, do profit by the activities of other birds that they see, but in a different way. Crows in a flock, seeing one of their number shot or poisoned, become very shy of a man with a gun, or of the situation in which the poisoning occurred. This type of learning through social facilitation is probably very widespread in birds. The role of a few tame birds can be very important in getting wild birds used to a sanctuary. Becoming tame or wary through habituation is very evident as is also the manner in which birds pay attention to the warnings of other birds.

Another type of imitation is found among birds such as mockingbirds that repeat many of the sounds they hear, and parrots that learn to imitate human speech. This is apparently imitation used in play.

The manner in which some young birds learn their song from the adult is imitation of a special sort, mentioned below.

Imprinting.—This is an innate disposition for birds to learn certain things only at early periods of their lives. A good example of imprinting is the manner in which young geese reared from the egg in isolation follow their keeper, the first moving object they see; they regard him as they would their parent, and later as a mate or rival. Imprinting can happen in a very short time, and it used to be considered permanent and irreversible, but this is not always true. There is no definite boundary between it and other types of learning. Imprinting, as a disposition to learn certain things in a certain way at an early stage, is recognized in the singing of some birds. Although the song of some species is largely innate, in others, when the young birds are raised in isolation and do not hear the song of their own species, they do not develop the typical song of the species. They may invent a song of their own or may copy that of some other species that they hear singing.

2. Play, Flocking, Dominance, etc.—*Play.*—Like the concept of instinct, that of play has been in and out of fashion. The concept was in vogue again in the mid-20th century. Certainly play is a very real component of some birds' activities. A flock of swallows flying about and carrying a feather, each one holding it for a few moments, then dropping it and another seizing it, and so on, is a good example. Other activities considered as play are the talking of parrots; the seizing of twigs as though they were prey by young raptorial birds; the juggling of fruits by hornbills; and the soaring of pelicans on an updraft of air. Such activities, apparently done for their own sake as leisure activities, are comparable perhaps to the exploratory activities of many birds that apparently need to be active. As a secondary effect play activities can be of importance in developing skills.

Flocking.—Since birds are able to move about easily, have keen eyesight and a wide awareness of their surroundings, it is not surprising, in areas where they are abundant, to find numbers of them coming together naturally as American robins do to a cherry tree, gulls to a fishing boat, or ducks, terns and American blackbirds to a favourite habitat in a prairie marsh. On the other hand, when a flock of sandpipers gathers on one part of a beach, or a flock of American blackbirds drifts across an October landscape, they are obviously held together by a liking for each others' company, a gregariousness.

This gregarious flocking is especially evident in the nonbreeding season and usually involves birds of one species, in larger or smaller numbers. But the liking for company often transcends species limits, as is well seen in the winter flocks of chickadees that are often accompanied by a nuthatch or two, or in the woodpecker that has shunned the company of its own kind for that of the chickadees. The great mixed flocks of birds of the tropical forest in which are included a dozen or more species and scores of individuals are good examples of interspecific gregariousness.

Sometimes single birds or a few individuals of one species join the flocks of other species and, as though caught up in the larger flock, may live and travel with it for some time. A few mallard ducks have been reported to have thus consorted with a sand grouse flock, an association that is remarkable considering the differences in habits and habitat between these species. Strays far from their normal haunts occasionally take up with quite different birds. An albatross from the southern oceans found its way to the North Atlantic and lived for 34 years with the gannets of the Faeroe Islands. Flocks of birds often derive advantages from co-operative feeding and from acting together to avoid their enemies.

There are some regular associations between different bird species, and between birds and mammals, that are advantageous for the birds. The hornbills in the Congo forests follow bands of monkeys for the sake of the insects that the monkeys stir up. The most extreme case of a bird-mammal association is that of the oxpecker of Africa that feeds entirely on the parasites of big game animals and cattle.

Dominance.—Within a flock made up of one species there may be a well-defined, rigid social hierarchy. This has been demonstrated in the so-called peck-order in the domestic hen. In a flock of hens the dominant hen (A) asserts its authority by pecking any hen below it, *i.e.*, all the others in the flock; the next (B) pecks all the hens, except hen A; and so on to the lowest bird in the hierarchy, which has no other hen to peck. The place of the birds in this social order is determined through aggressive encounters early in life, but the relationships do not always remain constant.

Low-ranking birds may become more vigorous and fight their way up to a higher rank. That this is sometimes the result of a physiological change has been demonstrated experimentally by the injection of hormones. Not all dominance is the straight-line A to B to C type. For example, in some birds, although A may peck B and B peck C, C may peck A, but not B. Canada geese families may behave as units, one family being dominant over another family.

Dominance, both between birds of a single species and between those of different species, can be observed easily at a feeding station, where, among a group of birds, the dominant bird is the first to feed. It has been thought that dominance is of value in reducing the amount of fighting in a flock, once the social hierarchy is established.

Although flocking is much less common during the breeding season, some species display in groups as do the blackcock, the ruff and the prairie chicken. Other birds nest in close colonies, as do terns on a sandbar, auks on a cliff and weaverbirds in a tree, even though many other, apparently equally suitable nesting places exist. In colonial nesting behaviour there may be advantages in numbers of birds to fight off predators; furthermore, the presence of such close neighbours may stimulate breeding.

In nesting, social aggregations may transcend species limits, as in feeding. This is well shown in the arid country of Central America, where a single, thorny tree may hold the nests of each of several species of birds including doves, orioles and flycatchers, while other trees nearby, each apparently equally suitable, are not used.

Species Recognition.—The first social contacts of the young bird are of course with its parents. All birds (except the megapodes, which start their lives without parental supervision) have some parental care. In geese the family, male, female and young, may stay together for nearly a year. In some grouse the family parties lose their identity in the autumn. Among most of the ducks, the male is never part of the family group, which breaks up when the young become full-winged. The same post-fledgling dispersal is probably true of most songbirds.

In some petrels and auks the young, cared for by the parents in the nest for a time, are soon deserted and left to follow their species' way of life without the influence of their parents. The young of the parasitic cuckoos and cowbirds, raised by foster parents, start their lives under the care of these parents and later form flocks with other young birds of their own kind.

Thus species recognition may be instinctive, but within a flock in which there is strict social dominance it is obvious that each bird recognizes every other bird, probably by minute individual differences in appearance. Voice may be important in species and individual recognition as well as in communicating between individuals. Certainly solitary plovers will come to a whistled imitation of their call, and a nesting gull will recognize the call of its returning mate. Also much information may be transmitted by signaling movements. An alert, upraised head, a flick of the wings or a sudden starting into flight of one member of a flock may alert the other members or send them fleeing even when they are unaware of any danger. One of the best examples of visual acuity and the rapid use of visual clues is the manner in which a flock of shore birds will twist and turn in unison, apparently taking their cue from the birds in front.

3. Migration.—Some birds have adapted their behaviour to living in one region part of the year and in another the rest of the year. Often their annual journeys back and forth, their migrations, take them to temperate or arctic regions for the favourable summer season when they breed, and to the more uniform tropical regions for the rest of their year when they do not breed. (*See* MIGRATION, BIRD.)

4. Summary.—The above is a short survey of some of the recent trends in the investigation of bird behaviour. To delve still deeper into the subject leads to speculation about what goes on inside the bird, especially inside its brain. There are the questions of how messages are received from the environment, how the data are organized and how the responses are initiated and controlled. All these internal processes may be influenced by hormones and by other physiological changes.

In every period of time there are fashions in terminology and in interpretation, in methods and in goals. Some students concentrate on the inherited aspects of the bird's activities; some try to analyze the extent of instinctive *v.* learned behaviour; some study learning; and some merely record what birds do.

Various approaches are used: observational, experimental, psychological and physiological. Philosophical discussions centre on directions and meanings in their widest sense. All these add to the richness of our understanding of a bird's activities. But such a diversity of approaches and schools of thought, of interpretation and language of presentation, make much of the work on bird behaviour the province of the specialist.

In everyday accounts of what we see, it is difficult to avoid subjective interpretations or anthropomorphizing. Indeed many of the exploratory activities of birds in trial-and-error learning and in latent learning could be discussed under the heading "curiosity." "Antagonism," "pugnacity" or "anger" would seem to express the quarrelsomeness of some woodpeckers, normally solitary in nature, when kept in captivity in close contact with each other. "Fear" could be the heading and theme of the paragraph on enemy recognition and avoidance. Indeed the "drives" of the psychologist sometimes appear to be synonomous with the "moods" and "emotions" of more general terminology. *See* also PSYCHOLOGY, COMPARATIVE. (A. L. RD.)

VI. TYPES OF LIVING BIRDS

Mammals are specialized for various modes of life: on land (as the deer and mouse), in water (as the whale), in the air (as the bat), in the ground (as the mole), etc. But most birds are specialized only for existence or progression through the air. Although it is common for birds to nest in holes or tunnels in the earth, which, in many cases, are excavated specially for this purpose, no bird has been able to adapt itself to continuous life underground, probably because its covering of feathers is not designed to withstand the constant abrasion that would take place in burrowing. Also, though many birds frequent the water, none are so wholly adapted to life beneath the surface as the whales. Birds thus have failed to utilize as completely as mammals the ecological environments that have been available to them—an example of the way in which greater specialization makes for inferior adaptability.

1. Land Forms.—Birds adapted to a terrestrial existence are found in many widely separated groups, as, for example, ostriches, quail, bustards, plovers, larks and pipits. Most of these appear to have adopted a terrestrial habit to secure food and safety from enemies. They run about on the ground and, though the greater number retain the power of flight, often trust to their legs to escape ordinary pursuit. Most of them show the greatest variety in regions of extensive plains, prairies or broad, open downs. The wholly terrestrial forms that have entirely lost the power of flight are comparatively few, and (as far as continental areas are concerned) are birds of considerable size and strength. Among living forms they include the ostriches of Africa, which ranged formerly to Arabia (extinct there by 1941); the cassowaries of the forests of New Guinea and adjacent areas; the emus of Australia; the kiwis of New Zealand; and the rheas of South America. These birds, though they appear to be united by certain peculiarities, differ widely from one another, and seem to represent ancient types of bird that were formerly more abundant, as a number of fossil forms are known. It will be noted that large flightless birds exist in modern times in all of the continents except North America, where they have not been represented since the Eocene.

The kiwis (*Apteryx*) of New Zealand, the most unbirdlike of living birds, are nocturnal and have different habits from the other species mentioned. They have long bills with the nostrils at the extreme tip, and move about by using the bill to test the ground before them as a blind man uses a cane, noting their surroundings partly by touch and partly by smell. On casual examination they seem to have no wings, but on investigation the wing is found concealed beneath the feathers, a tiny structure, a little more than three inches long when fully extended, and entirely without

flying function, as the bird is heavier than an ordinary fowl.

The cassowaries, like the kiwis, inhabit forest areas, but are far less peculiar. The wings are small, with heavy, naked quills nearly concealed beneath the long, hairlike feathers, and there is a curious casque on the head. It is said that the bird uses both casque and wing quills to fend off entangling vines in traveling through the jungle. The wings of emus also are small, but ostriches and rheas have larger wings, which they may extend while running, though they are wholly without power of flight. In all these birds the body is heavy and the legs are large and strong. With those fleetest in running there is a tendency to reduction in the number of toes, so that none has more than three and the ostrich only two. That these birds have come from flying ancestors is indicated by the wing, which, while small and weak, has the bones formed as in flying species. All the species discussed have the external surface of the breastbone smooth, without the great keel so characteristic of the flying birds. This is associated with there being no necessity for large muscle attachment because in flightless birds the muscles usually concerned in flying have little development.

There is another type of terrestrial bird that has developed more recently than those just discussed, found mainly on oceanic islands. This includes various species of flightless rails, and some other birds that have lived under conditions in which they had no enemies from whom it has been necessary to escape by flying. Thus these birds evolved into flightless forms; however, the wing retains the same form encountered in flying birds and the breastbone still has a keel, though this may be greatly reduced in size. The weka rails of New Zealand are the most striking living examples of this group; they are nearly as large as a fowl, and run with great ease and rapidity. Some other flightless rails are much smaller, for example the recently extinct Laysan rail (*Porzanula palmeri*), formerly native of Laysan Island in the Hawaiian Islands, which was not much larger than a newly hatched chicken. In running fast this bird extended its wings and flapped them rapidly, but was unable to rise from the ground. Many other insular birds show a tendency to degeneration of the wing but still can fly.

2. Water Forms.—Among birds adapted to life in the water, the penguins are pre-eminent. These include about 15 species found in southern seas, ranging in size from the great emperor penguin (*Aptenodytes forsteri*), which is 48 in. long and weighs up to 94 lb., to the little blue penguin (*Eudyptula minor*) of New Zealand, southeastern Australia and the Chatham Islands, which is only 16 in. in length. Penguins have thick, heavy bodies, more or less elongated, and are covered uniformly with dense, soft feathers, without the bare spaces or apteria that in other birds divide the feather growths into distinct tracts. The wing is a short, broad paddle, without developed quills, the feathers being close-set and stiff, almost like the scales of a reptile. In the water the penguin rests comparatively low. Beneath the surface it progresses literally by flying, the flattened wings driving the bird through its aquatic medium swiftly and gracefully, while the feet are extended behind and serve as a rudder. Penguins seem to have possessed their present type of body since Eocene time; but they must have come originally from a flying stock.

Other types of birds developed for life in the water include loons, or divers, and grebes, whose progress beneath the surface is accomplished, usually, by the use of the broad feet alone, the wings being held close to the sides, except when the birds are frightened or under other unusual circumstances. The downy young dive by use of both wings and feet, indicating that "flying" under water is perhaps a primitive method. The auks and guillemots use the wings beneath the surface as in the air above. The cormorants and snakebirds progress by use of feet, though wings may be partly open. Diving ducks, as mergansers, scaups, redheads, pochards and goldeneyes, regularly use the feet, though in the same group old squaws (long-tailed ducks), scoters and eiders may use both wings and feet beneath the surface. The curious diving petrels (*Pelecanoides*) of the southern hemisphere fly swiftly beneath the water and may burst out through the surface in full flight.

3. Night Flyers.—Birds adapted for life at night are fairly numerous and are typified especially by members of the nightjar and owl families, though specialized forms occur among a number of other groups. Most nocturnal birds have large eyes that usually reflect light with a prominent reddish or orange colour. The eyes of many nightjars glow like dull coals of fire by the reflected light of a flashlight and may be seen for a considerable distance. One of the American nighthawks (*Chordeiles acutipennis*) is an exception, since the eyes shine only faintly with a yellowish green hue. Most nocturnal birds actually see at night by a specialized eye adapted to collect the faintest rays of light. Only the kiwis (*Apteryx*) among habitually nocturnal species appear almost blind.

VII. GEOGRAPHIC DISTRIBUTION

The laws governing geographic distribution (*see* ANIMALS, DISTRIBUTION OF), through which each faunal area has its own peculiar forms, apply to birds as to all other animals, in spite of the easy method of travel possible for the bird. Few birds are cosmopolitan. As an example may be mentioned the sanderling (*Crocethia alba*), which at some season may be found along water almost anywhere on the earth, but which nests only in the arctic regions, passing southward in migration throughout the world, to return in spring to its breeding area. The barn owl (*Tyto* species), resident through wide areas in the temperate and tropical regions of the earth so that it reaches all the continents, has reacted to its environment in such a way that more than 50 geographic forms, some sufficiently distinct to be called species, have been recognized. In contrast to this, many kinds are confined within very narrow limits, as the very distinct Laysan teal (*Anas laysanensis*), found only about the shores of one small lagoon on Laysan Island in the Hawaiian Bird reservation, where it has a range of only about one square mile.

Birds, in general, have attained a vast distribution over the surface of the globe because of their ability in flight and their specialization for life on both land and water. As a result of this versatility and adaptability some form of bird is found at some season everywhere over the world, except perhaps in the centre of the great unexplored antarctic continent. Broad areas of the sea, away from the great ocean currents that flow like rivers through this aquatic medium, may appear birdless for days and weeks, but are crossed at certain seasons by some of the petrels in their wanderings. The seas and lands within the Arctic circle are visited by many birds, some of which, like the raven and snow bunting, nest far north in Greenland, and some, like ducks and gulls, in summer traverse the solitudes of the north polar sea.

As individuals, birds may be tremendously abundant in temperate regions, but it is within the tropics that the greatest variety of forms occur within small limits. The largest aggregations are found in regions of diversified topography, where the life zones change within a comparatively few miles from tropical to alpine. The greatest density and variety of birds have been reported from certain areas in South America. (A. WT.)

VIII. VITAL STATISTICS

1. Populations and Numbers.—The relative number of individuals of different species of birds is usually expressed in comparative terms: rare, common, abundant, etc. Of course, actual counts of birds seen per unit of time or unit of area are more satisfactory, and many data of this sort are used for estimates of populations over large areas.

In a few cases in which the bird species has small numbers and a limited range, or the members are large and conspicuous, reasonably accurate counts of the whole world population are possible. Some examples of North American species with very small numbers, and thus facing extinction, are the whooping crane (33 individuals in 1960), California condor (60 in 1950) and ivory-billed woodpecker (possibly extinct in the early 1960s). In a precarious state in other parts of the world are the cahow petrel of Bermuda, the shore plover of New Zealand and the Nene goose of Hawaii.

There are reasonably close counts of some species with larger numbers but with restricted wintering or breeding grounds: Ross's goose (2,000 birds nesting in arctic Canada in 1949), Kirtland's warbler (breeding only in Michigan, 1,000 birds estimated in 1959)

and greater snow goose (about 42,000 in 1954, on their wintering grounds in the eastern United States).

Some very numerous species with restricted breeding grounds have also had fairly close estimates made from counts: the greater shearwater, which breeds only on the island of Tristan da Cunha in the mid-south Atlantic, numbered 2,000,000–2,500,000 pairs in 1952; the gannet, which nests on islands on both sides of the North Atlantic, approximated 83,000 pairs in 1939.

But these numbers are small compared with the "millions" of such pelagic sea birds as Wilson's petrel and the whalebirds nesting in the antarctic and fluttering over the oceans. Many single roosts of common blackbirds (several species) in the central United States have been estimated to contain from 1,000,000 to 15,000,000 birds; a single roost of house sparrows in Egypt was estimated to contain 100,000 birds, gathered to their sleeping perches from a four-mile radius.

Censuses of breeding birds have provided interesting data on the density of some species. For instance, a census in a forest area in the eastern United States indicated that 26 species of birds occurred in the area and that their density ranged from 2 to 55 pairs per 100 acres, with a total density of all species reaching 325 pairs per 100 acres. Different habitats of course give different results, and the results vary from year to year.

Using such data as these, and estimating the extent of available habitat, it has been calculated that there are about 5,000,000,000 breeding land birds in the United States and 120,000,000 in Great Britain.

2. Ages and Sex Ratios.—*Age at Sexual Maturity.*—It is a common conception that most birds reach sexual maturity several months short of a full year and breed in their second year. In view of the known short life span of many birds this would seem to be essential for carrying on the species. That the period up to sexual maturity may be considerably shorter, however, is indicated by records of captive birds that have laid eggs at three to six months of age. At the other extreme there are some species, especially large birds, in which the young do not breed in their first year. Many hawks and gulls do not breed until they are two years old. Some large hawks and storks may be six years old, and some albatrosses eight, when they first breed. The age at first breeding also may differ between males and females of particular species. In some American blackbirds females commonly breed in the season following their birth, but the males do not breed until a year later.

Sex Ratio.—The preponderance of drakes over ducks in some hunters' bags and in traps operated for banding birds, and the preponderance of females in breeding colonies of some American blackbirds in which polygamy is practised, have led to much speculation regarding the sex ratio of birds at hatching and at later stages in life. In some species an approximation of the expected 50% males and 50% females has been found in young birds, for instance, barnyard fowl, some quail and the boat-tailed grackle. In 1940 an unbalanced sex ratio of 30% males and 70% females was reported for the young boat-tailed grackle; however, work reported in 1960 disproved that estimate in favour of the 50% male–50% female ratio.

Irrespective of the sex ratio in the whole population, units of populations may have a preponderance of one sex or another. In the blackbird breeding colonies mentioned above, there are two or three females to every male, in part at least because the earlier maturing first-year females are present and the first-year males absent. Drakes are often found in greater numbers than ducks since, while ducks are incubating their eggs, the drakes gather by themselves in flocks, sometimes far from the breeding grounds. In the nonbreeding season flocks of birds may be composed predominantly of one sex or the other, and such flocks may differ in migration, feeding and roosting patterns. For instance, in the southeastern United States flocks of male grackles commonly visit city parks, but the females stay in farming country out of town. In the northeastern United States the early arriving flocks of red-winged blackbirds are composed entirely of adult males.

Age and Mortality.—Compared with many lower animals birds are specialized in having fewer young and in giving the young considerable parental care to aid them in getting a start in life. Even a quail with 20 eggs or a robin with several clutches of 4 or 5 eggs a season represents conservation when compared with a frog that lays several thousand eggs each year. But despite the solicitude of adult birds for their young, mortality is high, and in the first year of life 35%–80% may die. The mortality rate of the survivors drops in subsequent years, as among the ducks, in which the first-year mortality rate is 50%–85% while in subsequent years it is 40%–65%. In gulls the death rate is 40%–60% in the first year and 18%–30% in following years. Average mortality per year for adults, however, expressed in percentage of those alive at the first of the year, remains high for many birds: 60%–80% for gallinaceous birds and 40%–70% for songbirds, pigeons and ducks. It drops to 20%–30% for swifts, owls, gulls and penguins, however. This gives a low average longevity after the bird reaches adulthood. The average life expectancy of adult gallinaceous birds has been estimated at one-half to one year; of songbirds and ducks, one to two years; of swifts, five years; and of gulls and terns, two to five years.

Some older birds do live considerably longer and continue to breed. Potential longevity is indicated by old-age records of banded birds which include those of a common tern 24 years old; an osprey 21; a mallard 15; a barn swallow 16; a blue jay 14; and a black-capped chickadee (or willow tit) 10. The ages recorded for birds in captivity, especially those of larger birds, are of course considerably greater. A pelican, an eagle and a sulphur-crested cockatoo are recorded as having lived past the half-century mark, and an eagle owl of Europe as long as 68 years. Among small birds a canary has reached 18 years, and there is a report of one having lived to 24 years. There have been records of parrots, ravens and eagles reaching much greater ages, but these are not adequately documented.

To evaluate the relative importance of the many various factors responsible for bird deaths is almost impossible. In the northern United States deep snow, covering nesting ground and food, is probably more important in keeping down the bobwhite quail population than is predation by either fox or hawk. It has been reported that in some areas more pheasants and king rails are killed by motor traffic on the roads than by natural predation. An example of decimation of populations caused by inclement weather in winter or in the migration season has been shown in the purple martins during occasional years in the New England states. (In a few years, however, the martins regain their former numbers.)

Man as a predator is able to control the numbers of many bird species, especially game birds. But man as a modifier of habitat is still more important: draining of a breeding marsh means death to the ducks, American blackbirds, black terns and willets breeding there just as surely as if every one of them had been shot. Destruction of hedges means the loss of the songbirds and quail that occupied them.

The mortality factors that keep the life expectancy of an adult quail at less than two years or a hawk at five years are not easily established. But it is probably a food and shelter factor balanced against predation, weather and disease. An area under normal conditions supports a certain number of birds. When the population is heavier, the extra birds are vulnerable and more likely to die. When disaster decimates a songbird population, it builds back to an optimum, then levels off.

3. Extinction.—Extinction is commonplace in evolution. But with man's ascendancy, the lives of some species have been cut off abruptly. There are 45 species and 43 subspecies which have become extinct since the beginning of the 18th century, and another 12 species and 7 subspecies probably are extinct. These represent such diverse groups as emus and certain parrots and sparrows. Almost all of the extinct forms lived on islands. Only six are known to have lived on the North American mainland: the Labrador duck (extinct in the late 1870s), the heath hen (early 1930s), eskimo curlew (1930s), passenger pigeon (1914), Carolina parakeet (two subspecies; 1914), and the great auk, which lived throughout the North Atlantic area (last recorded in 1850).

No birds are known to have become extinct on the South American or African continents, and only one has become extinct in

Europe—the great auk. In Asia there is one, the crested sheldrake of Korea (last recorded in 1916); and in Australia a species of grass wren has become extinct (last recorded in 1875). By contrast, 12 species and subspecies have become extinct in the West Indies, 13 species and 13 subspecies in the Hawaiian Islands, 14 species and 12 subspecies on central and western Pacific islands.

It is probable that direct killing by man was the immediate cause of extinction of only a few of these birds, such as the great auk and the passenger pigeon. In most cases extinction is the result of the change that man brings about in the environment, destroying habitats and introducing foreign predators and perhaps diseases. (A. L. Rd.)

IX. ORIGIN AND EVOLUTION

1. Bird Ancestry.—Bizarre as the idea may seem at first, birds are more closely allied to reptiles (*q.v.*) than to any other living group of vertebrates. The bird, while similar to the reptile in much of its structure, in its superior mental capacity, and in the concomitant adaptations that this has permitted, has far outstripped its lowly cousins, and so has flourished and multiplied while its cold-blooded relatives with decreasing numbers have fallen behind in the race of life.

The origin of the class Aves, the birds, is now generally accepted as found in the Archosaurian subclass of the Reptilia, more particularly in the suborder Pseudosuchia of the order Thecodontia. The known fossils of this group were of small size with relatively large heads, slightly built bodies, and slender hind limbs twice as long as the tiny front pair, so that the animals were definitely bipedal in locomotion. They come from deposits of early Triassic time, and are supposed to have been ancestral also to the pterodactyls, flying reptiles that existed until the Cretaceous period.

2. Fossil Birds.—The bones of birds are so poorly preserved in the fossil state that there is record now of only about 825 fossil forms, including some of questionable identity. The earliest fossils known are *Archaeopteryx* (*q.v.*) and *Archaeornis* of the Jurassic beds of Bavaria, creatures with toothed jaws, long, bony tails with feathers projecting along the sides and free fingers, that in spite of their reptilian form, were birds, since they were covered with feathers and were able to fly or at least to soar on their feathered wings. In the Cretaceous period two types of birds are known from nearly complete skeletons, *Hesperornis* (*q.v.*) and its allies, toothed, diverlike species that lived in water and seemed to have had no functional wings, and *Ichthyornis* (*q.v.*), with the articular surfaces of the vertebrae concave, which was aerial and may have had the habits of a gull. These four types are the most peculiar fossil birds known at present, since others, while often strange, are allied more closely to modern families.

From the beginning of the Tertiary period the fossils found are suggestive, in form, of existing birds, though in the Eocene some were highly peculiar, and are placed in extinct families. The species known from the Oligocene are more like living groups, and in the Miocene there occur a number of birds closely similar to those existing today. In Pleistocene beds there are found bones of numerous species still in existence, in addition to many that differ from modern forms.

The progress of the avian group since the coming of the Pleistocene ice seems to have been mainly one of decimation rather than of consistent evolutionary progress, since peculiar types seem to have been exterminated in numbers during the Pleistocene, and there is no indication that others have developed during this period to take their places except for the minor characters that distinguish subspecies or poorly marked species. The story of fossil birds still is far from complete, and much work remains to be done on many of those at present discovered, to establish their relationships.

X. CLASSIFICATION

It is difficult to arrive at an exact figure for the number of kinds of birds now known, but at a conservative estimate there are about 8,700 species, with at least 30,000 geographic races or subspecies.

The primary group or class, Aves, is one of the great divisions of the vertebrates and is equal in rank to the sharks and rays, bony fishes, amphibians, reptiles or mammals. This class is divided into two subclasses, the first, the Archaeornithes, containing the most primitive birds which are very close to reptiles, and the second, the Neornithes, all other known birds. The Neornithes are divided again into four major divisions or superorders, the Odontognathae, containing forms with teeth, the Ichthyornithes for the group of fossil species of the Cretaceous with vertebrae like those of fishes, the Impennes for the penguins and the Neognathae, including the remaining species with a more specialized modern type of palatal structure. These superorders are divided again into orders, suborders, superfamilies and families. An arrangement embodying modern ideas of classification follows.

Class Aves, Birds

Subclass Archaeornithes, ancestral birds
- Order Archaeopterygiformes, *Archaeopteryx, Archaeornis* (fossil)
  - Family Archaeopterygidae, *Archaeopteryx, Archaeornis* (fossil)

Subclass Neornithes, true birds

Superorder Odontognathae, new world toothed birds
- Order Hesperornithiformes, Hesperornithes
  - Family Hesperornithidae, *Hesperornis* (fossil)
  - " Enaliornithidae, *Enaliornis* (fossil)
  - " Baptornithidae, *Baptornis* (fossil)

Superorder Ichthyornithes, *Ichthyornis* and allies
- Order Ichthyornithiformes, Ichthyornithes
  - Family Ichthyornithidae, *Ichthyornis* (fossil)
  - " Apatornithidae, *Apatornis* (fossil)

Superorder Impennes, penguins
- Order Sphenisciformes, penguins
  - Family Spheniscidae, penguins (southern hemisphere)

Superorder Neognathae, typical birds
- Order Struthioniformes, ostriches
  - Family Eleutherornithidae, *Eleutherornis* (fossil)
  - " Struthionidae, ostriches (old world)
- Order Rheiformes, rheas
  - Family Rheidae, rheas (South America)
- Order Casuariiformes, cassowaries, emus
  - Family Casuariidae, cassowaries (Australian region)
  - " Dromiceidae, emus (Australian region)
  - " Dromornithidae, *Dromornis* (fossil)
- Order Aepyornithiformes, elephant birds
  - Family Aepyornithidae, *Aepyornis* (fossil and subfossil, Madagascar)
- Order Dinornithiformes, moas
  - Family Dinornithidae, *Dinornis* (fossil and subfossil, New Zealand)
  - " Anomalopterygidae, *Anomalopteryx, Emeus* and allies (fossil and subfossil)
- Order Apterygiformes, kiwis
  - Family Apterygidae, kiwis (New Zealand)
- Order Tinamiformes, tinamous
  - Family Tinamidae, tinamous (Mexico to South America)
- Order Gaviiformes, loons
  - Family Gaviidae, loons (northern hemisphere)
- Order Podicipediformes, grebes
  - Family Podicipedidae, grebes (cosmopolitan)
- Order Procellariiformes, albatrosses, shearwaters, petrels and allies
  - Family Diomedeidae, albatrosses (southern hemisphere and North Pacific)
  - " Procellariidae, shearwaters, fulmars (cosmopolitan)
  - " Hydrobatidae, storm petrels (cosmopolitan)
  - " Pelecanoididae, diving petrels (southern hemisphere)
- Order Pelecaniformes, tropic birds, pelicans and frigate birds
  - Suborder Odontopteryges, *Odontopteryx* and allies (fossil)
    - Family Odontopterygidae, *Odontopteryx* (fossil)
    - " Pseudodontornithidae, *Pseudodontornis, Osteodontornis* (fossil)
  - Suborder Phaëthontes, tropic birds
    - Family Phaëthontidae, tropic birds (tropical seas)
  - Suborder Pelecani, pelicans, boobies, cormorants, snakebirds

Superfamily Pelecanoidea, pelicans and allies
Family Pelecanidae, pelicans (tropics to warm temperate)
" Cyphornithidae, *Cyphornis, Palaeochenoides* (fossil)
Superfamily Suloidea, boobies, cormorants and allies
Family Pelagornithidae, *Pelagornis* (fossil)
" Sulidae, boobies, gannets (cosmopolitan)
" Elopterygidae, *Elopteryx, Eostega, Actiornis* (fossil)
" Phalacrocoracidae, cormorants (cosmopolitan)
" Anhingidae, snakebirds (tropics and subtropics)
Suborder Fregatae, frigate birds
Family Fregatidae, frigate birds (tropics and subtropics)
Suborder Cladornithes, *Cladornis* and allies (fossil)
Family Cladornithidae, *Cladornis, Cruschedula* (fossil)

Order Ciconiiformes, herons, storks and allies
Suborder Ardeae, herons, bitterns
Family Ardeidae, herons, bitterns (cosmopolitan)
" Cochleariidae, boat-billed herons (tropical America)
Suborder Balaenicipites, whale-headed storks
Family Balaenicipitidae, whale-headed storks (Africa)
Suborder Ciconiae, storks, ibises, spoonbills
Superfamily Scopoidea, hammerheads
Family Scopidae, hammerheads (Africa)
Superfamily Ciconioidea, storks
Family Ciconiidae, storks, jabirus (cosmopolitan)
Superfamily Threskiornithoidea, ibises
Family Threskiornithidae, ibises, spoonbills (cosmopolitan)
Suborder Phoenicopteri, flamingos
Family Agnopteridae, *Agnopterus* (fossil)
" Scaniornithidae, *Scaniornis, Parascaniornis* (fossil)
" Phoenicopteridae, flamingos (temperate and tropical regions)
" Palaelodidae, *Palaelodus, Megapaloelodus, Telmabates* (fossil)

Order Anseriformes, screamers, ducks, geese, swans
Suborder Anhimae, screamers
Family Anhimidae, screamers (South America)
Suborder Anseres, ducks, geese, swans
Family Paranyrocidae, *Paranyroca* (fossil)
" Anatidae, ducks, geese, swans (cosmopolitan)

Order Falconiformes, vultures, hawks, falcons
Suborder Cathartae, new world vultures
Superfamily Neocathartoidea, Neocathartes
Family Neocathartidae, *Neocathartes* (fossil)
Superfamily Cathartoidea, new world vultures
Family Cathartidae, new world vultures (the Americas)
" Teratornithidae, *Teratornis, Cathartornis* (fossil)
Suborder Falcones, secretary birds, hawks, falcons
Superfamily Sagittarioidea, secretary birds
Family Sagittariidae, secretary birds (Africa)
Superfamily Falconoidea, hawks, falcons and allies
Family Accipitridae, hawks, old world vultures, harriers (cosmopolitan)
" Pandionidae, ospreys (cosmopolitan)
" Falconidae, falcons, caracaras (cosmopolitan)

Order Galliformes, megapodes, curassows, pheasants, hoatzins
Suborder Galli, megapodes, curassows, grouse, pheasants
Superfamily Cracoidea, megapodes, curassows
Family Megapodiidae, megapodes (Australian region)
" Gallinuloididae, *Gallinuloides* (fossil)
" Cracidae, curassows, guans, chachalacas (Mexico to South America)
Superfamily Phasianoidea, grouse, pheasants, turkeys
Family Tetraonidae, grouse (northern hemisphere)
" Phasianidae, quails, pheasants, peacocks (cosmopolitan)
" Numididae, guinea fowl (Africa)
" Melcagrididae, turkeys (North America)
Suborder Opisthocomi, hoatzins
Family Opisthocomidae, hoatzins (tropical South America)

Order Gruiformes, cranes, rails and allies
Suborder Mesitornithides, roatelos, *Monias*
Family Mesitornithidae, roatelos, *Monias* (Madagascar)
Suborder Turnices, bustard quails, hemipodes
Family Turnicidae, bustard quails (old world)
" Pedionomidae, plain wanderers (Australia)

Suborder Grues, cranes, limpkins, trumpeters, rails
Superfamily Gruoidea, cranes, limpkins, trumpeters
Family Geranoididae, *Geranoides* (fossil)
" Eogruidae, *Eogrus* (fossil)
" Gruidae, cranes (cosmopolitan, except South America)
" Aramidae, limpkins (tropical and subtropical America)
" Psophiidae, trumpeters (tropical South America)
Superfamily Ralloidea, rails
Family Orthocnemidae, *Orthocnemus, Elaphrocnemus* (fossil)
" Rallidae, rails, coots, gallinules (cosmopolitan)
Suborder Heliornithes, sun grebes
Family Heliornithidae, sun grebes (tropical Africa, southern Asia, tropical America)
Suborder Rhynocheti, kagus
Family Rhynochetidae, kagus (New Caledonia)
Suborder Eurypygae, sun bitterns
Family Eurypygidae, sun bitterns (Central and South America)
Suborder Cariamae, seriemas and allies
Superfamily Phororhacoidea, *Phororhacos* and allies (fossil)
Family Phororhacidae, *Phororhacos* and allies (fossil)
" Psilopteridae, *Psilopterus, Smiliornis* and allies (fossil)
" Brontornithidae, *Brontornis, Rostrornis* and allies (fossil)
" Cunampaiidae, *Cunampaia* (fossil)
Superfamily Cariamoidea, seriemas and allies
Family Bathornithidae, *Bathornis* (fossil)
" Hermosiornithidae, *Hermosiornis, Procariama* (fossil)
" Cariamidae, seriemas (South America)
Suborder Otides, bustards
Family Otididae, bustards (old world)

Order Diatrymiformes, *Diatryma, Omorhamphus* and allies
Family Diatrymidae, *Diatryma* (fossil)
" Gastornithidae, *Gastornis, Remiornis* (fossil)

Order Charadriiformes, shore birds, gulls, auks
Suborder Charadrii, shore birds
Superfamily Jacanoidea, jaçanas
Family Jacanidae, jaçanas (tropics)
Superfamily Charadrioidea, plovers, sandpipers and allies
Family Rhegminornithidae, *Rhegminornis* (fossil)
" Rostratulidae, painted snipe (cosmopolitan, except North America and Europe)
" Haematopodidae, oyster catchers (cosmopolitan)
" Charadriidae, plovers, turnstones, surfbirds (cosmopolitan)
" Scolopacidae, snipe, woodcock, sandpipers (cosmopolitan)
" Recurvirostridae, avocets, stilts (cosmopolitan)
" Presbyornithidae, *Presbyornis* (fossil)
" Phalaropodidae, phalaropes (cosmopolitan, except Australia)
Superfamily Dromadoidea, crab plovers
Family Dromadidae, crab plovers (India to east Africa)
Superfamily Burhinoidea, thick-knees
Family Burhinidae, thick-knees (cosmopolitan, except North America)
Superfamily Glareoloidea, pratincoles, coursers
Family Glareolidae, pratincoles, coursers (old world)
Superfamily Thinocoroidea, seed snipe
Family Thinocoridae, seed snipe (South America)
Superfamily Chionidoidea, sheathbills
Family Chionididae, sheathbills (Tierra del Fuego to southern Indian ocean and Antarctica)
Suborder Lari, gulls, terns, skimmers
Family Stercorariidae, skuas, jaegers (cosmopolitan)
" Laridae, gulls, terns (cosmopolitan)
" Rynchopidae, skimmers (America, southern Asia and Africa)
Suborder Alcae, auks
Family Alcidae, auks, auklets, murres (northern hemisphere)

Order Columbiformes, sand grouse, pigeons, doves
Suborder Pterocletes, sand grouse
Family Pteroclidae, sand grouse (old world)
Suborder Columbae, pigeons, doves
Family Raphidae, dodos, solitaires (Mauritius, Réunion, Rodrigues)

Family Columbidae, pigeons, doves (cosmopolitan)

Order Psittaciformes, lories, parrots, macaws
Family Psittacidae, lories, parrots, macaws (cosmopolitan, except northern Eurasia)

Order Cuculiformes, plantain eaters, cuckoos
Suborder Musophagi, plantain eaters
Family Musophagidae, plantain eaters, touracos (Africa)
Suborder Cuculi, cuckoos, road runners, anis
Family Cuculidae, cuckoos, road runners, anis (cosmopolitan)

Order Strigiformes, owls
Family Protostrigidae, *Protostrix* (fossil)
" Tytonidae, barn owls (cosmopolitan)
" Strigidae, typical owls (cosmopolitan)

Order Caprimulgiformes, oilbirds, goatsuckers
Suborder Steatornithes, oilbirds
Family Steatornithidae, oilbirds (northern South America)
Suborder Caprimulgi, frogmouths, goatsuckers
Family Podargidae, frogmouths (India to Australia)
" Nyctibiidae, potoos (new world tropics)
" Aegothelidae, owlet-frogmouths (Australian region)
" Caprimulgidae, goatsuckers (cosmopolitan, except eastern Pacific)

Order Apodiformes, swifts, hummingbirds
Suborder Apodi, swifts
Family Aegialornithidae, *Aegialornis* (fossil)
" Apodidae, swifts (cosmopolitan)
" Hemiprocnidae, crested swifts (India to New Guinea)
Suborder Trochili, hummingbirds
Family Trochilidae, hummingbirds (new world)

Order Coliiformes, colies
Family Coliidae, colies (Africa)

Order Trogoniformes, trogons
Family Trogonidae, trogons (cosmopolitan, except Holarctic region)

Order Coraciiformes, kingfishers, bee eaters, rollers, hornbills
Suborder Alcedines, kingfishers, todies, motmots
Superfamily Alcedinoidea, kingfishers
Family Alcedinidae, kingfishers (cosmopolitan)
Superfamily Todoidea, todies
Family Todidae, todies (Greater Antilles)
Superfamily Momotoidea, motmots
Family Momotidae, motmots (tropical America)
Suborder Meropes, bee eaters
Family Meropidae, bee eaters (old world)
Suborder Coracii, rollers, hoopoes
Family Coraciidae, rollers (old world)
" Brachypteraciidae, groundrollers (Madagascar)
" Leptosomatidae, cuckoo rollers
" Upupidae, hoopoes (Eurasia and Africa)
" Phoeniculidae, wood hoopoes (Africa)
Suborder Bucerotes, hornbills
Family Bucerotidae, hornbills (Africa and southern Asia)

Order Piciformes, jacamars, barbets, toucans, woodpeckers
Suborder Galbulae, jacamars, barbets, toucans
Superfamily Galbuloidea, jacamars, puffbirds
Family Galbulidae, jacamars (tropical Mexico to South America)
" Bucconidae, puffbirds (Central and South America)
Superfamily Capitonoidea, barbets, honey guides
Family Capitonidae, barbets (tropics)
" Indicatoridae, honey guides (Africa and southern Asia)
Superfamily Ramphastoidea, toucans
Family Ramphastidae, toucans (Mexico to South America)
Suborder Pici, woodpeckers
Family Picidae, woodpeckers, piculets (cosmopolitan, except Madagascar and Australia)

Order Passeriformes, perching birds
Suborder Eurylaimi, broadbills
Family Eurylaimidae, broadbills (tropical Africa and Indo-Malaya)
Suborder Tyranni, ovenbirds, tyrant flycatchers and allies
Superfamily Furnarioidea, ovenbirds, wood hewers and allies
Family Dendrocolaptidae, wood hewers (Mexico to South America)
Family Furnariidae, ovenbirds (Mexico to South America)
" Formicariidae, ant thrushes (Mexico to South America)
" Conopophagidae, ant pipits (South America)
" Rhinocryptidae, tapaculos (Central and South America)
Superfamily Tyrannoidea, tyrant flycatchers, pittas and allies
Family Cotingidae, cotingas (new world)
" Pipridae, manakins (Mexico to South America)
" Tyrannidae, tyrant flycatchers (new world)
" Oxyruncidae, sharp-bills (Central and South America)
" Phytotomidae, plant cutters (South America)
" Pittidae, pittas (old world tropics)
" Acanthisittidae, New Zealand wrens (New Zealand)
" Philepittidae, asities, false sunbirds (Madagascar)
Suborder Menurae, lyrebirds
Family Menuridae, lyrebirds (Australia)
" Atrichornithidae, scrubbirds (Australia)
Suborder Passeres, songbirds
Family Alaudidae, larks (cosmopolitan)
" Palaeospizidae, *Palaeospiza* (fossil)
" Hirundinidae, swallows (cosmopolitan)
" Dicruridae, drongos (old world tropics)
" Oriolidae, old world orioles (old world)
" Corvidae, crows, magpies, jays (cosmopolitan)
" Cracticidae, bell magpies, Australian butcherbirds (Australia)
" Grallinidae, magpie larks (Australia)
" Ptilonorhynchidae, bowerbirds (Australia, New Guinea)
" Paradisaeidae, birds of paradise (Australian region)
" Paridae, titmice (Eurasia, Africa, North America)
" Sittidae, nuthatches (northern hemisphere, Australian region)
" Hypositticlae, coral-billed nuthatches (Madagascar)
" Certhiidae, creepers (Eurasia, North America, Australia)
" Paradoxornithidae, parrotbills, suthoras (Nepal to China)
" Chamaeidae, wren tits (Oregon and California)
" Timaliidae, babbling thrushes (old world)
" Campephagidae, cuckoo shrikes (old world)
" Pycnonotidae, bulbuls (old world)
" Palaeoscinidae, *Palaeoscinis* (fossil)
" Chloropseidae, leaf-birds
" Cinclidae, dippers (northern hemisphere, South America)
" Troglodytidae, wrens (cosmopolitan, except Africa and Australia)
" Mimidae, thrashers, mockingbirds (new world)
" Turdidae, thrushes (cosmopolitan)
" Zeledoniidae, wren thrushes (Costa Rica and Panamá)
" Sylviidae, old world warblers (cosmopolitan)
" Regulidae, kinglets (northern hemisphere)
" Muscicapidae, old world flycatchers (old world)
" Prunellidae, accentors, hedge sparrows (Europe and northern Asia)
" Motacillidae, wagtails, pipits (cosmopolitan)
" Bombycillidae, waxwings (northern hemisphere)
" Ptilogonatidae, silky flycatchers (southwestern United States to Panamá)
" Dulidae, palm chats (Hispaniola)
" Artamidae, wood swallows (Africa, India and Australian region)
" Vangidae, Vanga shrikes (Madagascar)
" Laniidae, shrikes (cosmopolitan, except South America)
" Prionopidae, wood shrikes (old world tropics)
" Cyclarhidae, pepper shrikes (Mexico to South America)
" Vireolaniidae, shrike vireos (continental tropical America)
" Callaeidae, wattled crows, huias, saddlebacks (New Zealand)
" Sturnidae, starlings, glossy starlings (old world)
" Meliphagidae, honey eaters (Australian region)

Family Nectariniidae, sunbirds (Africa, Asia and Australian region)
" Dicaeidae, flowerpeckers (Africa, Indo-Malaya and Australian region)
" Zosteropidae, white-eyes (Africa, southern Asia and Australian region)
" Vireonidae, vireos (new world)
" Coerebidae, honey creepers, bananquits (tropical America)
" Drepanididae, Hawaiian honey creepers (Hawaiian Islands)
" Parulidae, wood warblers (new world)
" Ploceidae, weaverbirds (Africa, Eurasia and Australia)
" Icteridae, blackbirds, American orioles, troupials (new world)
" Tersinidae, swallow-tanagers (eastern Panamá to tropical South America)
" Thraupidae, tanagers (new world)
" Catamblyrhynchidae, plush-capped finches (northern Andes)
" Fringillidae, grosbeaks, finches, buntings (cosmopolitan, except Australian region)

(A. Wt.)

See Animal Coloration; Aviary and Aviculture; Bird Watching; Ecology, Animal; Egg; Feather; Flight (Natural); Migration, Bird; Nest; Ornithology; Songbird; Wildlife Conservation; *see* also Index references under "Bird" in the Index volume.

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(A. L. Rd.; A. Wt.)

BIRD BANDING: *see* Migration, Bird.

BIRD LOUSE, a common name for those species of chewing lice (Mallophaga) that live on birds. They are small parasitic insects feeding on the feathers and sometimes the blood of their hosts. *See* Mallophaga.

BIRD OF PARADISE. Among the most beautiful birds in the world are the birds of paradise, perching birds closely related to the bowerbird (*q.v.*) and crow, and belonging to the family Paradisaeidae. There are about 20 genera and 43 species, of which 17 genera and 35 species are confined to New Guinea and nearby islands; 3 species occur in the Moluccas, while several species of the less spectacular riflebirds are native to eastern Australia. The females and young are plain coloured, but the males are frequently rich in orange, yellow, green, blue, brown and red of many shades, with soft, velvety, long or peculiarly shaped plumes. Some are rich black with iridescent colours, as in the riflebirds. Birds of paradise are distributed from the hot swampy lowlands through the forests of oak and beech to the upper tree line at 13,000 ft. on towering New Guinea mountains.

They range in size from that of a small thrush to that of a magpie, and the males' plumes are spread in fantastic displays during courtship. In most species courtship is solitary, *i.e.*, one male woos one female; but communal ceremonies occur in the true plume birds (*Paradisaea*), the flagbirds (*Parotia*) and Macgregor's bird of paradise (*Macgregoria*). Some hang upside down while displaying their beautiful plumes to the female; others, like the flagbirds, sit on a low twig over a cleared "dance floor." Males do not usually participate in nest life, about which little is known. Eggs are generally orange streaked with brown.

The largest and one of the best known of the Paradisaeidae is the great bird of paradise (*Paradisaea apoda*), skins of which first reached Europe on Magellan's ships. It is a beautiful species, rich in cinnamon and fawn, yellow on the head and back of neck, with emerald-green throat, and resplendent golden-whitish plumes cascading over the back from the sides of the breast. The lesser bird of paradise (*P. minor*) is a somewhat smaller, less brilliantly coloured species, also common throughout New Guinea. Birds congregate on special trees at the beginning of the breeding season, when the males display for the females. They are possibly polygamous. These forms were prized for their beautiful plumes. Plume hunting, each season just after the annual molt, began about 500 years ago, developed rapidly from 1880 to 1910—when 50,000 to 100,000 skins reached the European markets—and was finally prohibited in 1924.

Among the most beautiful are the blue bird of paradise (*P. rudolphi*), with delicate blue plumes spreading like a fan from the sides of the breast; the superb bird of paradise (*Lophorina superba*), a small dark bird with a conspicuous spreading breastshield of glossy green and a huge black velvet cape that can be raised over the head; the king bird of paradise (*Cicinnurus regius*), bright scarlet, with two very long wirelike plumes from the tail with small circular green tips; the beautiful little golden-silky bird of paradise (*Loboparadisea sericea*); the magnificent bird of paradise (*Diphyllodes magnificus*), a small bird with spreading yellow, erectile cape, a glistening velvety breastshield and two long coiled wire plumes from the tail; the long-tailed flagbird (*Parotia wahnesi*), one of the six-wired birds of paradise, with a spreading "skirt" and a pair of triple-wires tipped with bits of feather, upward and forward from behind the eyes; the twelve-wired bird of paradise (*Seleucides ignotus*), with a magnificent large rich dark bib, bright yellow under parts and 12 long recurved wires from the tail; and the King of Saxony's bird of paradise (*Pteri-*

dophora alberti), a small bird with two very long fern-frond plumes growing from the back of the head. These are all inhabitants of the forests of New Guinea.

A. R. Wallace's standard-wing (*Semioptera wallacei*), a native of the northern Moluccas or Spice Islands, has a triangular, brilliant green breastshield and two pairs of pale ribbonlike standards raised from the bend of the wings.

Ten of the genera of birds of paradise are known to crossbreed and produce hybrids, and 4 species of *Paradisaea* have produced species hybrids, resulting in the naming of 17 "rare species" of birds of paradise, usually described each from a single skin found among the tremendous numbers in European shipments.

See also BIRD: *Reproduction.* (G. F. Ss.; X.)

BIRD-OF-PARADISE FLOWER is the name commonly applied to the flowers of species of *Strelitzia,* members of the Musaceae or banana family, but particularly to *S. reginae,* the species so frequently found in conservatories and greenhouses, where it is grown for its bananalike foliage and the very odd, showy flowers. The name *Strelitzia* was given for the wife of George III, Charlotte Sophia, of the family Mecklenburg-Strelitz, who was a patron of botany. The plants of *S. reginae* attain a height of about three feet, possess large strong roots, require a fertile soil, copious water and good light. The oblong leaves are about a foot in length, stiff and borne on radical leafstalks two to three times as long as the blades. The scapes are higher than the leaves; the spathe is about six inches long, nearly horizontal, purplish at the base, and commonly possesses about six flowers that are orange and purplish in colour. The plant is serviceable for house decoration and may be used also on the porch or lawn in summer. It will withstand much neglect but may fail to bloom regularly when badly handled. Seeds may be induced to set if the flowers are hand pollinated, but the usual method of propagation is by suckers and division. The bird-of-paradise flower is an important florist's crop in California and Hawaii, from where it is shipped to market throughout the United States. It is particularly striking when mixed with other flowering plants, especially orchids.

PHOTOGRAPH, J. HORACE MCFARLAND CO.

BLOOM OF THE BIRD-OF-PARADISE FLOWER (STRELITZIA REGINAE)

(J. M. BL.)

BIRD PROTECTION: *see* WILDLIFE CONSERVATION.

BIRDSEYE, CLAUDE HALE (1878–1941), U.S. topographic engineer and first president of the American Society of Photogrammetry, was born on Feb. 13, 1878, at Syracuse, N.Y. He graduated from Oberlin college in 1901, did postgraduate work at Ohio State and Cincinnati universities, and joined the U.S. geological survey, in which service he explored and mapped the regions of Kilauea volcano, Hawaii (1912), and Mt. Rainier, Wash. He served overseas during World War I, and in 1923 led an expedition through the Marble and Grand canyons of the Colorado river from Lee's Ferry, Ariz., to Needles, Calif. In 1929 he resigned from the geological survey to become president of the Aerotopograph Corporation of America and in 1930 was in charge of surveys by aerial photography of the sites for Hoover dam. He returned to the geological survey in 1932 and was assistant to the director until his death on May 30, 1941, in Washington, D.C.

(D. MN.)

BIRD'S NEST, EDIBLE, the nest of a species of swift of the genus *Collocalia,* composed chiefly of the saliva of birds. They are to be found in the East Indies and Australia and are valued by the Chinese for the making of bird's nest soup. *See* SWIFT.

BIRD WATCHING. The development of bird watching as a popular pastime and scientific sport took place almost entirely in the 20th century. The widespread use of the term itself appears to date from Edmund Selous' book, *Bird Watching* (1901). Modern bird watching was made possible largely by the development of optical aids, particularly binoculars, which have enabled people to see and study wild birds better than ever before. Whereas in the 19th century almost all students of birds used guns and could only identify an unfamiliar species when its corpse was in their hands, thousands of modern bird watchers have brought the accurate identification of live birds in the field to a pitch of skill never before achieved in civilized history.

This newly acquired skill was the basis of the great surge of interest in wild birds that occurred from about the 1880s onward. Though bird watching first became popular in Great Britain, the United States was never far behind, and by the early 1960s it was almost equally popular in Scandinavia, the Netherlands, Germany, Switzerland and the older countries of the British Commonwealth. There are bird watchers, and usually some club or society for them, in almost every country in the world.

About 1,000 natural history societies exist in the United Kingdom alone, mainly in England, of which 47 are devoted solely to bird watching; many of the rest have active ornithological sections. As a result almost the whole of England is covered by a network of annual reports recording the more unusual birds seen in the district or county during the year, and the sifting of these records is one of the most important activities of the societies. The first such annual report appeared for Hertfordshire as early as 1878. Almost every English county also has a book devoted to the history of its avifauna. Middlesex (1866) was the first county to be so treated. In the United States the first illustrated book on the birds of a single state appeared in 1910.

No small part of the credit for increasing the interest in bird watching among the public belongs to the numerous authors of popular bird books, stretching as far back as Gilbert White's *Natural History of Selborne* (published 1788, although dated 1789) and H. D. Thoreau's *Walden, or Life in the Woods* (1854), and culminating in such essential aids to the bird watcher in the field as H. F. Witherby's five-volume *Handbook of British Birds* (1938–41) and Roger Tory Peterson's *A Field Guide to the Birds* (1934), which gives the field marks of all North American birds found east of the Rocky mountains.

Numerous journals and magazines, such as the *Audubon Magazine* (United States), *British Birds, La Terre et la vie* (France) and *De Levende Natuur* (Netherlands), have also played their part; and so have the radio authorities, led by the British Broadcasting corporation, whose natural history unit at Bristol was a world pioneer in presenting natural history to mass audiences. One of their earliest "hits" was the woodpecker film of Heinz Sielmann, the outstanding German ciné photographer.

From about 1930 there was a great increase in field work, including photography, by amateur bird watchers in the Anglo-Saxon, Germanic and Scandinavian countries, whereas in the Latin and Slavonic countries ornithology remained much more the province of the professional zoologist. In Great Britain this movement was led by the British Trust for Ornithology (B.T.O.), founded in 1932 by a group headed by H. F. Witherby, E. M. Nicholson and B. W. Tucker. The B.T.O. organizes co-operative inquiries in which large numbers of amateurs take part, such as sample censuses of herons and great crested grebes and surveys of winter roosts of gulls. The wildfowl counts of the International Wildfowl Research bureau are run as a co-ordinated international effort throughout western Europe.

Bird observatories originated as far back as the 1840s, when Heinrich Gätke began to record the vast numbers of migrant birds that pass every spring and autumn through the island of Heligoland in the North sea. British ornithologists, stimulated by Gätke's work, began in 1880 to organize co-operative observations on migration on their side of the North sea, and this eventually led to the discovery by William Eagle Clarke of the importance as migration stations of Fair Isle and other islands off the coast of Scotland.

The modern phase of bird observatory activity in Europe began in 1935–36, when R. M. Lockley opened the first permanent one on the Pembrokeshire island of Skokholm. By the early 1960s there were about 15 British bird observatories, mainly on islands or promontories along the coast line, closely linked with the British

Trust for Ornithology, while others were scattered around the coasts of Europe from Ottenby (Sweden) in the Baltic to Ushant on the west coast of France and Capri (Italy) in the Mediterranean.

The main activity at British bird observatories as they developed in the 1950s and 1960s was the trapping and subsequent ringing (banding) (*see* MIGRATION, BIRD) of birds under the national ringing scheme, founded by H. F. Witherby, and run by the British Trust for Ornithology from the British museum (Natural History). Similar ringing schemes are found throughout the world, especially in Europe and North America.

Side by side with the actual watching of birds grew up a strong movement to protect them by legislation and public understanding (*see* WILDLIFE CONSERVATION). In this the lead was taken in the United States by the National Audubon society and in Britain by the Royal Society for the Protection of Birds.

Starting in Vienna in 1884, there has been a series of international ornithological congresses, which in the 20th century came to be held at four-year intervals. These scientific gatherings are attended by several hundred amateur bird watchers as well as by the leading professionals.

See also BIRD.

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BIRDWOOD, WILLIAM RIDDELL BIRDWOOD, 1ST BARON (1865–1951), British field marshal, who was the first commander of the Australian and New Zealand army corps (Anzac) and is especially remembered for his part in the Gallipoli campaign of World War I, was born at Kirkee, India, on Sept. 13, 1865. Educated at Clifton college, he entered the army through the militia in 1883, passed through the Royal Military college, Sandhurst, and joined the 12th lancers (1885), transferring to the 11th Bengal lancers in 1887. He took part in the Black Mountain (1891) and Tirah (1897) campaigns on the Indian frontier, and in the South African War (1899–1902). In South Africa he first met Lord Kitchener, who became the greatest influence in his military life. Birdwood was on his staff in South Africa and in India from 1902 to 1909. He commanded the Anzac forces in the landing at Gallipoli in 1915 and soon gained the confidence of his troops. As commander of the Dardanelles army he was responsible for the later evacuation of the peninsula, which was praised as a masterpiece in planning and execution. He moved to France with the Anzac infantry in 1916, and in May 1918 took command of the 5th army, in whose victorious advance the Anzacs played a prominent part. After holding the northern command in India (1920–24), he became commander in chief, India (1925–30). From 1931 to 1938 he was master of Peterhouse, Cambridge; he was appointed captain of Deal castle in 1935 and was created Baron Birdwood, of Anzac and of Totnes, in 1938. He was the author of *Khaki and Gown* (1941) and *In My Time* (1946). He died near London on May 17, 1951. (R. G. TH.)

BIRETTA, a square, stiff cap worn by the Roman Catholic clergy, its colour varying with the rank of the wearer; that of the pope is white; of the cardinals, red; of bishops, purple; and of the lower clergy, black. Its use is not confined to liturgical functions. The biretta is descended from the *biretum* or "barret cap," once a common item of headgear, whose other descendants include the *barett* worn by the Lutheran clergy, German lawyers and the deans and rectors of universities; the *barrette* of French judges and barristers; the black cap of the English judge; and the "college cap" familiar in English and American universities and popularly known as the mortarboard. *See* VESTMENTS, ECCLESIASTICAL.

BIRGER JARL (d. 1266), the virtual ruler of Sweden from 1248 until his death. Before 1238 Birger had married Ingeborg (d. 1254), the sister of King Eric Ericsson, and in 1248 he was created *jarl* or earl of Sweden (Lat. *dux Svecie*). On King Eric's death in 1250 Birger obtained the election of his own son, Valdemar, to the throne. He secured his dynasty's ascendancy after a bitter struggle with the league of Uppland magnates known at that time as the Folkungar. Birger established closer ties with Denmark and Norway, confirmed by marriage alliances: in 1251 he married his daughter to the Norwegian heir apparent and in 1261 he himself married the Danish queen Mechthild. He extended Swedish influence to southern Finland and attempted to control the trade routes to Russia but in 1256 this policy was thwarted by the Russians under Alexander Nevski. However, to develop Sweden's commercial contacts, Birger concluded a trading treaty with Lübeck which was of great importance in Sweden's future development. In internal affairs, Birger enlisted the church's support for the monarchy against the magnates and the provincial assemblies and developed the king's legislative powers on the concept of the king's peace. Under him Sweden first developed a general meeting of the estates on the western European model and Stockholm finally established its position as the administrative centre of Sweden. (G. T. WE.)

BIRINGUCCIO, VANNOCCIO (1480–*c.* 1539), Italian metallurgist and armament maker, known chiefly for his descriptions of processes for the extraction of metals and the preparation of chemical substances in his book *The Pirotechnia,* was born in Siena, on Oct. 20, 1480. Biringuccio enjoyed the patronage and suffered the vicissitudes of the Petrucci family. He held a post in the armoury of the Siena commune in 1513 and after periods of exile returned to the service of the Republic of Siena in 1530. In 1538 he became head of the foundry of Pope Paul III.

The Pirotechnia was first published in 1540. Unlike the obscure alchemical writings of the period, it gave clear practical instructions and became a standard reference book. It is now valuable to historians of science as a source of information on the state of chemical knowledge of the time.

See C. S. Smith and M. T. Gnudi, *The Pirotechnia of Vannoccio Biringuccio,* Eng. trans. (1942). (WA. W.)

BIRJAND, the chief town of a district (Shahrestan-e Birjand) of eastern Iran, in the *ostan* (province) of Khurasan, is built on low hills in a barren treeless valley of the Kuhistan uplands, 4,440 ft. above sea level. The town is divided by the broad and usually dry bed of the Khusf river. Pop. (1956) 13,926. The inhabitants include a strong Sunni element, an Afghan community and some Indian merchants. It was formerly the seat of semi-independent rulers of the Qayenat (Qainat), and a caravan centre on the road from Meshed (Mashhad) to the south which now joins the railhead at Zahedan. Birjand has partly maintained its commercial position in spite of the modern changes in traffic.

The district grows wheat and barley, some cotton and fruits. Water is scarce though cultivation on rainfall succeeds in upland locations. Saffron is a famous product especially in the neighbouring district of Qayen (Qain). The wool is excellent and carpet-making remains important though declining in quality. (H. Bo.)

BIRKBECK, GEORGE (1776–1841), English physician, pioneer in the foundation of classes for working men and first president of Birkbeck college, London, was born at Settle, Yorkshire, on Jan. 10, 1776. In 1799 Birkbeck was appointed professor of natural philosophy in Anderson's institution, Glasgow, where he started a class for mechanics. He then practised medicine in London, also promoting the foundation in 1823 of the London Mechanics' institution. He was president of the institution until his death in London on Dec. 1, 1841, and endowed it with £3,700. In 1907 it was renamed Birkbeck college and in 1920 it was recognized as a school of the University of London for evening and part-time students. The success of the London institution led to the establishment of mechanics' institutions all over Britain, especially in the larger industrial cities. Some developed into technical colleges.

See C. Delisle Burns, *A Short History of Birkbeck College* (1924). (S. J. C.)

BIRKENHEAD, FREDERICK EDWIN SMITH, 1ST EARL OF (1872–1930), British statesman and lawyer, best remembered for his remarkably successful tenure of the lord chancellorship and as one of the most influential members of Lloyd George's post-World War I coalition government, was born at Birkenhead on July 12, 1872, the eldest son of a barrister, Frederick Smith. Educated at Birkenhead school and at Wadham college, Oxford, he made a great mark as an undergraduate debater, and was president of the Union in the Hilary term of 1894. He obtained first

class honours in law in 1895, was called to the bar by Gray's Inn in 1899 and at once began a highly successful common-law practice in Liverpool. In 1901 he married Margaret Furneaux, the daughter of an Oxford don. At an early stage he took a keen interest in politics and in 1906 was elected, despite the prevailing tide of Liberal success, as Conservative member of parliament for the Walton division of Liverpool. His maiden speech on March 12, 1906, was one of the finest pieces of satire and invective ever heard in the house of commons, and made his parliamentary reputation overnight. He took silk in 1908 and for the next few years made a huge income which, however, he habitually anticipated and overspent, for he never had any idea of the meaning of money. His capacity for work was astounding and his energy never flagged, despite a life of strenuous exercise and constant pleasure reminiscent of the days of Charles James Fox.

Smith soon became a leading figure in his party and was prominent in opposition to the Parliament act of 1911 and in the struggle (1912–14) to exclude Ulster from the provisions of the Home Rule bill. On the formation of the first coalition government of World War I in May 1915 he became solicitor general, succeeding Sir Edward Carson as attorney general a few months later. In 1918 Lloyd George offered him the lord chancellorship which he accepted with some misgivings because it effectively extinguished any prospect of becoming prime minister. The appointment was not popular. It shocked the king and many others who knew of Smith's reckless mode of life or had felt the lash of his tongue. In fact he was an excellent lord chancellor, his judgments were sagacious, and he was responsible for one of the greatest law reforms of the day, the Law of Property act (1922). Along with Winston Churchill, his close personal friend, and the prime minister he dominated the coalition cabinet, and played a major part in the negotiations leading to the Irish treaty of 1921. On the fall of the coalition government in 1922 he was created an earl (having previously been made a baronet in 1918 and raised to the peerage in 1919). He declined to serve under Andrew Bonar Law or in Stanley Baldwin's first cabinet but in 1924 he became reconciled to the official Conservatives. He was secretary of state for India from 1924 to 1928 when he resigned to make some much needed money in business. He died in London on Sept. 30, 1930.

One of the ablest lawyers and greatest orators of his day, Birkenhead yet possessed qualities which made him many enemies. Orthodox politicians mistrusted him and politically he was a brilliant failure.

Birkenhead's *Life*, 2 vol. (1933–35; rev. ed., 1 vol., 1959), was written by his only son and successor, FREDERICK WINSTON FURNEAUX SMITH (1907–), 2nd earl. (R. N. W. B.)

BIRKENHEAD, a municipal, county and parliamentary borough and seaport of Cheshire, Eng., on the Wirral peninsula facing Liverpool at the mouth of the Mersey, 16 mi. N.N.W. of Chester by road. Pop. (1961) 141,683. Area 13.4 sq.mi. A Benedictine monastery, of which considerable ruins remain, was founded about 1150 by Hamon de Masci (Massey) and drew revenues from tolls at the Mersey ferry. Birkenhead ("headland overgrown with beech") was a hamlet of 106 inhabitants in 1810; its development was largely the result of the establishment of boilerworks and a shipyard on Wallasey pool in 1824 by William Laird, a pioneer of iron ships. Laird also laid out, on a rectangular plan, the nucleus of Birkenhead, with the aid of the architects of the New Town of Edinburgh. Sir Joseph Paxton of Crystal Palace fame laid out Birkenhead park (1847). In Arrowe park was held the third International Boy Scouts' jamboree in 1929, 21 years after the foundation of the movement by Lord Baden-Powell. James Telford, Alan Stevenson and Alexander Nimmo favoured, in 1828, the conversion into a basin of Wallasey pool, the creek of the Mersey north of the priory where Laird's yard was standing. After parliamentary powers were obtained the first docks were constructed by James Rendel in less than five years and opened in 1847. Since 1858 they have been controlled by the Mersey Docks and Harbour board. There are nearly ten miles of quayage.

The town, which could still be described as a beautiful watering place in 1833 when it was recognized as a township, was incorporated in 1877, became a parliamentary borough in 1861 and, after an increase of boundaries, a county borough in 1888. Besides sharing in the general trade of the Merseyside port, Birkenhead developed an individual trade in the export of midland manufactures and in trade with the east. The two great floats or main basins of the dock system attracted a gigantic flour milling industry which made Birkenhead the largest milling centre in Europe. A vast cattle and meat trade is carried on at lairages and abattoirs on the river front. Besides the shipbuilding industry, which produced the famous Confederate raider, "Alabama," in 1862 and H.M.S. "Ark Royal," the aircraft carrier, in 1955, there is ship repairing and a variety of industry including heavy and light engineering, food processing and clothing manufacture.

The ferry service dates from 1330. Birkenhead was the first town in Europe to have streetcars. The railway tunnel under the Mersey to Liverpool was completed in 1886 and the Mersey tunnel for road traffic, known as Queensway, was opened by King George V on July 18, 1934. It is more than 2 mi. long and has an internal diameter of 44 ft., allowing four traffic lanes. Its capacity per hour is 4,150 vehicles moving at 20 m.p.h. and spaced 100 ft. apart. The roadway is of cast iron, with rubber paving blocks in various sections, and the interior is lined with a glass dado. Public buildings include the town hall, the Williamson art gallery (1928), the central library (1934), St. Aidans Theological college, the general hospital and the fine Technical college opened in 1955.

BIRKHOFF, GEORGE DAVID (1884–1944), U.S. mathematician, was born at Overisel, Mich., on March 21, 1884. Following his secondary education at Lewis institute, Chicago, he attended The University of Chicago and Harvard university (A.B., 1905; A.M., 1906), and returned to The University of Chicago to complete his graduate studies (Ph.D., 1907). He taught at the University of Wisconsin, Madison (1907–09), at Princeton university, Princeton, N.J. (1909–12), then at Harvard until his death. Birkhoff was extraordinarily stimulating as a lecturer and as a director of research. At the middle of the 20th century many of the most productive mathematicians of the United States had either written their doctoral dissertations under his direction or done postdoctoral research with him.

Birkhoff's own research, notable for both breadth and depth, was primarily in the fields of mathematical analysis and analysis applied to dynamics. His dissertation and much of his later work dealt with the solutions of ordinary differential equations and the associated expansions of arbitrary functions. Using matrix methods, he also contributed fundamentally to the theory of systems of differential equations and the analogous theory of difference equations. A striking achievement was his proof (1913) of a geometric theorem having applications to dynamics conjectured by Henri Poincaré. Another of Birkhoff's major contributions to dynamics was the ergodic theorem (1931), which transformed the Maxwell-Boltzmann (*see* CHEMISTRY: *Physical Chemistry: The Maxwell-Boltzmann Law*) ergodic hypothesis of the kinetic theory of gases (to which exceptions were known) into a rigorous principle that, through use of the Borel-Lebesgue measure theory, placed the exceptional cases in proper perspective. Birkhoff developed his own theory of gravitation, subsequent to Einstein. He also constructed an important mathematical theory of aesthetics, which he applied alike to art, music and poetry. All of this creative work was renowned internationally, and stimulated further scientific discoveries. Birkhoff served as dean of the Harvard faculty of arts and sciences (1935–39); he was president of the American Mathematical society (1924–26) and of the American Association for the Advancement of Science (1936–37). He died Nov. 12, 1944, in Cambridge, Mass.

Among his works are *Relativity and Modern Physics* (1923); *The Origin, Nature and Influence of Relativity* (1925); *Dynamical Systems* (1928); *Aesthetic Measure* (1933); with Ralph Beatley, *Basic Geometry* (1941); and *Collected Mathematical Papers* (1950).

(J. L. WH.)

BÎRLAD (formerly BÂRLAD), a town in eastern Rumania, is the administrative centre of the district of the same name. Pop. (1956) 31,599. It lies on the Bîrlad river, which is tributary to the Siret and is navigable by small vessels as far as the town. An old Thracian settlement, first mentioned in documents in 1408, Bîrlad has few historic buildings except the 17th-century Dom-

neasca church. It has long been a market for farm produce but after 1950 expanded industrially, with factories manufacturing ball bearings, clothing, soap and textiles. The town has a state theatre and museum, and is a junction on the Galaţi-Iaşi railway. Nearby are traces of Palloda, a Roman frontier camp.

BIRLING (Logrolling) is a favourite outdoor sport of the North American lumberjack. Its origin can be traced to the spring log drives of the New England states, particularly the state of Maine, during the early lumbering era, from where it moved westward to the Great Lakes region and then to the Pacific northwest. On the spring drives the lumberjacks, turned rivermen, obtained their experience in managing themselves on the moving carpet of logs. Agility and nimble-footedness were the prime requisites, as well as levelheadedness, since the slightest misstep or miscalculation of the eye might send them beneath the logs into a swirling current of white water to drown.

Clad in "stagged" (shortened) overalls or jeans, which were light and dried quickly, woolen shirts, high-topped calked ("corked" to a real riverman) boots that gripped the soft bark of the logs, with pike poles or peaveys in their hands, they would leap from log to log, pushing, prying and pulling to keep the logs moving and ever striving to prevent jams (the bane of the rivermen, along with low water) at curves in the river, on sandbars, rocky narrows, windfalls and deadheads. From the daily work of the rivermen the sport of birling developed. It required skill and endurance to hop with an opponent on a log, spin it rapidly in the water with the feet, stop ("snub") it suddenly, reverse its motion, and in various ways maneuver an adversary off balance and into the water. Dislodging an opponent constituted a fall; two falls out of three constituted a match. Birling rules became standardized as the sport progressed. Camp championship contests were held, followed by intercamp contests, and eventually they became intersectional, finally culminating in national championship tournaments, called rodeos. The contests were usually held after the drive reached the sawmills. The lumberjacks bet freely on their favourites, and large sums of money changed hands. It was not until 1888 that the first public birling match was sponsored. The first world's championship tournament was held in 1898, at the Omaha, Neb., exposition. Thomas Fleming of Eau Claire, Wis., won the honour of being the first world's champion.

(G. T. S.; X.)

BIRMINGHAM, a city, county and parliamentary borough (which returns 13 members to parliament), in northwest Warwickshire, Eng., lies 113 mi. N.W. of London by rail and 108 mi. by road. Its northern suburbs adjoin Staffordshire and its southern and southwestern suburbs border on Worcestershire. Area 79.9 sq.mi. Pop. (1961) 1,105,651. Birmingham is England's largest provincial city.

Birmingham stands in the centre of an upland area, isolated by the valleys of the rivers Trent, Severn and Avon, and known as the Birmingham or Midland plateau. It is situated in the valleys of three small and unimportant rivers—the Tame, Cole and Rea (which all flow into the Trent)—and on the rising ground between these valleys. The site is undulating, rising from 267 ft. above sea level in the east to 736 ft. in the west, while at the Lickey hills, which form the city's southern extremity, the land rises to 1,000 ft.

The City Centre.—Victoria square is the heart of Birmingham's city centre, flanked on the southwest by the Town hall, a building in the classic tradition modeled on the Temple of Castor and Pollux. It was designed by Joseph Hansom, who invented the Hansom cab and John Welch, and is the principal meeting place and concert hall in the city. Mendelssohn's *Elijah* was given its first performance there in 1846, and since then most of the great orchestras and concert celebrities have appeared. On the north of Victoria square is the Council house, the foundation stone of which was laid in 1874 by Joseph Chamberlain during his mayoralty. The building, in Italian Renaissance style, contains spacious reception rooms, Lord Mayor's parlour, committee rooms and offices, and its clock tower, locally known as "Big Brum," is Birmingham's best-known landmark. Adjoining is the City of Birmingham Museum and Art Gallery, visited by about 2,000 people daily and famous for its pre-Raphaelite paintings and English water colours. It has departments of archaeology and natural history, and nearby in Newhall street, is a Museum of Science and Industry, which includes a collection of veteran cars.

Two of the city's principal thoroughfares radiate from Victoria square—Colmore row and New street. In Colmore row, surrounded by lawns and flower beds, is the cathedral church of St. Philip. Designed in the baroque style by Thomas Archer and consecrated in 1715, it contains some stained glass windows portraying the Nativity, Crucifixion, Ascension and Last Judgment by Edward Burne-Jones, a native of Birmingham. The parish church of St. Martin is in the former Bull Ring, standing on the site of a Norman church and twice rebuilt since the 13th century. Inside are stone effigies of the de Bermingham family and a chapel of the Guild of the Holy Cross dedicated to the memory of an American airman, James Neale Thorne, who fought and died with the Royal Air Force in World War II. Among other notable ecclesiastical buildings in the city centre is the cathedral of St. Chad, built in 1839–41 to the design of Augustus Pugin, the first Roman Catholic cathedral to be built in England after the Reformation. Its interior is made interesting by much fine modern glass, some rare 15th-century carving in the episcopal throne, stalls and lectern from Cologne and an old pulpit from Louvain.

Corporation street, built toward the end of the 19th century as a result of clearing 45 ac. of slum property, was again being redeveloped in the mid-20th. It contains the Victoria Law Courts, built between 1887 and 1891, and designed by Sir Aston Webb with Ingress Bell; opposite is the Central hall, Birmingham's principal Methodist church, and nearby the modern headquarters of the city's fire and ambulance service.

To the west of Victoria square is the Central library and beyond at the beginning of Broad street is the Hall of Memory, commemorating those citizens who were killed during World Wars I and II, and the first section of the Civic centre (opened 1939). The old Bull Ring, an ancient market area, was demolished and redevelopment began in 1960. Provision was made for retail markets, a self-contained shopping centre, and parks and open spaces.

Suburbs.—Although primarily an industrial city, Birmingham has many pleasant residential suburbs and more than 4,000 ac. of parks and open spaces. Westward and beginning less than one mile from the city centre is Edgbaston, still with many gracious residences, although now with a number of modern office blocks, including the Chamber of Commerce which moved from New street in 1960, and several hotels. Cannon Hill park on the outskirts of Edgbaston is the city's principal ornamental park of about 80 ac., where the main conservatory containing many interesting tropical plants is open to visitors. Opposite is the County Cricket ground, one of the most up-to-date in the country and of test match standard with comfortable seating for about 30,000 spectators. Beyond Edgbaston is Harborne, a village taken into the city in 1891. David Cox, the painter, is buried in the churchyard of the parish church of St. Peter.

Southwest of the city is Bournville where about 11,000 people are employed in its cocoa and chocolate industry. The adjoining estate, founded by George Cadbury (*q.v.*) in 1879, is still regarded as an outstanding instance of enlightened planning. By the village green are Selly manor and Minworth Greaves house, two splendid examples of medieval building. There is also a unique carillon of 48 bells. Nearby King's Norton, with its ancient church and half-timbered school house, and Northfield, with a church with traces of Norman work, are two districts in which evidences of historical associations are still to be seen. Beyond are the Lickey hills, one of the finest stretches of unspoiled countryside in the Midlands, rising to 1,000 ft.

On the other side of the city, where industry is more apparent, Birmingham merges almost imperceptibly into the adjoining county boroughs of Smethwick and West Bromwich (*qq.v.*). On the northwest boundary is Handsworth, where beneath the 500-year-old tower of the parish church lie Matthew Boulton, James Watt and William Murdock (*qq.v.*), pioneers and leaders of the Industrial Revolution in England. Nearer the city is Aston hall, a Jacobean mansion built by Sir Thomas Holte between 1618 and

1635 and later occupied by James Watt, son of the great engineer. Acquired by the corporation in 1864, it is now restored to its former grandeur and furnished as a private house of the period.

To the east of Birmingham, where many municipal houses have been built, is the modern airport at Elmdon, and there the city merges into the more rural area of Solihull (*q.v.*), raised to borough status in 1954 and a popular residential district.

Cultural Life.—Birmingham is the centre of cultural life for a large area. It is one of the few cities in England with a permanent orchestra, and the City of Birmingham Symphony orchestra, while not a municipal enterprise, is generously assisted by the city council. It gives frequent concerts in the Town hall, including a popular summer season of Promenade concerts. Birmingham is well known as the home of the Repertory theatre founded by Sir Barry Jackson, where many plays and players, later world famous, first came before the public.

The Central library in Ratcliff place is the hub of the Birmingham library system, which includes 34 branch libraries. The reference library contains more than 700,000 volumes, many rare and valuable. There the Shakespeare Memorial library, one of the largest of its kind in the world, has more than 35,000 books and pamphlets in more than 70 languages. A Technical library and Commercial and Patents library meet the special needs of industry and of the business community.

The University of Birmingham is at Edgbaston with a medical school adjoining the Queen Elizabeth hospital. It takes its roots from Mason Science college, opened in 1880 through the generosity of Sir Josiah Mason, a local manufacturer, and largely through the influence of Joseph Chamberlain a royal charter was granted in 1900 founding the university, with Chamberlain as its first chancellor and Oliver Lodge (later Sir) as its principal. The university has faculties of science, arts, medicine, commerce and law and has been a centre for much modern research. Music and the arts have in the nearby Barber Institute of Fine Arts a building housing an impressive collection of works of art and a fine concert hall. A new university library was built and the latest addition is a building for the faculty of commerce and social science.

The oldest educational institution in Birmingham is the grammar school of King Edward VI which, after its foundation in 1552, stood in New street until 1936, when it moved to Edgbaston near the university. The girls' high school, founded in 1883, is also at Edgbaston, and the foundation also controls a number of branch grammar schools. There are more than 500 schools under the control of the local education authority, covering educational requirements from nursery schools to advanced levels in technology, commerce and art. Educational facilities are also provided at the Birmingham and Midland institute with its school of music, the Selly Oak group of colleges for the study of ecclesiastical and social subjects, Saltley Church of England Training college for men teachers, a Methodist theological college and a Roman Catholic college. Private schools include preparatory and high schools for boys and girls and schools specializing in business training, music, dancing and drama. Since the end of World War II more than 100 new schools and colleges have been built.

Communications.—Birmingham's situation at the heart of England makes it a natural centre for road, rail, canal and air communications. It is on two main British railways services, and road developments, particularly the motorway (M.1) and improvements to routes to Wales, have been made.

The city owns a modern airport at Elmdon (7 mi. from the city centre on the main Coventry road) with direct air services to several continental cities and to Dublin and Belfast. It serves a traffic area containing a population of about 5,000,000, and has a main instrument runway of 5,000 ft. Birmingham is also the centre of an extensive canal system.

Industry.—The city claimed more than 1,500 different trades in the early 1960s and this diversity of industry is one of the main reasons for its uninterrupted industrial prosperity. By the end of the 19th century, although the older-established trades of gunmaking, jewelry, goldsmithing and silversmithing continued, the engineering trades had greatly increased in importance; the bicycle trade was by then established and the motor and electrical industries were beginning their spectacular careers. The automobile industry, established in the early 1900s, employed about 22,000 workers in the early 1960s, and produced on average 7,000 vehicles weekly. Although some of the world's largest and most modern factories are located in Birmingham, the city's industrial pattern is not made up entirely of mammoth concerns, and the characteristic industry is still the small firm. The latter, often a family concern, number at least 1,600, each employing less than 100 workers. To meet the needs of small firms the corporation built two "flatted" factories in which the whole or part of a floor is rented to a small firm.

Birmingham's manufactures include practically everything in metal, from pen points and fine jewelry to railway rolling stock. The city is probably best known for its automobiles, motorcycles and bicycles and their component parts and accessories, brassware, silverware and electroplated goods, buttons and badges, electrical equipment, machine tools, paints, plastics, chocolate, sporting guns and such unusual manufactures as handcuffs, police whistles, ceremonial maces and chains of office. Many firms admit visitors to their plants upon application.

History.—Birmingham is of far more recent growth than most other large British cities. It has no ancient cathedral or medieval castle, and although little is known of the origin of Birmingham, it seems certain that the settlement did not exist as such before Anglo-Saxon times. In Roman times an important road, the Ryknield street, crossed what is now the city, and traces of a Roman camp were found near the site of the Queen Elizabeth hospital at Edgbaston. At the time of Domesday (1085–86) Birmingham lay in the heart of a sparsely populated area, a small community "worth 20 shillings" and having nine tenants living under the lord of the manor probably near the spot where St. Martin's church now stands. At that time several villages, now part of the modern city, were larger and more important than Birmingham.

Its first market charter (possibly confirming earlier rights) was granted in 1166, followed in 1250 by a concession of a four-days fair at Whitsuntide, but it was not until the early 14th century that Birmingham emerged as a centre of any significance: in 1327 only Warwick and Coventry had more taxpayers. There was a reference to a "goldesmythe" in Birmingham in 1460 and in 1538 the historian Leland described it as "a good market towne . . . with many smithes . . . that use to make knives and all manner of cuttynge tooles and many lorimers that make byts and a great many naylors." The tradition of working in metal thus appears early in Birmingham's history, and during the Civil War its people demonstrated their manufacturing resources and a sturdy independence by providing 15,000 sword blades for the parliamentary forces and by declining orders for weapons for royalist forces, so showing, it was said, "as great fame for hearty, wilful, affected disloyalty to His Majesty as any place in England."

The 18th century saw the foundation of a daily newspaper, *Aris's Gazette*, the establishment of Taylors and Lloyds bank, later to become Lloyds bank, the cutting of the Birmingham canal linking the town with the coal fields of south Staffordshire and, from an industrial point of view most important of all, the partnership of Matthew Boulton and James Watt and the establishment in 1762 of the Soho manufactory. Invention and experience, coupled with a desire to raise the standard and reputation of Birmingham-made goods, were the preoccupation not only of Boulton and Watt but of Joseph Priestley, who discovered oxygen, William Murdock, who invented gas lighting, John Baskerville, the printer, and many others who did so much to lay the foundation of Birmingham as a great industrial centre. These scientific thinkers and industrialists, along with others such as Erasmus Darwin and William Small, Josiah Wedgwood, the potter, Sir William Herschel, the astronomer, John Smeaton, engineer and designer of the Eddystone lighthouse, and Samuel Galton, were members of the Lunar society, notable for its meetings at which scientific and philosophical questions and problems were discussed.

Later in the 18th century, theatres, schools and libraries and a hospital were opened, and the inauguration of the well-known music festivals were further indications of the growth of Birmingham,

the population of which increased from 15,000 in 1700 to about 70,000 a hundred years later.

So far, Birmingham's development had been concerned mainly with industry, and "local government" remained unaltered, and indeed until the second half of the 18th century Birmingham was still very much under the rule of the lord of the manor, "very nearly as the Saxons left it." Neither had Birmingham in its earlier history played any prominent part in parliamentary affairs, but early in the 19th century the question of the corn laws and later parliamentary reform aroused the town with far-reaching effects. Mass meetings were held on Newhall hill, and in 1830, at a public meeting called by Thomas Attwood, J. Scholefield and G. F. Muntz, the Birmingham Political union was formed, the main object of which was to obtain "by every just and legal means such a reform in the Commons House of Parliament as may ensure a real and effectual representation of the lower and middle classes of the people in the House." The movement spread to other parts of the country and Birmingham's lead stimulated a widespread demand for reform, resulting in the Reform act of 1832. Afterward, it was said that the Birmingham union with its motto "Peace, Law and Order," saved the country from disaster. After this long struggle for political expression, Birmingham, recognizing the great part played by Attwood and Scholefield, returned them both unopposed as its first members of parliament.

Even with political representation obtained, however, local government in Birmingham was in a rudimentary state. In 1769 a body of Street commissioners was appointed, but although they acquired the market rights from the lord of the manor and built the Town hall, they "worked in the dark, unseen by the public eye and irresponsible to the public voice," which for a town now of considerable importance with a population of well over 100,000 left much to be desired. The town eventually received a charter of incorporation in 1838, despite objections "that the trading interests of the town would be seriously injured by the annual excitement of a muncipal election." A mayor, 48 councilors and 16 aldermen were soon elected and officials appointed, and for the first time in its history Birmingham enjoyed a representative form of local government. It soon became apparent that the charter did not give the council all the powers it had hoped to possess, and there was still divided control and responsibility with the Street commissioners, and a government enquiry in 1849 revealed a sorry state of affairs with polluted wells, open sewers in streets, crowded lodging houses and stagnant ditches.

As a result, an Improvement act was passed in 1851, which abolished the Street commissioners and gave the council supreme control of the civic administration of the town. Even then, local "economists" succeeded for years in producing a period of stagnation in local affairs, but the election of Joseph Chamberlain marked the beginning of a new era in civic administration in Birmingham. Chamberlain was elected mayor in 1873 and twice re-elected to that position, and his association with municipal affairs is still remembered far beyond the bounds of Birmingham. The year 1875 is particularly worthy of note, when an improvement scheme swept away a congested slum area and gave the town Corporation street, and in the same year the gas and water undertakings were acquired.

In 1889 the town was elevated to the rank of city, and in 1896 Queen Victoria conferred the title of lord mayor upon the chief magistrate.

In 1891 the area of the city was increased to 12,365 ac., and in 1911 by the Greater Birmingham scheme the borough of Aston Manor and the urban districts of Erdington and Handsworth, King's Norton and Northfield, and the rural district of Yardley, comprising most of the residential suburbs, were incorporated into the city, increasing its area to 43,601 ac.

Administration.—Birmingham is a county borough controlled by a council of 152 members, and provides a wide range of public services. Its water supply comes from mid-Wales, 73 mi. away. The corporation carried on large-scale housing projects between World Wars I and II and building since then has included many blocks of multistory flats. Twenty-one homes for old people are provided and 19 children's homes and 5 residential nurseries are maintained. The public health department maintains more than 50 child welfare centres and a number of day nurseries. The city's first health centre with accommodation for six doctors was opened in May 1960. Local transport services are provided by the corporation, which also runs a civic restaurant and catering service, the municipal airport (which after government requisition reverted to the corporation in April 1960) and the only municipal bank in the country.

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BIRMINGHAM, the largest city in Alabama, U.S., and the leading industrial city of the south, is in the north central part of the state. It is the seat of Jefferson county and a port of entry in the Mobile customs district. Population (1960) 340,887. (For comparative population figures *see* table in ALABAMA: *Population.*) The standard metropolitan statistical area (Jefferson county), including Bessemer (*q.v.*), Fairfield and other suburban communities, had a population of 634,864 in 1960.

In 1871, on the site where the east-west and north-south railroads met in a cotton field the year before, the city was founded by a land company backed by railroad officials. It was named for Birmingham, Eng. In the census of 1880 the population was 3,086; in 1890 it was 26,178. The United States Steel company bought out the main local steel company in 1907 and Birmingham continued to develop as an industrial centre throughout the 20th century. The city adopted a commission form of government in 1910, but voted to replace it with a mayor-council form in 1962.

Located in the narrow Jones valley, it is protected by mountains to the southeast and northwest. Its residential environs spread over the mountain slopes and into the valleys beyond.

All the materials needed for making steel are found in close proximity and the industrial development of the city is based largely on immense mineral deposits: coal (approximately 66,000,000,000 tons), including good coking varieties; limestone and dolomite, used in fluxing steel; and iron (approximately 1,700,000,000 tons of red ore and 27,000,000 tons of brown ore). Graphite, marble, barites, bauxite, pyrite, quartz, millstone, cement rock, clays, sand and gravel and others are found in smaller quantities. Electric energy is supplied by hydroelectric and steam plants.

Pig iron and steel have always been the city's leading products. The city's varied industries manufacture more than 3,000 different commodities, ranging from acetic acid to zinc sulfate. The district produces several million tons of coal and coke annually, most of it in by-product ovens yielding vast quantities of coal tar and helping to supply the city's mains with gas. The area produces about 5,000,000 tons each of pig iron and steel every year. Other important products are cast-iron pipe (60% of the national supply of pressure pipes), aircraft, wire, nails, steel cars, rails, stoves, cotton gins, machinery for coal mining, brick, cement, lumber and lumber products, cottonseed oil and meal, corn meal, textiles, rubber tires, chemicals, mattresses, meat products, soft wood, especially yellow pine, and explosives.

Birmingham-Southern college, a coeducational Methodist institution, occupies 250 ac. on a hill overlooking the city. It was created in 1918 by the consolidation of Birmingham college, opened in 1898, and Southern university, established at Greensboro, Ala., in 1859. Howard college, a Baptist coeducational institution which was opened at Marion in 1842 as an academy and moved to Birmingham in 1887, occupies a campus of 400 ac. near the city. Daniel Payne college, maintained by the African Methodist Episcopal church and established there in 1889, and Miles college, founded in 1907 and supported by the Methodist church, are Negro institutions.

The medical and dental colleges of the University of Alabama are located in a 12-block $50,000,000 medical centre near the heart of the city. Near them are located the crippled children's

clinic, eye clinic, veterans' hospital, nutritional clinic, University hospital, public health building and the University of Alabama centre where evening undergraduate courses are offered. Three blocks away is the Southern Research institute.

Adjoining Birmingham's business district is the civic centre, including the city hall, county courthouse, Birmingham Museum of Arts, which houses the Kress collection, a city auditorium and the public library, which includes the large Tutwiler collection of southern history. In other sections of the city are the beautiful old ante-bellum home, Arlington, built in 1842 and maintained as a historic shrine, and the large iron statue of Vulcan, the Roman fire god, on top of Red mountain. (H. T. SH.)

BIRNEY, JAMES GILLESPIE (1792–1857), U.S. politician and abolitionist, was born in Danville, Ky., Feb. 4, 1792, of Scotch-Irish parents. He graduated from the College of New Jersey (now Princeton university) in 1810, studied law in Philadelphia, Pa., and passed the bar examination in 1814. He then returned to Danville to practise law and in 1816 was elected to the Kentucky state legislature. Birney moved to Huntsville, Ala., in 1818, was elected to the state legislature in 1819 and served as alderman and as mayor in Huntsville. While in Alabama he became interested in the American Colonization society and in 1832 became its agent in the southwest. He returned to Danville to devote his full time to the abolitionist cause. In 1834 he freed his slaves and wrote his *Letter on Colonization* which led him into the American Anti-Slavery society. In 1837 he became its executive secretary. In the meantime he had abandoned his plan to establish an abolitionist newspaper in a slave state and had moved to Ohio. On Jan. 1, 1836, the *Philanthropist* began publication; on July 12 the office in Cincinnati was broken into by a mob, one issue of the paper was destroyed and the press was thrown into the Ohio river.

By 1839 Birney felt that an antislavery political party should be formed. This caused a split in the American Anti-Slavery society. Those favouring political action withdrew and were successful in forming the Liberty party. In 1840 and again in 1844 Birney was its candidate for the presidency of the United States. He received few votes in 1840 but in the election of 1844 enough votes were cast in New York state for the Liberty party ticket to defeat Henry Clay and elect James K. Polk. Birney fell from a horse in 1845, suffered a severe paralytic stroke and, although mentally alert and active in writing, could never again deliver a public address. He died in Eagleswood, near Perth Amboy, N.J., Nov. 25, 1857.

See William Birney, *James G. Birney and His Times* (1890). (R. E. AT.)

BIROM, a small but politically prominent heterogeneous people of the Jos plateau, Nigeria, of about 60,000 population, in many respects representative of the societies that comprise Nigeria's "pagan [*i.e.*, neither Muslim nor Christian] middle belt." Their language is affiliated with the Bantu languages, within the Central branch of the Niger-Congo family, and thus is closely related to the languages of, *e.g.*, the Nigerian Tiv (*q.v.*) and Katab (Atyap), but contrasts with the Hamito-Semitic languages of many of their close neighbours, including the Ron (sometimes confused with Birom), Sura and Angas—peoples otherwise ethnically very similar. (*See* AFRICAN LANGUAGES.)

A "naked hill-people," and subsistence farmers, Birom were nonetheless unmatched horsemen, and defended themselves successfully against the Muslim Hausa and Fulani (*qq.v.*) slave raiders through the 19th century.

Under British administration, Birom received particular attention, owing to the wealth of tin in their territory, and to their dignified preservation of austere traditional values while exposed to a measure of alien influence, especially European, but also Muslim, probably unequaled in Nigeria.

The nucleus of a federation of splinter peoples centring approximately about the village of Riyom (8° 45′ E., 9° 30′ N.), including culturally (and linguistically) related but discrete Rukuba, Irigwe and Aten (among others), Birom came at length to serve as a model among local peoples with a similar cultural tradition—both those that, like Birom, had resisted and those that had submitted to the Muslim states before the advent of the British. Their prestige derived from their seniority in the development of a centralized organization and from their dedication to the principle of "accommodating self-determination," as well as from their nominal wealth from tin royalties.

See H. D. Gunn, *Peoples of the Plateau Area of Northern Nigeria* (1953). (H. D. GU.)

BIRON, the name of a branch of the house of Gontaut, distinguished in French history, which took its name from the territory of Biron in Périgord.

ARMAND DE GONTAUT (1524–92), baron de Biron, was born in 1524. As a page of Margaret, queen of Navarre, he attracted the attention of the marshal de Brissac (Charles de Cossé), who took him to Piedmont. There he commanded the artillery but was lamed by a wound. He brought back to the royal army in France the professional spirit of the Italian soldiers, and, in the battles of 1568–69, won the post of grand master of the artillery, held by Brissac before him. He took La Rochelle in 1573, commanded in Guienne and in 1577 was made marshal of France, with command in the south against Henry of Navarre. In 1581–83 he commanded the duc d'Anjou's forces in Artois. Having been a loyal friend of Henry III, he became in 1589 the chief commander of the army under Henry IV. The latter owed much to his sagacity at the battles of Arques and Ivry and in the many sieges, but Biron was believed to be prolonging the war for his private advantage. He was killed at the siege of Épernay on July 26, 1592. There is an edition of his correspondence by E. de Barthélemy (1874).

CHARLES DE GONTAUT (1562–1602), the first duc de Biron, son of Armand, won the favour of Henry IV by his courage and enterprise at Arques and Ivry and was made admiral of France and Brittany in 1592 after his father's death. He was relieved of that post and made marshal in 1594 on the recovery of Paris, when he was sent to regain Burgundy; and in 1597 he ended the war in the north by the recapture of Amiens. He was made *duc et pair* in 1598 but was discontented with the king's handling of his government of Burgundy. His mission to Brussels (1598) entangled him in intrigue with Spain, as his duties in Burgundy had with Savoy. He commanded the force which gained Bourg in 1600; but his opponent, Charles Emmanuel I, duke of Savoy, was secretly promising him his daughter in marriage. Henry could not decide to take any real action until 1601, when Biron was known to be working with the malcontents led by the comte d'Auvergne (*see* ANGOULÊME, CHARLES DE VALOIS, DUC D'). Biron was arrested at Fontainebleau, found guilty of treason in sending the duke of Savoy full particulars of the French army and beheaded in the Bastille on July 31, 1602.

The duchy of Biron was revived in 1723 for Charles's brother's grandson CHARLES ARMAND DE GONTAUT (1663–1756), who had been captured at Oudenaarde (1708) and was made marshal in 1734. His son and successor LOUIS ANTOINE DE GONTAUT (1700–88) commanded the *gardes françaises* in Paris for many years and was also a marshal. His successor was his nephew ARMAND LOUIS DE GONTAUT (1747–93), socially notorious as duc de Lauzun before inheriting his uncle's duchy (*see* the *Mémoires* published in 1822; new ed., 1858). Armand Louis had military ambitions. He had raised colonial troops and taken Senegal in 1779; he fought in the American Revolution under the comte de Rochambeau; he put his signature to notes on invading England and other military topics. But he was nephew of the Choiseuls and friend of the duc d'Orléans (Philippe Égalité), and he had no favour at court. Even after 1789 he was overshadowed by La Fayette. His chance came with the war in 1792. From Rochambeau's staff he secretly devised with C. F. Dumouriez a plan which gave him the chief role in Belgium. He marched for Mons with 10,000 men who on April 29 fled from a much smaller force at Quiévrain. He was happy to escape from his own men, and this was his only action. Commanding on the Rhine in July, transferred in 1793 to Italy and sent, after Orléans was arrested, to command in the west, he was never present when there was actual fighting. He had accepted every political change, but after 40 days in this last command he was dismissed on July 11 on denunciation by C. P. H. Ronsin and J. A. Rossignol. Robespierre, attacking Ronsin's party, could not

risk the countercharge of leniency to a former peer, and Biron was guillotined on Dec. 31, 1793. (I. D. E.)

BIRON, ERNST JOHANN (1690–1772), German adventurer who became duke of Courland and for a short time regent of Russia through the favour of the Russian empress Anna, was the grandson of a German groom in the service of Duke Jacob III of Courland. Born at Kalnciems (Latvia) on Nov. 23 (new style; Nov. 13, old style), 1690, he received what little education he had at the academy of Königsberg, from which he was expelled for riotous conduct. In 1714 he set out to seek his fortune in Russia and unsuccessfully solicited a place at the shabby court of the princess Sophia Charlotte, consort of the tsarevitch Aleksei Petrovich. Returning to Mitau (Jelgava), he succeeded in gaining a footing at the court of Anna Ivanovna, then duchess of Courland, through one of his sisters, who was the mistress of the ruling minister, Petr Mikhailovich Bestuzhev-Ryumin (1664–1743), the lover of the duchess. Around 1727 Biron supplanted him in Anna's favour, and from henceforth to the end of her life his influence over her was paramount. On her elevation to the Russian throne in 1730, Biron, who had in the meantime married Fräulein B. G. Trotta von Treiden, came to Moscow, and honours and riches were heaped upon him. He was made grand chamberlain and a count of the empire and was presented with an estate at Wenden (Cesis). He soon made himself detested by Russians of every class. He was mean, treacherous, rapacious, suspicious and vindictive. On the extinction of the line of Kettler, the estates of Courland, in June 1737, elected him their reigning duke. He was almost as much loathed in Courland as in Russia, but large sums of money speedily convinced the electors. On her deathbed Anna appointed him regent during the minority of Ivan VI.

Biron's regency lasted three weeks. At midnight on Nov. 19–20 (N.S., 8–9, O.S.), 1740, he was seized in his bedroom by his ancient rival, B. C. von Münnich. The commission appointed to try his case condemned him to death by quartering, but this sentence was commuted to banishment at Pelym in Siberia. In 1742 the empress Elizabeth, who felt indebted to him for benevolent treatment while he was in power, permitted him to return and to settle in Yaroslavl. The former regent re-emerged for a brief moment in 1762 when the philo-German Peter III summoned him to court. Catherine II re-established him (1763) in his duchy, which he bequeathed to his son Peter. He died at Mitau, his capital, on Dec. 29 (N.S.; 18, O.S.), 1772.

See R. N. Bain, *The Pupils of Peter the Great* (1897). (Lo. L.)

BIRR (Biorra), an urban district and market town in Offaly (formerly King's) county, Republic of Ireland, lies on rising ground beside the Camcor river, 82 mi. W.S.W. of Dublin by road. Pop. (1961) 3,872; area 2.5 sq.mi. Trade is carried on in corn, in timber and in beer; there are shoe and moquette factories. An abbey was founded there by St. Brendan of Birr (d. 573), to whom the parish church is dedicated. The district was not included in the county until the time of James I, when Birr castle, the chief seat of the O'Carrolls, and a considerable area of land were granted by the crown to Sir Lawrence Parsons. A descendant, William Parsons, 3rd earl of Rosse, built the famous reflecting telescope which he housed in the castle and first used in 1845. With it he made many important discoveries in astronomy, including that of spiral nebulae. (*See* Rosse, William Parsons.) One of his sons was Sir Charles Algernon Parsons (*q.v.*), the inventor of the steam turbine.

BIRRELL, AUGUSTINE (1850–1933), British statesman and man of letters, who as chief secretary for Ireland (1907–16) was held responsible for failure to anticipate the Easter rising in Dublin in 1916, was born at Wavertree, near Liverpool, on Jan. 19, 1850. After graduating from Trinity hall, Cambridge, he was called to the bar in 1875. During the 1880s he became a notable figure in literary circles, published two series of essays entitled *Obiter dicta* (1884 and 1887) and a study, *Charlotte Brontë* (1887). He took silk in 1894 and from 1896 was professor of law at University college, London. In 1889 he had entered the house of commons as a Liberal, and except for the period 1900–06 he remained in parliament until 1918. In 1905 he was made president of the board of education in Sir Henry Campbell-Bannerman's government, but in 1907 was transferred to the chief secretaryship for Ireland. There his greatest success was in the Liberal tradition; a convinced believer in religious freedom, he was responsible for the founding of the Roman Catholic National University of Ireland. However, Birrell was temperamentally unfitted to understand the passionate complexities of Irish affairs and although he was not responsible for major decisions of policy, the day-to-day administration of Irish affairs suffered from his *laissez faire* attitude. In 1916 the Easter rising gave as great a shock to the chief secretary as to the house of commons. Amid general condemnation, tempered by respect for his frank avowal of responsibility, Birrell resigned. He died in London on Nov. 20, 1933.

BIRTH: *see* Childbirth.

BIRTH CONTROL, although literally encompassing all means of preventing live births, including abortion, in this article is used as synonymous with contraception; *i.e.*, the prevention of conception. Some forms of contraception apparently are of very old origin. In *Medical History of Contraception* (1936), Norman Himes cites evidence of the existence of contraception among the Romans, Greeks and the ancient Egyptians and Asians. The Book of Genesis documents Onan's use of a well-known method in early biblical times (Gen. xxxviii, 8–10).

Despite the antiquity of contraception, the birth control movement is of fairly recent origin. Thomas Robert Malthus (1766–1834), English economist and former curate, in his seven editions of *An Essay on the Principle of Population* (first edition 1798, seventh edition 1872) probably provided much of the incentive for this movement although he virtually ignored the possibility of contraception as a means of population control.

Taking as *postulata* man's sex urge and his need for food, Malthus developed the argument that population tends to increase much faster than subsistence. Possibly without intention of rigid accuracy, he put this in striking form by the statement, "Population, when unchecked, increases in a geometrical ratio. . . Subsistence increases only in an arithmetical ratio." Malthus' basic theory, reaching its full development in the second edition of his *Essay*, contained three main points:

(1) Population is necessarily limited by the means of subsistence.
(2) Population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks.
(3) These checks . . . are all resolvable into moral restraint, vice, and misery.

Malthus has been criticized on two major scores: he did not foresee the future importance of contraception as a means of population control, and he did not foresee the immense possibilities for increasing agricultural and industrial production through discoveries and technical improvements. His defenders point out, however, that his basic tenets are still relevant to the demographic situations in underdeveloped areas.

Some students have argued that Malthus was unaware of contraception. It is true that there is nothing in his writings that is universally accepted as unequivocal evidence of his awareness of the existence of contraception. Some, however, have marshaled at least presumptive evidence that he was not ignorant about these matters. They think it probable that Malthus did not mention contraception as a means of population control because he did not regard it as being of sufficient or potential importance to merit consideration.

HISTORY OF OPPOSITION

Trials of Neo-Malthusians.—Whatever may have been the reason for his failure to mention contraception, Malthus unwittingly gave stimulus and name to the 19th century forerunners of the birth control movement, who were called Neo-Malthusians because they seized upon Malthus' essays as an argument for the spread of knowledge of contraception. In 1822 Francis Place, a London tailor, reform politician and father of 15 children, issued a tract endorsing Malthus' views and advocating the use of contraception among the working classes. *Moral Physiology*, by Robert Dale Owen, son of the British social reformer Robert Owen, published in New York in 1831 and in London in 1832, discussed the needs and some of the existing methods of family limitation. A

pamphlet on the same subject, *The Fruits of Philosophy* by Charles Knowlton (*q.v.*) of Boston was published in the United States in 1832.

The Knowlton pamphlet was reprinted and sold in England for over 40 years before there was any interference. However, in 1876 a Bristol publisher was indicted for selling copies of an edition in which, it was alleged, obscene pictures had been inserted. He was found guilty and sentenced. At this juncture two free-thinkers, Charles Bradlaugh and Mrs. Annie Besant, became interested in the matter and carried out a prearranged sale of the Knowlton pamphlet to provide a test case. The famous Bradlaugh-Besant trial of 1877 terminated in no clear-cut immediate legal victory for either side. The pamphlet was adjudged to be obscene but the defendants finally were acquitted on a technicality in Feb. 1878.

A direct result of the Bradlaugh-Besant trial was a great increase in the sale of the publication concerned. There were several subsequent trials but by and large it cleared the way for the free circulation of birth control literature in England. Furthermore, although it may simply have been coincidence, the long-continued decline in the birth rate in England began about this time.

The Malthusian league, formed in 1877, published the journal the *Malthusian* from 1879 to 1921; in 1922 it was succeeded by the *New Generation.* In 1921 Marie Stopes, a zealous leader and author of several books on contraception, started the first birth control clinic in England.

Although the reported year of its founding varies from 1878 to 1882, a birth control clinic established during this period by Aletta Jacobs in Amsterdam, the Netherlands, is generally recognized as the first one in the world. Neo-Malthusian leagues were established for propaganda purposes in the Netherlands and Germany in the 1880s.

Margaret Sanger.—Margaret Sanger was the leader of the birth control movement in the United States. Beginning her career as a trained nurse in the Lower East Side of New York city, she soon saw the relation between frequent pregnancies and maternal and infant mortality. In 1913 Mrs. Sanger went to Europe to consult with leaders and workers in the fields of maternal health and contraception. Returning to the United States in 1914 she and some of her friends founded the National Birth Control league. From the outset, the avowed purpose of the league was to sponsor the publication of *Woman Rebel,* a periodical devoted to woman's right to plan the size of her family. The first issue of *Woman Rebel* appeared in March 1914. It was barred from the mails, and so were the four following issues. In Aug. 1914 Margaret Sanger was indicted under the federal statutes on obscenity but the case finally was dismissed in 1916. She opened the first birth control clinic in the United States Oct. 16, 1916. That same year she was arrested for "maintaining a public nuisance" and in 1917 served 30 days in the workhouse. In 1929 her 15th street clinic was raided and the clinic records were confiscated. However, at a subsequent hearing the case was dismissed when prominent doctors and liberals in New York city came to the defense of Mrs. Sanger and her colleagues.

The work begun by Mrs. Sanger is carried on by the Planned Parenthood Federation of America, a national organization composed of state and local affiliates. The International Planned Parenthood federation is composed of national affiliates and holds biennial meetings.

Legal Opposition.—The Comstock act, enacted in 1873, was the first federal law on contraception in the United States. Named for its chief protagonist, Anthony Comstock (1844–1915), founder of the New York Society for the Suppression of Vice (1873), the law was designed mainly to ban the importation, mailing and dissemination in interstate commerce of obscene and pornographic literature and materials; contraceptive literature and devices were specifically included in the category of obscene materials.

The federal laws are an outgrowth of the Comstock act. However, as interpreted in federal courts, the law is not regarded as broken unless there is intent to use the materials unlawfully and immorally. It is considered legal to ship contraceptives to authorized persons such as physicians and druggists. State laws against contraception have in most cases followed the federal pattern, not only with respect to their original provisions but also with respect to the changes induced by interpretation in the courts.

Approximately three-fourths of the states in the 1960s had laws prohibiting or restricting the giving of information on contraception, or on advertising, display or sale of contraceptive devices. In most of these cases the laws explicitly exempt physicians or druggists, and some explicitly exempt medical schools, medical books and professional journals. Except in two of the remaining states these exemptions probably would be implied even if not expressly stated. The two exceptions are Massachusetts and Connecticut; in these states physicians are prohibited from giving contraceptive advice to their patients for any reason whatever. The U.S. supreme court declined on June 19, 1961, to rule on the constitutionality of the Connecticut ban on contraception.

Medical Opposition.—As might be expected, individual and local attitudes of doctors toward contraception frequently are related to the doctor's own religion, age and cultural environment. Physicians who are themselves Roman Catholic are naturally more likely to espouse the Catholic viewpoint on contraception than are non-Catholics. Within any religious group the older physicians perhaps tend to be more conservative than the younger physicians. Fear of censure may influence local policies regarding contraception. Thus in July 1958 the hospital commissioner of New York city forbade a doctor in a city hospital from prescribing a contraceptive for a Protestant patient even though the doctor believed that another pregnancy would endanger the patient's life. After much protest by various groups the board of hospitals reversed the ban by an 8–2 vote.

In the United States medical opposition has lessened considerably since 1900. This has been caused in part by successes of the birth control movement on the legal front. Opinion polls indicate that most physicians approve of contraception although many may not be very enthusiastic about it. Doubtless in many cases in the past doctors have been uncertain as to the status of the laws. Much of the uncertainty was removed when a decision was handed down by the U.S. circuit court of appeals on Dec. 7, 1936, approving the importation of contraceptives by one whose purpose was scientific and legitimate and affirming the right of physicians to prescribe contraceptives "for the purpose of saving life or promoting the well-being of their patients." In 1937 the house of delegates of the American Medical association went on record as acknowledging contraception as a proper part of preventive medicine and the American Medical association's committee to study contraceptive practices reported that there appeared to be no law to prevent physicians from furnishing dispensary patients with any information that lawfully might be furnished to any other patients. "In all cases," the report stated, "the legal justification is the medical need of the patient."

Contraception has been incorporated as an integral part of the public health programs in several states, particularly in the south. The value of contraception for health and economic needs has been stated by the American Public Health association in the *American Journal of Public Health* (Dec. 1959):

> The American Public Health Association, retaining cognizance of the principle of religious freedom by all religious groups as expressed, for example, in the First Amendment of the Constitution of the United States, believes therefore that:
>
> 1. Public health organizations at all levels of government should give increased attention to the impact of population change on health.
>
> 2. Scientific research should be greatly expanded on (a) all aspects of human fertility; and (b) the interplay of biological, psychological, and socioeconomic factors influencing population change.
>
> 3. Public and private programs concerned with population growth and family size should be integral parts of the health program and should include medical advice and services which are acceptable to the individuals concerned.
>
> 4. Full freedom should be extended to all population groups for the selection and use of such methods for the regulation of family size as are consistent with the creeds and mores of the individuals concerned. (American Public Health Association, *American Journal of Public Health,* vol. xlix, no. 12 [Dec. 1959], p. 1704.)

Religious Opposition.—On religious grounds, the Roman Catholic Church in particular has opposed the use of contraception, giving its official approval only to the so-called rhythm method of

abstinence during periods of assumed female fertility. The church has condemned the practice of artificial birth control as contrary to the natural law because it is a frustration of the primary end of the sexual act, which is procreation, and therefore is unnatural, contrary to right reason, conduct unbecoming rational beings, and so morally wrong.

Sanction of the use by Roman Catholics of the rhythm method in child spacing and family limitation was given in the encyclical on marriage (*Casti connubii*) by Pope Pius XI in 1930:

> . . . . Nor are those considered as acting against nature who in the married state use their right in the proper manner, although on account of natural reasons either of time or of certain defects new life cannot be brought forth.

The rhythm method is expounded in *The Rhythm of Sterility and Fertility in Women* by Leo J. Latz, M.D., first published in 1932 with ecclesiastical approbation.

Many Protestant ministers and laymen may be opposed to contraception, but there is no common doctrine on contraception within any of the Protestant denominations corresponding to that within the Roman Catholic Church. Similarly, none of the other religions of the world opposes contraception in a manner comparable with that of the opposition of the Roman Catholic Church.

The statement of the Roman Catholic bishops of the United States in Nov. 1959 reaffirmed the Roman Catholic stand against artificial contraception and decried efforts to introduce such practices in the underdeveloped areas of the world. The impact of the church on the fertility behaviour of the various predominantly Roman Catholic countries and areas is by no means uniform. Ireland apparently hews close to the line of church doctrine on contraception and the Irish have resorted to postponement of marriage or permanent bachelorhood and spinsterhood to maintain a low birth rate. Because of low proportions of the population married at young ages the general fertility rate is very low. However, the fertility rate of Irish married women is relatively high as compared with that of married women of comparable age in other countries.

In the heavily Catholic Canadian province of Quebec, both general and marital fertility rates are relatively high because marriages are young and fertility is largely uncontrolled.

In France there apparently has long been a gap between Catholic doctrine and practice regarding contraception. For many years France exhibited conspicuously low birth rates and offered the pre-World War II example of a country with fewer births than deaths.

BIRTH CONTROL AND POPULATION CHANGES

To the married couple, birth control is a means of preventing unwanted pregnancies and of spacing births in the interest of the health of the mother and children and of the general welfare of the family. In an impersonal demographic context, birth control is a means of keeping the birth rate in balance with a low death rate.

In 1650 the population of the world was about 500,000,000. By the second half of the 20th century it was about 2,700,000,000, a fivefold increase in three centuries. The increase was especially large for peoples of European origin. In 1650 Europe had about 100,000,000 people or about one-fifth of the world's population. In 1950 the peoples of European origin, in Europe and elsewhere, probably numbered about 800,000,000 or about one-third of the world's population. Thus the increase in the population for peoples of European origin was about eightfold and that for peoples of non-European origin only about threefold.

The European peoples increased more than the others during this time because they had the first benefits of the commercial, agricultural and industrial revolutions.

The availability of new lands in the western hemisphere and Oceania provided both a stimulus and safety valve for population growth in Europe. Population growth was especially rapid in the new world where the abundance of land and the relatively large proportion of young men and women stimulated rapid increase of population. The British colonies in the new world furnished to Benjamin Franklin and Thomas Jefferson, as well as to Malthus, examples of areas in which the human population doubled in a generation.

Precise data on early trends in fertility and mortality are lacking but available materials suggest that in England and Wales both birth and death rates were about 35 per 1,000 population around 1650. Whereas death rates began declining shortly thereafter, the birth rates remained at this level until the time of the Bradlaugh-Besant trial in 1877–78. Close interpretation of the data is not warranted, but most students agree that the lag in the decline of the birth rate behind that of the death rate accounted for the great increase of European peoples.

Demographic transition is the term sometimes given to the change from high to low birth and death rates. According to this concept the different countries of the world are in various stages of this transition, or "vital revolution." The modern countries of the west have completed the transition, in that both birth and death rates have declined. Some of these countries, especially the United States and Canada, exhibited marked increases in birth rates after World War II but there is no indication of any return to the large families common at the beginning of the 20th century.

At the other extreme are the countries that were just beginning the transition in the second half of the 20th century. These were largely in the underdeveloped areas of Asia and Africa and they included about one-half of the world's population. Until the end of World War II the high birth rates of these areas were offset by high death rates. However, since World War II the death rates have been reduced with amazing rapidity with the help of new drugs and insecticides. In the meantime, the birth rates have remained high and many of the countries are exhibiting rapid growth. There are some who argue the necessity of encouraging the inhabitants of these countries to find ways and means of reducing their fertility rates in order to facilitate their efforts at economic development and the raising of their levels of living. Others take a different viewpoint for religious, political or other reasons.

Contraception and Fertility.—Prior to the studies of contraception in the late 1920s and early 1930s, there were two schools of thought regarding the reasons for the long-time declines in fertility and the relatively low fertility of the "upper classes" in cities. On the one hand there was the biological interpretation, represented by Oswald Spengler in Germany, Corrado Gini in Italy and Raymond Pearl in the United States. This interpretation attributed the general decline in fertility and the existing differentials in fertility, which were correlated with urban-rural and socioeconomic status, to the relatively low reproductive capacity of urban people of higher socioeconomic status. The growth of cities was accompanied by an increasing proportion of urban white-collar workers in the total population and hence, according to this view, by the decline in the general level of fertility.

The other school of thought held that increased use of contraception was the cause of the decline in fertility rates and that variations in the prevalence and effectiveness of contraception underlay the group differences in fertility.

Subsequent studies of the prevalence and effectiveness of contraception, including those by Pearl himself, confirmed the major importance of contraception. Those studies, which have related to different areas and different population groups, indicate that when the factor of contraceptive practice is held constant the differentials in fertility by socioeconomic status tend to disappear. By indicating very high pregnancy rates among urban groups of high socioeconomic status during periods of noncontraceptive practice, some of the studies also served to cast doubt on any theory that the long-standing decline in birth rates connoted declines in reproductive power. The resurgence in the birth rate itself after World War II suggests that there has been no considerable loss in reproductive power. These increases have been proportionately largest among urban white-collar workers.

Some students have held that in the western countries contraception has tended to originate in the upper socioeconomic groups of cities and to spread outward to rural regions and downward to groups of lower socioeconomic status. If this is the process, differential fertility itself may be a transitional phenomenon which will disappear after the spread of contraception has run its course.

There has indeed been a considerable diminution of class differences in fertility in the United States and other western coun-

tries. During the 20 to 30 years prior to World War II, some trend toward equalization of fertility rates appeared to arise from the more rapid decline in the fertility of the manual workers than of the white-collar workers. During the 1940–50 decade there was a marked narrowing of class differences in fertility in the context of general increases in the level of fertility. This came about because the increases in fertility tended to be proportionately larger for the "upper" than for the "lower" socioeconomic groups. The trends suggest that as family planning becomes more common, class differences in fertility may become less pronounced. However, under conditions of fairly universal planning of fertility greater sensitivity of births to business conditions might occur and hence more short-time fluctuations in fertility levels.

Prevalence of Contraception.—A study in 1955 of a representative cross section of approximately 2,700 white married women 18–39 years old in the United States indicated a wide prevalence of knowledge of, and some experience with, contraception. Many of those who avowed no previous attempts at contraception also indicated some form of impaired fecundity. Among the fecund couples (husband and wife physiologically capable of participating in reproduction) 83% reported some past conscious effort at family limitation. By religion of the couple, the percentages were 96% for Jews, 88% for Protestants and 71% for Roman Catholics. By education of the wife the percentages ranged from 68% for those of grade school status to 91% for those of college attainment.

However, in only a minority of the families (29%) was the fertility-planning status classified as "completely planned" in that the couples had no pregnancies except those that occurred when contraception was deliberately discontinued or omitted in order to conceive.

By religion, the proportion of completely planned families was highest for Jews (57%), lowest for Roman Catholics (16%) and intermediate for Protestants (32%). Despite the differences in proportion of completely planned families it should be emphasized that the great majority of the fecund couples of each religion has used or will use contraception.

Contraception in Communist Countries.—A succinct summary of the Communist policy on contraception was presented by Nikita S. Khrushchev in a Radio Moscow broadcast to southeast Asia in Jan. 1955, in which he said the theory of overpopulation is a "cannibalistic" theory invented by bourgeois ideology to cut down the birth rate. In contrast, he said, under socialism a rise in the birth rate is regarded not only as a means of increasing the supply of labour but as essential to the growth of the socialist state.

However, there is much variation among the different Communist countries with respect to actual legislation and practice regarding contraception. The U.S.S.R. has gone through several alternating phases with respect to laws on abortion. Some of its legislation has been intended to discourage high birth rates and some has been intended to encourage them.

Communist China began its existence with a doctrinal opposition to contraception, swung to advocacy of contraception during 1955–57 and later returned to opposition. Even during 1955–57 the attack on Malthus continued; the argument for contraception was that of protecting the health of mothers and children.

THE POPULATION EXPLOSION

During the years since World War II there has been increasing public discussion of the dangers of a "population explosion." Attention has already been given to the fact that for three centuries following 1650 the European peoples increased at a higher rate than others. Growth doubtless will be heavier for the peoples of non-European origin, especially those in Asia and Africa, in the second half of the 20th century. In the past population growth in these countries has been held in check by high death rates. Since World War II, however, the death rates in most of the underdeveloped areas have declined sharply following the use of new drugs and insecticides. Birth rates in most of these have remained high and populations have increased greatly. Furthermore, there are no new continents to help absorb the increase as was the case when Europe had its period of rapid population growth.

There are various interpretations regarding the implications of this situation. Some are very pessimistic about the outlook for underdeveloped areas. The two horns of the dilemma that they see are (1) the difficulty of introducing desires for family limitation in areas in which high value is placed on the large family and (2) the possibility that technical assistance programs will be more difficult or even self-defeating unless declines in death rates are accompanied by declines in birth rates. Continuing population explosions in these areas may mean that the capital needed for development will have to be spent for more food, rather than for schools, roads, dwellings and factories.

Some groups are optimistic. The Marxists hold that with proper political organization increases in production will keep ahead of increases in population. Others admit the seriousness of the problem but maintain hope that production can somehow keep ahead of population growth or that modernization will somehow induce a lowering of fertility levels. It is true that both Japan and Puerto Rico have demonstrated the length to which people may go to control family size when they are sufficiently motivated. Japan's birth rate has declined sharply since 1950, largely by the means of abortion. Puerto Rico has had a much smaller decrease in birth rate than Japan but has managed to minimize population growth partly by migration to the U.S. mainland, partly by sterilization and partly by contraception. In both areas, and also in many larger and more agrarian countries there have been surges of interest in national population trends and in the development of programs of family planning. These stirrings of national interest in the problem may provide some hope to those who believe that the underdeveloped areas have a fighting chance to work out their demographic and family planning problems if these are approached in the context of efforts at improvement in health, education, employment opportunities and levels of living.

See also BIRTH RATE; POPULATION.

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Memorial Fund; Office of Population Research; National Institute of Maternal Health; Population Research and Training Center; Planned Parenthood Federation of America; and International Planned Parenthood Federation. (C. V. K.)

BIRTHMARK, a circumscribed new growth on the skin, usually of congenital origin. The scientific term is nevus. It may be present at birth or appear later in life. The most common site of appearance is the face. Birthmarks may be composed of various tissues or combinations of tissues. The more common types are the vascular ones and the pigmented nevi (moles).

The vascular birthmarks, which are caused by enlarged small blood vessels or lymph vessels, may be flat, nonelevated, port wine-coloured marks. These appear frequently on the face, where they may extend to the mid-line, or they may involve an extremity or one-half of the body. Such marks on the face may be associated with vascular nevi of the meninges or with other intracranial involvement which through increase of cerebral pressure may produce convulsions or paralyses. Vascular birthmarks on an extremity, especially a lower extremity, may be accompanied by enlargement of the extremity so that it becomes longer and larger than the unaffected leg.

Other vascular birthmarks are elevated above the surface of the skin. These have a tendency to grow during early life and then spontaneously decrease in size or completely disappear. Some, however, do not follow this course and become very large, ulcerated and cause other complications.

Birthmarks composed of a mixture of nerve, fat and connective tissue may be disfiguring. Pendulous overgrowths of these birthmarks may produce unsightly enlargements of the affected parts or may be associated with other congenital defects. *See* also SKIN, DISEASES OF. (G. C. AN.)

BIRTH RATE, as applied to the human species, is the ratio between (1) the number of babies born alive in a given population during a year and (2) the average number of persons in that population during the year (usually taken as the number living at the mid-point of the year).

Crude Birth Rate.—When the term "birth rate" is used without qualifying adjectives it usually refers to the crude birth rate—the number of babies born alive per 1,000 persons in the total population in a given year—which can be computed for more areas or groups of people than can the more refined rates mentioned below. Crude birth rates for most countries of the world have been published annually by the United Nations in the *Demographic Yearbook* since 1948. Rates for selected countries are shown in Table I. Before making comparisons it is important to read the footnotes indicating whether the data are relatively complete, are affected by irregularities or incomplete coverage, or are not rated. Many births go unrecorded in some of the countries with rates classified under incomplete coverage or not rated and the real rate is much higher than that shown. Among the countries with relatively complete data those with high birth rates (40 or over) are in Latin America or Asia, and those with low rates (less than 20) are in Europe. The crude birth rate of a country which takes a reliable census but does not register births (or fails to record many babies) can be estimated from the number of young children counted in the census, if allowance is made for those dying before the census date.

Trends.—In most of the countries that were economically well developed by the second half of the 20th century the crude birth rate had decreased during the preceding 50 to 100 years (or more) although in some the rates of the 1950s exceeded those of the 1930s. In the United States the rate (adjusted for incomplete registration) decreased fairly steadily from an estimated 54 to 60 per 1,000 in 1800 to a low of 18.4 in 1936, but was between 24 and 27 in each year between 1946 and 1961. A major decline began in France about 1800; in Sweden about 1860; in Ireland, England and Wales about 1870; in Italy about 1890; and in Japan about 1920. (*See* Table II.)

Effect of War on Birth Rate.—In most of the countries which were deeply involved in World War I the crude birth rate was much lower during the war than before or after. (*See* Table II.) By 1925–29, however, in most cases it was close to the value that would be expected from a continuation of the prewar downward trend.

TABLE I.—*Crude Birth Rate (Births per 1,000 Total Population) for Selected Countries, 1958*

Country	Birth rates per 1,000	Country	Birth rates per 1,000
North America		Europe (cont.)	
Canada	27.6*	Poland	26.2*
Mexico	44.4*	Spain	21.8*
Puerto Rico	32.7*	Sweden	14.2*
United States	24.2*	United Kingdom	16.8*
Central America		Yugoslavia	23.8*
Costa Rica	44.8*	Africa	
Guatemala	48.7*	Algeria, Moslem pop.	34.5†
Nicaragua	41.2†	European pop.	20.2*
South America		Egypt (U.A.R.)	40.3†
Argentina	22.7*	South Africa	
Chile	35.5*	European pop.	24.5*
Colombia	43.3†	Asia	
Ecuador	45.9†	Ceylon	35.5†
Peru	38.2†	Formosa (Taiwan)	41.7*
Venezuela	45.3*	Hong Kong	38.8*
Europe		India	26.4†
Austria	17.1*	Iran	42.8†
Belgium	17.1*	Iraq	11.8†
Czechoslovakia	17.4*	Israel	26.7*
Finland	18.5*	Japan	17.9*
France	18.2*	Malaya, Federation of	43.2*
Germany, Federal Republic of	17.0*	Pakistan	21.2†‖
Germany, Democratic Republic	15.9‡	Philippines	20.2†
Greece	19.0†	Singapore	42.0*
Hungary	16.1*	Syria	26.6†
Ireland	20.9*	Oceania	
Italy	17.9*	Australia	22.6*
Netherlands	21.1*	New Zealand	
		European pop.	26.6*

*Virtually complete data. †Incomplete coverage or other irregularities. ‡Completeness not stated. §1957. ‖1951.
Source: *United Nations, Demographic Yearbook, 1960.*

Changes associated with World War II were more variable, depending largely on differences in the country's active participation in the fighting, and on the extent of the prewar decline of the birth rate. The birth rate in most countries was higher in the postwar than wartime years, but declined during the 1950s.

Causes of Trends.—In most of the countries with a long-time downward trend the chief cause appears to have been the desire of an increasing proportion of persons to restrict the number of their children so as to improve the living conditions of the family. The most commonly used means of implementing this desire was some type of contraceptive practice (including rhythm or periodic continence). (*See* BIRTH CONTROL.) Other means included delayed marriage (common in Ireland) and abortion (common in Japan after World War II). The scanty evidence available indicates on the whole that there was not a decrease in fecundity—the physiological ability of couples to have children—but some decline may

TABLE II.—*Crude Birth Rate (Births per 1,000 Total Population) in Selected Countries Since 1861–80 or 1925–29**

Country	1861–1880	1881–1900	1901–1910	1910–1914	1915–1919	1920–1924
United States†	40–42	34–36	31–32	29.8	28.4	26.8
Ireland	26.4	23.2	23.3	23.0	20.5	20.5
England and Wales	35.3	31.2	27.2	24.2	19.4	21.3
France	25.8	23.0	20.6	18.8	11.3	19.9
Netherlaods	36.0	33.4	30.5	28.2	25.5	26.7
Sweden	31.0	28.1	25.8	23.7	20.8	20.3
Germany	38.2	36.4	33.0	28.2	16.8	23.1
Austria	38.8	37.5	34.7	29.6	15.8	22.6
Hungary	....	42.3	37.0	35.0	20.2	30.2
Italy	36.9‡	36.4	32.7	31.6	22.7	30.1§

Country	1925–1929	1930–1934	1935–1939	1940–1945	1946–1950	1951–1955
United States†	23.2	19.7	18.8	21.2	24.8	25.1
Chile	40.3	34.1	32.9	33.1	35.2	33.9
Ireland	20.3	19.5	19.4	21.2	22.2	21.4
England and Wales	17.1	15.3	14.9	15.6	18.0	15.3
France	18.5	17.3	14.9	14.9	21.5	19.1
Netherlands	23.4	21.7	20.3	22.0	25.9	21.9
Sweden	16.3	14.4	14.5	18.1	18.2	15.2
Germany	19.7	16.3	19.4	17.4‖	16.5¶	16.0¶
Austria	18.4	15.1	14.7	18.4	16.8	15.0
Hungary	26.6	23.2	20.1	19.1‖	20.4	21.2
Yugoslavia	34.9	33.0	27.9	....	28.8#	28.1
Italy	27.2	24.5	23.2	20.5	21.4	18.1
Japan	34.0	31.8	29.2	28.9	30.9	22.0

*The rates for groups of years are the averages of the rates for single years. †Adjusted for underregistration of births. Rates for 1910 and earlier are estimated from children enumerated in the census. ‡1872–80. §1921–24. ‖1940–44. ¶Federal Republic of Germany. #1947–50.
Source: United Nations, *Demographic Yearbook;* Statistique Générale de la France, *Annuaire Statistique;* Scripps Foundation studies.

have taken place in certain groups. (*See* FERTILITY AND FECUNDITY.)

The much higher crude birth rates in the United States during 1946–56 than 1930–39 occurred mainly because more women married and started childbearing at younger ages. Studies in later years showed only a small increase in the average number of children among couples having at least one child, but a somewhat larger increase appeared likely to occur. Less was known about the reasons why some other countries had higher birth rates during 1945–56 than during preceding years.

Birth Rates by Age and Marital Status of Mother and Birth Order of Child.—The crude birth rate tends to be high if women aged 17 to 35 make up a large proportion of a population and to be still higher if a large proportion of these women are married. Because such proportions vary from one country to another, and within many countries from one decade to another, crude rates are not precise enough for the accurate measurement of differentials and trends in human fertility. The more specific birth rates which are commonly used are: (1) the general fertility rate, which relates the total number of births to the number of women of reproductive age (ages 10–49 or 15–44 are commonly used); (2) rates like the foregoing except for births of specified order (*i.e.*, first births, second births, etc.); and (3) age-specific rates, which relate the number of births of the women of a given age at childbirth (*e.g.*, 20–24) to the number of women of that age in the

TABLE III.—*Birth Rates per 1,000 Women of Specified Age in Selected Countries*

Country	Year	Age*					
		15–19	20–24	25–29	30–34	35–39	40–44
United States†.	1936–40	52.9	131.9	118.0	80.1	48.1	16.7
	1941–45	57.0	153.0	137.6	95.0	51.7	15.6
	1946–50	77.1	197.7	166.4	106.1	55.7	15.8
	1951–55	87.9	226.1	183.5	113.3	57.2	15.5
	1956–57	95.2	254.4	198.0	117.2	60.6	16.0
Chile . . .	1952	68.3	186.7	206.6	177.5	123.0	62.1
England and Wales . .	1957	29.6	152.6	157.3	91.4	46.5	12.2
France . .	1958	20.9	154.1	173.9	107.9	61.1	17.0
Netherlands .	1958	6.5	115.2	203.8	155.0	93.7	34.5
Sweden . .	1957	38.4	133.7	136.8	87.0	44.4	13.6
Yugoslavia .	1957	47.3	185.4	149.2	86.9	42.8	20.0
Italy . . .	1951	15.7	101.7	141.0	110.7	72.2	29.3
Japan . . .	1957	4.3	99.3	169.6	89.8	35.6	8.3

*Excludes births to women under 15 or over 44 years old.
†Adjusted to allow for incomplete registration; birth rates for groups of years are the averages of the rates of single years.
Source: United Nations, *Demographic Yearbook, 1956* and *1959*, and United States National Office of Vital Statistics, *Vital Statistics of the United States, 1954* and *1957*.

population. These rates are occasionally restricted to married women.

The age-specific rate for all women (*i.e.*, single and ever married) usually rises with age to a maximum in the 20s and then declines. (*See* Table III.) The rise reflects the increasing proportion of women married, and the later decline is due chiefly to measures restricting family size and to the effect of approaching middle age on reproductive capacity. The rates at ages 15–19 and 20–24 are relatively high in the United States because more women marry at younger ages. The age-specific rate for married women usually is highest at ages 15 and 16 (*i.e.*, the youngest ages at which marriage occurs except in countries which permit child marriage), premarital pregnancy being an important factor.

The higher crude birth rate in the United States during 1946–55 as compared with that during 1930–39 reflected mainly an increase in the age-specific rates for women under 35, and in the rates for second, third and fourth births. (*See* Tables III and IV.) The importance of first and second births in the economically developed countries is illustrated in Table IV, where more than half of the rate for all births comes from first and second births in each country except in Chile.

Birth Rates for Cohorts of Women.—Birth rates for the women born in given years (birth cohorts) or for the women married in given years (marriage cohorts) are available for a few countries. They have the great advantage of describing the fertility of actual groups of women as they proceed through life. In the United States the number of births per 1,000 women living to age 47 (*i.e.*, the cumulative birth rate by age 47) decreased from

TABLE IV.—*Birth Rates per 1,000 Women Aged 10–49, by Birth Order of Child, in Selected Countries*

Country	Year	All births	Birth order				
			First	Second	Third	Fourth and fifth	Sixth and higher
United States*	1936–40	59.5	21.8	14.0	8.1	8.1	7.5
	1941–45	68.7	25.3	17.9	9.9	8.8	6.8
	1946–50	88.2	30.1	23.7	12.7	10.1	6.6
	1951–55	89.0	26.0	25.0	16.8	14.0	7.2
	1956–57	94.3	25.9	24.6	18.4	16.9	8.5
Chile . . .	1952	100.8	28.1	19.6	14.7	18.6	19.7
England and Wales . .	1953	51.6	20.3	15.6	8.0	5.6	2.1
France† . .	1953	65.0	19.9	17.4	11.8	10.7	5.0
Netherlands .	1953	76.8	22.1	18.7	12.7	13.7	9.5
Yugoslavia .	1954	92.3	28.9	23.7	15.1	14.6	9.8
Italy† . .	1951	57.4	19.6	14.6	8.4	8.2	6.1
Japan . .	1953	69.0	19.4	17.6	14.7	12.2	5.0

*Adjusted to allow for incomplete registration; birth rates for groups of years are the averages for single years. †Excludes illegitimate live births (and in France infants dying before their birth is registered).
Source: United Nations, *Demographic Yearbook, 1955*, and United States National Office of Vital Statistics, *Vital Statistics of the United States, 1954* and *1957*.

about 3,900 for the women in the cohort of 1875 (born between July 1, 1874 and June 30, 1875) to 2,270 as of age 47 for those in the cohort of 1910. This illustrates the great decline that took place in the average number of children per family in the United States. An increase in family size was under way during the 1950s, however, for the women in the cohort of 1931 who were about 29 years old on Jan. 1, 1960, already had a cumulative birth rate considerably larger than that of the 1910 cohort by age 47. The tendency for more U.S. women to marry and start childbearing at younger ages is illustrated by the large rise in the cumulative birth rate by age 25 from 856 per 1,000 women for the cohort of 1915 to 1,704 for the cohort of 1935.

Socioeconomic Differentials.—Information about the birth rates of women belonging to different socioeconomic groups is available for some of the countries which are more developed economically. As a rule the relationship is inverse—the higher the socioeconomic status the lower the birth rate. For example, the 1959 United States vital statistics report shows that among white women who were 15–44 years old and were (or had been) married, the cumulative birth rate was about 1,780 for college graduates, 1,965 for high school graduates and 3,224 for those with less than eight years of schooling. Similarly, among white women married once and living with husband, the cumulative birth rate by ages 15–44 was about 1,996 for those with husbands in professional, technical and kindred occupations; 2,333 for those with husbands classified as craftsmen and foremen; and 2,649 for those with husbands classified as labourers (excluding mine and farm labourers). The few studies of causes that have been made indicate that the socioeconomic differentials in birth rates have occurred chiefly as a result of differences in the extent and effectiveness of efforts to control family size rather than differences in the number of children desired. In some countries the tendency, beginning in the 1940s, was for differences in birth rates to become smaller as control measures became widespread.

Religious Differentials.—From a world standpoint the size of the birth rates of the major religious groups depends much more on the stage of economic and social development reached by the members of the group than on the religious teachings themselves. In most western countries with important numbers of Roman Catholic and Protestant couples the birth rate of the former is somewhat higher than that of the latter. In the United States a study of a representative sample of white married couples showed that among wives the cumulative birth rate of 1959 (*i.e.*, up to ages 44) was 2,282 per 1,000 for Catholic wives, 2,220 for Protestant wives and 1,749 for Jewish wives. The small difference between the cumulative birth rates of Catholic and Protestant wives is associated with a somewhat older age at marriage and higher proportion in urban areas for Catholic women than Protestant women. Other studies show substantially higher birth rates among Mormons, and much higher rates among a few small groups in rural areas; *e.g.*, the Hutterites.

See also Index references under "Birth Rate" in the Index volume.

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BIRTHSTONES. From ancient times supernatural powers have been attributed by astrologers to inanimate objects; among these gem stones were early assigned certain occult powers. In Greek and Roman times, the force was thought to be inherent in the stones. Medieval astrology related the effectiveness to the birth date of the individual and different stones were considered propitious depending upon the planetary configuration of the individual's horoscope. The stones now associated with each month have only slight relationship to the ancient beliefs for the list is tempered by availability and cost. Before mineralogy had progressed to the point of chemical analysis, colour was of greater importance than some of the other physical properties, and little distinction was made between emerald and chrysoprase, or topaz and citrine quartz. When it came to healing the eyesight or warding off evil spirits, both were equally effective. Even the names used in ancient times do not necessarily refer to the stones that go by those names in the 20th century; the sapphire of the Bible is much more likely to have been lapis lazuli than what is now known as sapphire, and "adamas" (diamond) was probably white sapphire or white topaz.

With the uncertainty of name and limited appeal of some of the stones of the older selections that were popularly and commercially associated with the different months, it is natural that, from time to time, changes have been made in the accepted list. Originally the stones were considered to be those of the breastplate of the Jewish high priest, but in actual usage the parallelism is not close. In the 20th century the list was supplemented with a series of synthetic stones which were recommended as the equivalents of the rarer, less attractive or less durable of the natural stones. The natural stone list was also expanded to make it more acceptable to both sexes. The list that follows gives the traditional stones and modern variations.

Month	Traditinnal gem stone	20th century expansion	Synthetic supplement: trade name	Material of synthetic stone
January	Garnet		Garnet	Dark red syothetic corundum
February	Amethyst		Amethyst	Purple synthetic corundum
March	Bloodstone	Aquamarine	Aquamarine	Light blue synthetic spinel
April	Diamond		White sapphire	Colourless synthetic spinel or corundum
May	Emerald		Emerald	Cultured emerald or synthetic green spinel
June	Pearl	Alexandrite	Cultured pearl, Alexandrite	Changeable synthetic corundum, (synthetic spinel is rare)
July	Ruby		Ruby	Red synthetic corundum
August	Sardonyx	Peridot	Peridot	Green synthetic spinel
September	Sapphire		Sapphire	Blue synthetic spinel or corundum
October	Opal	Tourmaline (pink or green)	Rozircon	Pink synthetic corundum or spinel
November	Topaz (precious)	Topaz quartz (citrine)	Topaz	Yellow synthetic corundum
December	Turquoise	Zircon	Zircoo	Medium blue synthetic spinel

See George Frederick Kunz, *The Curious Lore of Precious Stones* (1913). (F. H. PH.)

BIRUNI, AL- (ABU-AL-RAYHAN MOHAMMED IBN AHMAD AL-BIRUNI) (973–1048), Arab scholar and scientist, one of the most learned men of his age and an outstanding intellectual figure, was born in Sept. 973 of Persian parentage at Khwarizm (Khiva, in the Uzbek Soviet Socialist Republic, U.S.S.R.). Possessing a profound and original mind of encyclopaedic scope, he was conversant with Turkish, Persian, Sanskrit, Hebrew and Syriac in addition to the Arabic in which he wrote, and applied his talents in many fields of knowledge, excelling particularly in astronomy, mathematics, chronology, physics, medicine and history. He corresponded with the great philosopher Ibn Sina (Avicenna). Some time after 1017 he went to India and made a comprehensive study of its culture. Later, he settled at Ghazni in Afghanistan, where he died on Dec. 13, 1048. In religion he was a Shi'ite, but with tendencies to agnosticism. His most famous works are *al-Athar al-Baqiya* ("Chronology of Ancient Nations"); *Tafhim* ("Elements of Astrology"); *al-Qanun al-Mas'udi* ("The Mas'udi Canon"), a major work on astronomy, which he dedicated to Sultan Mas'ud of Ghazni; *Tarikh al-Hind* ("A History of India"); and *Kitab al-Saydala*, a *materia medica*. In his astronomical works he discussed with approval the theory of the earth's rotation on its axis and made accurate calculations of latitude and longitude. In physics, he explained natural springs by the laws of hydrostatics, and determined with a remarkable degree of accuracy the specific weight of 18 precious stones and metals, while in geography he advanced the daring view that the valley of the Indus had once been a sea basin.

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BISAYAN, the name of a people composing 43% of the Christian population of the Philippines and inhabiting the archipelago's central islands, south of Luzon, north of Mindanao. The three major Bisayan cultural-linguistic groups, in order of size, are Cebuano (*q.v.*) of Cebu, Siquijor, Bohol, eastern Negros, western Leyte, southern Masbate and northern Mindanao; Hiligaynon (*q.v.*) of Panay, western Negros, southern Mindoro, Tablas, Romblon, Sibuyan, Guimaras and northwestern Masbate; and Samaran (*q.v.*) of Samar, eastern Leyte and Biliran. Although divided by linguistic and cultural differences of varying degrees, the Bisayans form a basically homogeneous group.

Living representatives of the first settlers of the Bisayas, the Negritos ("little Negroes") still live in the hilly or mountainous regions of Negros and Panay. Although Bisayan prehistory is inadequately known, evidence indicates Neolithic habitation of the region. In prehistoric times peoples from China, carriers of Neolithic and Bronze Age cultures, moved southward through Luzon into the Bisayas. Archaeological sites of these cultures exist in Panay, Negros and Leyte. One of the oldest-known Philippine manuscripts (*Maragtas*) gives a circumstantial 13th-century account of the arrival at Panay from the Indonesian Buddhistic empire of Srivijaya of a group of Bornean *datus* ("chiefs") and their followers. In this manner, and also by earlier Indian traders, Vedic, Brahmanistic and Buddhistic elements diffused to the Bisayas and are still evident in their languages, folklore and art.

When Magellan's fleet arrived at Cebu in 1521, according to Pigafetta, the port had a thriving Asian trade. The Bisayans possessed their own system of weights and measurements, calendar and method of writing. They had borrowed selectively and integrated in a unique fashion elements from the great Asian civilizations.

Most Bisayans, tilling the soil and fishing the seas, represent the traditional Bisayan way of life. Located along roads, rivers, on plantations or in the more isolated interiors, the typical Bisayan village consists of two- and three-room bamboo and wooden pile dwellings, thatched with palm. The diet is mainly rice and fish, with some vegetables and fruits. In Cebu and eastern Negros, however, ground cornmeal replaces rice as the staple cereal. Social events centre around baptisms, marriages, funerals, school programs, annual *fiestas* and the Catholic religious calendar.

A Bisayan elite lives in a highly literate western oriented urban society. The two major Bisayan urban centres are Cebu city (259,194), situated in the Philippines' most densely populated island, and Iloilo city (150,976) in Panay. The most noteworthy Bisayan universities are Silliman (Dumaguete, Negros) and San Carlos (Cebu). Two presidents, Sergio Osmeña (Cebu) of the

commonwealth and Carlos Garcia (Bohol) of the republic created in 1946, have come from the Bisayas. *See* also BISAYAN LANGUAGE. (D. V. H.)

BISAYAN LANGUAGE, a language of the Philippines belonging to the Malayopolynesian family, is very closely related to Tagalog and Bikol. Bisayan is by far the Philippine language with the largest number of native speakers (8,500,000). These are distributed over the central islands of the Philippines (those south of Luzon and Mindoro and north of Mindanao) and the northern and western coasts of Mindanao.

There are a number of distinguishable dialects. The three major dialects are Cebuano (also called Sugbuhanon; 4,700,000 speakers), Hiligaynon (also called Panayan or Ilongo; 2,300,000 speakers) and Samar-Leyte (also called Samaran; about 1,200,000 speakers). (*See* also BISAYAN.) There are two minor dialects: Aklan, spoken by about 200,000 in northwestern Panay, and Hantik, spoken by about 2,000 people in small groups on the western coast of Panay.

There is little tendency among Filipinos to learn Bisayan as a second language. Although knowledge of the national language, Tagalog, is increasing, Bisayan continues to be used increasingly in books, periodicals, movies and radio broadcasts. In these, Cebuano is the dialect most used. (I. DN.)

BISCAY (VIZCAYA), a Basque province of northern Spain. Pop. (1960 est.) 630,434; area 2,210 sq.km. (853 sq.mi.); density of population 285 per square kilometre (739 per square mile). Originally one of the tribal territories of the Vascons, it was vested in the crown of Castile and León in 1379; however, the juridical peculiarities of each Basque province, *e.g.*, the "lordship" of Vizcaya and the "county" of Guipúzcoa, indicate the difficulties the central government has always had in ruling these fiercely independent peoples. Privileges toward some form of regional autonomy were granted to the Basque provinces (Vascongadas), notably in the *Concierto Económico* of 1925 signed with the national exchequer. After the Nationalist victory of 1937, however, this agreement was canceled and dreams of a Basque state Euskadi were pushed further into the background. The situation is complicated by the labour force in the industrial centre of Bilbao, whose immigrant population is not Basque-speaking. Indeed, western Vizcaya can no longer be considered truly Basque; a distinctive dialect of Euskera is only spoken now in the eastern districts. (*See* also BASQUE.)

The confused pattern of mountainous relief, formerly thickly forested and aloof from the interior highways, helped to keep the Vascongadas a distinct ethnic unit. Like Guipúzcoa, Vizcaya lies north of the main watershed and is contained by the drainage basins of the Nervión and Cadagua rivers and centred on the ria (inlet) of Bilbao. It has a corrugated pattern of relief, trending west-northwest–east-southeast in two main mountain alignments. Near the coast is the first range, Monte Aoiz (3,411 ft.), overlooking the border with Guipúzcoa in the Deva valley and extending in headlands seaward from Monte Sollube (2,244 ft.). The second and more extensive range forms an inland arc, connecting near the Peña de Aitzgorri (5,082 ft.) with the Navarrese mountains of Aralat and then swinging northeastward as far as the lower massifs of the Encartaciones. Although it forms the main watershed, it is broken by transverse corridors such as the Valle de Aramoyona and the upper valley of the Nervión, to provide cols of strategic importance to north-south lines of communication. These separate this dissected anticline into a series of broken calcareous cuestas or ridges. Between the coastal and interior ranges the Nervión valley follows a broad synclinal depression, the axis of the province. To the west the transverse drainage flowing into the Nervión near Bilbao presents a more open country with no clear frontier to the neighbouring province of Santander. Consequently Biscay has been affected by Castilian influences such as exposure to the hot, dry air streams of the Meseta in summer, while the mountain trends favour less generous rainfall in the valleys than that of neighbouring Guipúzcoa. Island stands of evergreen forests therefore mingle with the Atlantic flora of deciduous oaks. Cereal lands and vineyards are there more important than farther east though the pastoral economy was still dominant in the second half of the 20th century. More than three-fourths of the province was under rough pasture or forests, with about 30% cultivated. Maize occupied about one-third of the cropped area and apple orchards were also important. Farms are scattered in isolated *caseríos*, although in the western valleys of Carranza and Lanestosa the Castilian influence of hamlets is clear.

Bilbao (*q.v.*), nine miles from the head of its estuary, is the great industrial centre of the province. A population of more than 400,000 is concentrated along the banks of the Nervión embracing Bilbao and its industrial suburbs including Baracaldo (*q.v.*). Bilbao alone has about 600 factories, mostly engaged in metallurgic and some chemical industries. At its port are important shipyards, and about 35% of Spanish shipping is registered there. Biscay is the most important iron ore producer of Spain. It has been calculated that between 1876 and mid-20th century 212,000,000 tons of iron ore were extracted, approximately 80% being exported to the United Kingdom. An increasing proportion of its diminishing reserves thereafter was extracted to supply its own heavy metallurgic industries.

There are ten fishing ports of some importance along the coast, the chief being Bermeo (12,460) and Ondárroa (6,389). The industry was modernized with fleets of steam trawlers and coastal smacks.

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BISCAY, BAY OF (Sp. GOLFO DE VIZCAYA of which Biscay is a corrupt form; Fr. GOLFE DE GASCOGNE), an extension of the North Atlantic ocean, is bounded on the east and northeast by France and on the south by Spain. It has a maximum depth of 15,525 ft. a little south of its centre. The continental shelf is 100 mi. wide off Brittany but gradually narrows to less than 40 mi. when traced southwestward. Off the north coast of Spain the sea floor is steeply shelving. The Loire, Gironde and Adour are the principal rivers entering the bay. Off the 15th-century mouth of the Adour the Cap Breton submarine canyon penetrates the continental shelf for 30 mi. The canyon walls are cut in consolidated Eocene strata and are vertical in places. The bottom sediment of the bay is largely sand and mud. The salinity averages $35^0/_{00}$ (3.5%), the same as for the North Atlantic in this latitude. Because of its open situation to the west and southwest, heavy seas are frequent, especially in winter when the westerly wind belt moves south.

Principal ports are Brest, Saint-Nazaire, La Rochelle and Bayonne in France and Bilbao, San Sebastián and Santander in Spain; Nantes and Bordeaux are also reached by ocean-going ships. Resorts along the French coast include La Baule, Biarritz and Saint-Jean-de-Luz. (A. H. W. R.)

BISCEGLIE, a coastal town and resort in the province of Bari, region of Puglia, Italy, on the Adriatic, lies 34.5 km. (21 mi.) N.W. of Bari. Pop. (1957 est.) 41,702 (commune). In the medieval part of town there are examples of Roman-Apulian architecture: the cathedral (11th century), and the churches of S. Adoeno and Sta. Margherita (1197), with the Gothic tomb of the Falcone family. There are also the *palazzi* ("palaces") of the Mazzalorsa (15th century), Frisari (16th century) and Tupputi (17th century). The large Piazza Vittorio Emanuele II, with its trees and gardens, is the centre of the modern town. There is progressive and intensive market gardening: cherries, dessert grapes, vegetables, almonds and many kinds of fruit are exported, especially to central and southern Europe. The town contains a harbour for fishing boats, wine- and oil-producing establishments, engineering shops, furniture factories and sawmills for producing packaging material.

The Romans called the town Vigilae, from the many guard towers along the coast. In the 11th century it was conquered by the Normans; Robert Guiscard made it a countship and ceded it to the Norman count Peter II, who began the building of the cathedral (1073), fortified the town and provided it with a high tower, which still remains. The *castello* was built under the Hohenstaufens and enlarged and embellished by the Angevins.

After having had various feudal rulers, among whom was Lucrezia Borgia, Bisceglie became a free city in 1532 under the Demiano regime. In 1536 Charles V gave the town a coat of arms and the title of Città. Bisceglie then became part of the kingdom of Naples, and in 1861 it was joined to the kingdom of Italy.

BISCUIT (U.S. Cookie or Cracker), a baked product made from the flour or meal of wheat, or other cereal, together with varying quantities of fat, sugar, leavening agents and other ingredients. Its name is derived from Old French *bescuit* ("twice-cooked") since originally the mixture was hardened by returning it to the oven after baking—a method still used in some home cookery recipes. In the United States some types of biscuits are known as cookies or crackers, and the term biscuit refers to small shapes cut or dropped from a raised bread mixture.

Although biscuits are made in a variety of shapes and sizes they are usually small and flat. They have a low moisture content and a characteristically crisp texture. The main types of biscuit in Great Britain are cream cracker, semisweet (rich tea, marie, petit beurre), sweet (digestive, shortcakes), chocolate-coated (sweet and semisweet), sandwich biscuits (cream-filled), wafer (sugar or cream-filled); in the United States, crackers (soda, graham, oyster), semisweet (lunch or milk), marshmallow-covered cookies, sandwich (cream-filled), wafers (sugar or cream-filled); in continental Europe, semisweet (petit beurre), sweet (sablé shortcake), wafers (sugar or cream-filled).

For thousands of years natives of India have been making a flour and water dough that they roll into thin sheets and cook on both sides to make a *chappatti*. By adding shortening, sugar, essences and aerating agents in various quantities it is possible to produce a variety of biscuits from this basic recipe. There are five main types: (1) Wafers are made simply by adding a very small amount of sugar and colour to flour and water. (2) Crackers are biscuits generally leavened by yeast and containing little, if any, sugar, and a small percentage of fat. The dough is hard and has to be rolled into sheets and laminated (*see* below) before cutting in order to give texture to the biscuit. It is baked at about 500° F. for approximately 3½ minutes. (3) Semisweet biscuits have more shortening, sugar, leavening, sirup, malt and essences. Because of the extra ingredients, the dough is more pliable than cracker dough but still requires laminating before cutting. It is baked at a lower temperature for about 5½ minutes. (4) Sweet biscuits have a high shortening and sugar content with the result that the dough is pliable and is handled on the cutting machine. It is baked in a moderate oven for approximately 7½ minutes. (5) Specialities, such as ginger nuts, have a high shortening content and an exceptionally high sugar and sirup content. This is a very pliable dough that requires slow baking for 14 minutes.

Ingredients.—Flour forms the largest part by weight of any biscuit. The type of flour used depends upon the type of biscuit required; crackers require a "strong" (high protein and gluten content) flour almost like bread flour, but the sweet shortcake types require a "soft" (low protein and gluten content) flour. English wheat produces an excellent flour for semisweet and sweet biscuits, while American wheat is essentially strong and suitable for crackers.

Sugar is refined from cane or beet, and granulated sugar is ordinarily used in dough. Besides sweetening the biscuit, the sugar adds colour and flavour and helps to give a crisp bite. Other types of sugar, such as invert sugar, molasses, corn sirup, honey and malt extract, are used to give various qualities to the biscuit.

Shortening is the most important ingredient because it determines the eating quality, and in some cases the flavour, of the biscuit. The most important shortenings are butter, lard, oleo and hydrogenated oils such as coconut and palm kernel. Large manufacturers make their own compound.

Baking powders or leavening agents are compounded by each manufacturer to give the effect he desires. Crackers require yeast but the other types of biscuit are usually leavened with a mixture (baking powder) of ammonium bicarbonate, sodium bicarbonate (baking soda) and tartaric or other acids. These agents give off carbon dioxide and water vapour on heating and thus aerate the biscuit. Other ingredients are added either to give special flavours or appearances. The commonest of these are eggs, milk, dried fruit, chocolate, cheese, nuts, spices and essences.

Manufacture.—Mixing machines are all automatically controlled and have capacities of up to 1,300 lb. They have central rotating beaters that knead the dough and can be set to given times on low or high speeds, depending on the type of dough required. Crackers are a speciality since they are made of yeast dough and have to be left to stand twice during the mixing process so that they can "prove," or ferment. All other doughs, however, with the exception of certain manufacturers' own variations, are mixed in the ordinary manner. The dough of crackers or semisweet biscuits is deposited in a laminator when it is mixed.

Continuous mixers are used extensively. These are small machines that handle about 100 lb. of dough and are fed continuously with correctly proportioned ingredients. The machine produces a continuous stream of dough that is regulated to the production capacity of the oven. This method produces a consistent dough whereas the large batches of 1,300 lb. may vary from batch to batch.

The laminator automatically rolls sheets of dough to any given thickness, places several sheets in a pile and dusts the top of every sheet with a small amount of flour and fat. The pile is then rolled out to make one laminated sheet before being fed to the cutting machine. This process gives a light flaky texture, particularly to the cracker biscuit.

Cutting machines consist of a series of rollers that are 32 to 42 in. wide. As the mass of dough is passed from the laminator, it is rolled into a continuous sheet that is gradually reduced in thickness depending upon the type of biscuit being made. As this sheet passes through the cutting machine, the cutter stamps out shapes of dough at the rate of thousands per minute and at the same time pierces holes that allow the steam to escape during baking. Embossed designs can also be made on the dough at this stage. Sweet biscuit dough, being more pliable, is not laminated but passes straight from the mixing process to rotary molders, where it is pressed into molds and deposited upon a web feeding the oven.

Traveling ovens are continuously fed from the cutting machines and can be any length up to 300 ft. The cut shapes of dough travel on steel or wire bands between gas burners or electric elements at temperatures from 250° to 500° F., depending on the type of biscuit. This is called direct firing. The temperature in any section of the oven can be regulated. Indirect firing, a process in which hot air is blown into the baking chamber, is also common. Infrared and high-frequency heating came to be employed in the early 1960s in order to reduce the baking time and thus the oven length.

From the oven, the biscuits are automatically transferred to a canvas web on which they cool as they are carried to a stacker to be lined up for packaging. If, however, they are required for sandwiching or chocolate coating, this process takes place directly after cooling.

Packaging.—In the United States most biscuits are wrapped and this method of packaging is used generally in Great Britain and Europe. Moistureproof materials such as cellulose film and laminated or coated papers are sealed by heated elements and give an airtight pack. In many factories wrapping is fully automatic: in some cases biscuits are counted, in others they are simply fed by volume into the wrapping machines. A popular American method is to drop weighed quantities of biscuits into a bag that is then sealed automatically. These packets are filled into an outer container that is sealed before being transferred to the warehouse.

Flow production is the essence of modern biscuit manufacturing. Once the ingredients are in the mixing machines the processes are continuous until the filled carton arrives at the warehouse.

Production.—Production methods in the United Kingdom and United States are similar and the efficiency of the industry has been greatly increased by automation. In the United States unsweetened biscuits (crackers) are most popular whereas in Great

Britain sweet and semisweet biscuits account for four-fifths of the production.

The industry in the United States is proportionally smaller and less important than in the United Kingdom, where it has assumed a position of considerable importance since World War II.

(J. C. Fl.; R. C. Bl.)

BISECTOR, a point that divides a line segment into two equal parts (also used in the Latin feminine form "bisectrix"); a line that divides a plane angle into two equal angles; a plane that divides a dihedral angle in the same way; or, more generally speaking, any line or plane that divides any geometric magnitude (like a parallelogram, sphere, or cube) into two congruent parts. In crystallography, it denotes the bisector of the angle between the optic axes.

BISHARIN: *see* Beja.

BISHOP, SIR HENRY ROWLEY (1786–1855), English composer and conductor, remembered for the songs "Home, Sweet Home" and "Lo, Here the Gentle Lark," was born in London, Nov. 18, 1786. He began writing theatrical music in 1804 and for many years was closely connected with the theatre, composing the music for many light operatic pieces, productions of Shakespeare's plays and adaptations of Scott's novels and arranging operas by well-known composers. He held appointments at Covent Garden (1810), the King's theatre, Haymarket (1816–17), Drury Lane (from 1825) and Vauxhall (1830).

For Drury Lane he wrote his ambitious and unsuccessful *Aladdin* (1826), his only opera without spoken dialogue, as a rival to Weber's *Oberon* at Covent Garden. He was a founder of the Philharmonic society (1813). He became professor of music successively at Edinburgh (1841) and at Oxford (1848) and was knighted in 1842. His works included oratorios, part songs and glees. His slender talent is seen at its best in the tuneful songs which remain popular; "Home, Sweet Home," an early example of the theme song, from *Clari* (1823), became world-famous. He died in London April 30, 1855.

BISHOP, ISABELLA LUCY (née Bird) (1831–1904), English traveler and writer whose works caused her to be elected the first woman fellow of the Royal Geographical society (1892), was born on Oct. 15, 1831, at Boroughbridge hall, Yorkshire. She was the daughter of the Rev. Edward Bird and related to the Wilberforces. Delicate and nervous, she took enthusiastically the advice of doctors to go abroad for her health, and became famous as a traveler and author, with strong missionary interests. She was a keen horsewoman and a pioneer of photography. In 1873–74 she visited the Hawaiian Islands and the Rocky mountains, but her reputation was made by later travels in Asia, described in *Unbeaten Tracks in Japan* (1880), *The Golden Chersonese* (1883), *Journeys in Persia and Kurdistan* (1891), *Among the Tibetans* (1894), *Korea and Her Neighbours* (1898), *The Yangtze Valley and Beyond* (1899). In 1881 she married John Bishop, an Edinburgh physician, who died in 1886. In 1901 she rode 1,000 mi. in Morocco and the Atlas mountains. She died in Edinburgh on Oct. 7, 1904.

See Anna M. Stoddart, *The Life of Isabella L. Bird* (1906); Dorothy Middleton, "A Lady's Life in the Rocky Mountains," *The Cornhill*, no. 994 (1952–53). (D. Mn.)

BISHOP, the title of the highest order in the threefold ministry of the Christian church (*see* Holy Orders; Ministry, Christian). A bishop is customarily consecrated to his office by a metropolitan (*q.v.*) and at least two other bishops. He normally possesses spiritual power over a diocese (*q.v.*); a bishop without this authority is known as an assistant, auxiliary, coadjutor, suffragan or titular bishop. In addition to the normal functions of a priest, a bishop has power to confer holy orders, to consecrate places and things set apart for holy use and, in the west, to administer confirmation. Of those churches that rejected the threefold ministry at the Reformation and later, certain Lutherans and Methodists have retained the title "bishop." *See* Episcopacy; *see* also Index references under "Bishop" in the Index volume.

BISHOP AUCKLAND, an urban district in the Bishop Auckland parliamentary division of Durham, Eng., 12 mi. S.S.W. of Durham by road. Pop. (1961) 35,276. It is an industrial and market town on high ground near the confluence of the Wear and the Gaunless. Though the Romans had a fort (Vinovia) at Binchester nearby, Bishop Auckland did not become important until the bishops of Durham resided there in the 12th century. Their castellated palace, Auckland castle, in an 800-ac. park, containing a deer house, has a 17th-century chapel. It became the official residence of the bishops in 1836. King James I founded the grammar school in 1605. Coal, mined systematically from at least the 18th century, is excellent for coking. Flooded workings caused some of the collieries to close, but an official dewatering scheme, completed in 1954, reopened the coal fields. Other industries were established and the town is also a shopping centre. To the west is Escomb with a Saxon church and south is St. Andrew Auckland with the ancient parish church for Bishop Auckland dating to the 13th century. Farther to the southwest is St. Helen Auckland which, despite its modern industries, preserves a little 12th–13th century church and an 18th-century Palladian house.

BISHOP'S CASTLE, a market town and small municipal borough in the Ludlow parliamentary division of Shropshire, Eng., on a steep hillside above an important lowland route from south Shropshire into Wales, 21 mi. S.S.W. of Shrewsbury by road. Pop. (1961) 1,229. The historic road from Ludlow past Stokesay was controlled, probably from the 8th century, by the bishops of Hereford who built a castle about 1085–1100, where the gap narrows between the mountain lines of Longmynd and the Clun forest. Only a small garrison was required to keep a check on the Welsh and to regulate the town which had sprung up around this strong point on the "road of the castles." The castle is now in ruins and the site partly occupied by the Castle hotel and gardens. The town hall dates from 1608 and there are still some half-timbered houses.

In 1573 Elizabeth I granted the townsmen, on request, a charter confirming their privileges given in nine earlier charters to the bishops. From then until 1832 the borough returned two members to parliament.

Agriculture and stock rearing are the industries; sales of cattle take place regularly. The local railway to Craven Arms, started in 1863, ceased to function in 1935.

BISHOP'S STORTFORD, a market town and urban district of Hertfordshire, Eng., lies on the steep banks of the river Stort, 14 mi. N.E. of Hertford and 31 mi. N.N.E. of London. Pop. (1961) 18,308. The town is largely residential with a variety of schools and colleges. Industries include malting, the preparation of seeds, light engineering, flour milling and matchmaking. There is a large weekly cattle market (Thursday). The manor, mentioned in Domesday Book, was formerly the property of the bishops of London. William I built a church there, and the small Waytemore castle, which he gave to the bishop. Only a vault and a font of the original church survive, but the 14th–15th century St. Michael's church (Perpendicular), high above the valley, has an interesting collection of documents relating to local history. The castle was destroyed by King John, and only a few stones remain; its dungeon, the "Bishop's Hole," was used as an ecclesiastical prison until the 16th century. The town apparently did not become a borough in the full sense, though it was represented in six of the parliaments of Edward II and Edward III. Its commercial importance grew with the opening of the Stort navigation in 1769, and it became a malting centre and a depot for grains and other goods. Cecil Rhodes was born at Netteswell House, which became the Cecil Rhodes Memorial museum in 1938 and was reconstructed in 1952–53. Hatfield forest (National Trust property) four miles east of the town is of great interest to the naturalist.

BISHOPS' WARS, the name given in English history to the two brief campaigns fought between Charles I and the Scots in 1639 and 1640, caused by Charles's endeavour to enforce Anglican observances in the Scottish Church, and by the determination of the Scots to abolish episcopacy. In the first war there was no engagement, but in the second the Scots' seizure of Northumberland and Durham made it necessary for Charles to summon the Long parliament (Nov. 1640), and thus precipitated the English Civil War. *See* Covenanters; Leven, Alexander Leslie.

BISITUN (Bisotun or Behistun), a village and a precipitous rock in Kermanshah *ostan* (province), Iran, situated at the foot of the Zagros range, which rises to 4,000 ft. at this point, between Kermanshah city and Hamadan, where there are a number of springs which are favourite camping places for caravans. This was on the old road from ancient Ecbatana to Babylon, and it was there that Darius the Great placed his famous trilingual inscription on the face of the rock (*see* Darius). Mention of this is first made by Diodorus Siculus, who stated that it was the work of Semiramis (*q.v.*) and identified the bearded figure of Darius with that of this mythical queen. Darius carved his inscription in bas-relief about 500 ft. above the spring, in a difficult though not inaccessible rock face. The inscription is in Babylonian, Old Persian and Elamite. The Old Persian consists of four and one-half columns, the Elamite of three columns and the Babylonian covers two faces of the overhanging rock immediately below the Elamite version. The inscriptions were first reached and copied by Henry Creswicke Rawlinson (*q.v.*), an officer in the East India company's service seconded for work in Persia. Between 1835 and 1847 he copied all the inscriptions and with his knowledge of local dialects managed to read the version recorded in Old Persian. Rawlinson published his findings in 1849 in the *Journal of the Royal Asiatic Society* and virtually accomplished the task of deciphering the Old Persian cuneiform texts. The Babylonian text was, however, to present far greater difficulties. This task was also largely achieved by Rawlinson with the help of Edward Hincks (*q.v.*), an Irish scholar, and Félicien de Saulcy, a French one, and by 1850 the decipherment of this text was practically completed.

The Behistun inscription was severely weathered and difficult to read, and in an effort to clarify some of Rawlinson's readings A. V. Williams Jackson, an American, mounted the ledge below the inscriptions in 1903. The following year L. W. King and R. Campbell Thompson, working on behalf of the British museum, London, made a complete copy of the texts by means of a kind of boatswain's chair, swinging across the face of the rock. Their copy remained the standard text of the inscriptions until 1948. In that year George Glenn Cameron, working on behalf of the American Schools of Oriental Research and the University of Michigan, led an expedition to recopy the texts. In this they were successful, partly by the aid of Latex squeezes (rubber molds), by photographs, and partly by rechipping the rock face on which a tufa deposit had formed, partially obscuring the cuneiform signs. Other signs were, however, much more eroded than they had been in 1904, because a stream which feeds the springs had washed down over part of the inscription and eroded the signs at the top of the inscription to a depth of between five and six inches. The earlier orientalists had not been able to copy the four columns of writing lying to the right of the relief, although Campbell Thompson had decided that it was in Elamite. It has now been possible to copy all these columns, which were confirmed to be Elamite and actually a copy of the Elamite text which appears below and to the left of the relief depicting Darius with a group of captives. This copy enabled doubtful passages in the other version to be restored, gaps in the text to be more accurately measured, and determination of the year in which these events took place.

The inscription records the way in which Darius after the death of Cambyses killed the usurper, Gaumata, and gained power after defeating the rebels. Decipherment provided an important key for the study of the cuneiform script. Bisitun or Bisotun is a colloquial expression for the site, Behistun being the classical name given by Yaqut, the Arab geographer, and classical Persian authors.

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(M. V. S.-W.)

BISK (Bisk or Biysk), the second town after Barnaul of the Altai *krai* of the Russian Soviet Federated Socialist Republic, U.S.S.R., lies on the right bank of the Biya river 12 mi. above its confluence with the Katun to form the Ob. Pop. (1959) 146,000. At the head of navigation and terminus of a railway from Barnaul and Novosibirsk, Bisk is the starting point of the Chuya highway, a motor road across the Altai mountains to the Mongolian People's Republic. The town manufactures boilers, electric furnaces, food-processing machinery, matches, linen, leather goods, sugar and tinned meat. Nearby is the largest fur farm of the U.S.S.R. (silver fox, sable and mink). (R. A. F.)

BISKRA, a town and commune of Algeria, in the south of Batna *département* and on the northern edge of the Sahara. It lies at about 360 ft. altitude, south of a wide, open depression between the Aurès range and the Tell Atlas (always a route for conquerors and nomads), and is the centre of the Zab (or Ziban) group of oases. Pop. (1954) 52,511, of whom 1,730 were Jews or Europeans. About 19,700 live permanently in the town built in the mid-19th century on a grill plan beside St. Germain fort, itself constructed on the site of the former Turkish kasbah. The rest inhabit about ten villages of sun-baked brick houses, scattered among the palm gardens or on their verges. The new town is a centre of civil and military administration and commerce. The mildness of the winters (52° F. in January) and the beauty of the oasis and the distant horizons have made it a winter resort. The villagers cultivate the 5 sq.mi. of the oasis, with more than 150,000 date palms (many of the *deglat-nour* type for export) and thousands of various fruit trees (olives, apricots, pomegranates). In the cold season the surplus water of the Wadi Biskra irrigates downstream vast fields of wheat and barley which are harvested in April. The town is on the railway from Constantine to Touggourt, and linked by main road to the former, and has an airport. It is also near the oil pipeline from Hassi-Messaoud to Bougie.

Biskra stands on the site of Vescera, a post of the Roman limes (fortified boundary). After the Arab conquest it became a prosperous centre from the 9th to 11th centuries; in the 12th it was the capital of the Zab, almost autonomous in spite of its ties with the dynasties of Tunis or Bougie; and from the 13th to 15th centuries it was the chief centre of the southwestern states of the Hafsids, practically independent of Tunis. The Turks occupied it in 1552 and built a fort, and in 1844 it was garrisoned by the French.

(J.-J. Ds.)

BISLEY, village, Surrey, England, 3½ mi. N.W. of Woking and about 29 mi. from London by road. Pop. (1951) 1,071. Bisley common is the site of the ranges of the National Rifle association, which were transferred there from Wimbledon in 1890. The ranges are the scene of important British and international shooting competitions.

BISMARCK, OTTO, Prince von (1815–1898), Prussian statesman, the founder and first chancellor of the German empire, was born on April 1, 1815, at Schönhausen in Brandenburg. His father, Ferdinand von Bismarck-Schönhausen, was a Junker landowner who had served in the Prussian army; his mother, Wilhelmine Mencken, was the daughter of an untitled bureaucrat who had risen high under Frederick William III. The contrast between his parents did much to cause the conflict in Bismarck's own nature. In physical appearance and avowed tastes he was a Junker: powerfully built, devoted to country pursuits and with an enormous appetite for food and drink. Mentally and emotionally, however, he was sophisticated and highly bred, sensitive to the point of hysteria, with a subtle intellect and a gift of expression which put him in the highest class of German writers.

Early Years.—Bismarck went to school in Berlin, living with his mother and developing a romantic nostalgia for the family estates, which he seldom visited. He read law first at Göttingen university and then at Berlin; he was a disorderly student, though he passed his examination. He then entered the Prussian service, and became a judicial administrator at Aachen. There he was drawn into the international society which stopped at the spa on the way to other watering places; and at one time absented himself without leave for some months in order to follow across Germany an English girl with whom he had fallen in love. The adventure came to nothing and the criticism of his official superiors drove Bismarck to resign from the service at the age of 25. He declared, "I will play music as I like it or none at all." The family estates were running into difficulties, and Bismarck took over the manage-

ment of them from his father and to some extent from his elder brother.

Under his mother's influence, Bismarck as a youth had been a deist, indifferent to Christianity. In the country, he came to know his Pietist neighbour Adolf von Thadden; and he was deeply affected by the death of Von Thadden's daughter, Marie. Soon after he fell in love with another girl of this Pietist circle, Johanna von Puttkamer, whom he married in July 1847. To win her hand Bismarck avowed his own conversion, though he was inclined to lay down to God the conditions on which he would acknowledge his existence.

The 1848 Revolution.—In 1847 Bismarck became a member of the united diet, the quasirepresentative body which Frederick William IV summoned in order to authorize a loan for the building of a railway to East Prussia. Bismarck stood out as the provocative spokesman of absolutism and reaction, dismissing the mildest liberal measures with contempt. The diet demanded that it should be summoned regularly; when the king refused this it rejected the railway loan and was prorogued. Before it could meet again the revolution of 1848 swept Germany and Frederick William IV himself capitulated to the revolution in Berlin on March 19. Bismarck wished to organize a military repression and civil war. When the king pleaded that he had been unable to sleep for worry, Bismarck replied, "A king must be able to sleep." He attempted to force the king's abdication and suggested to Princess Augusta, wife of the king's brother William, that her husband, too, should withdraw in favour of his young son, who would then become the helpless figurehead of the reaction. Augusta indignantly refused and remained the mortal enemy of Bismarck throughout her life. In later years he launched the version that Augusta had made the proposal to him and that he had rejected it out of loyalty to the king—one of many instances in which he put the best appearance on failure and sought to mislead posterity.

Bismarck was in eclipse so long as liberalism prevailed in Germany. He was elected neither to the national assembly at Frankfurt nor to the first Prussian parliament at Berlin. In October the army occupied Berlin, and Frederick William IV issued a more monarchist constitution. Bismarck was elected to the new second chamber. In April 1849 the Frankfurt parliament offered the imperial crown to Frederick William. He refused it; and Bismarck was one of the few who welcomed this refusal. Frederick William next attempted to gain the leadership of northern Germany with the co-operation of the princes. This challenge to Austria was opposed by Bismarck; and when open conflict seemed to be approaching in Oct. 1850, he advocated return to Austro-Prussian dualism. He welcomed enthusiastically the Prussian surrender at Olmütz, when Frederick William's schemes were abandoned, and praised Austria as "a German power that is fortunate enough to rule over foreign peoples." He hoped that, with the defeat of the revolution, Prince Metternich's "system" with its Holy Alliance of Austria, Russia and Prussia would be restored. These views made him an obvious choice to represent Prussia at the federal diet at Frankfurt. He arrived there on May 11, 1851, renewing a career in the service of the state that was to last without interruption for 39 years.

Beginning of the Struggle With Austria: Frankfurt.—Bismarck went to Frankfurt as the leading advocate of co-operation with Austria in German affairs. Within a fortnight, his outlook was revolutionized, and he became convinced that the Austrian statesmen would never treat Prussia as an equal. The men who had defeated the revolution in Austria no longer thought in Metternich's cautious terms. They believed that they could hold the revolution in check without any assistance from their former conservative partners, Russia and Prussia. But if the challenge came from Austria, Bismarck was not slow to take it up. He disputed every formal sign of Austria's leadership, though Austria was in fact "the presiding power" at the diet by virtue of the federal act; and he carried on a relentless personal feud with successive Austrian representatives. Hitherto only the Austrian had smoked at meetings. Now Bismarck, too, pulled out his cigar case. Such trivialities were to reshape the destinies of central Europe. Bismarck soon came to speak with contempt of Frederick William IV and of Otto von Manteuffel, his foreign minister. He believed that they were sacrificing Prussia's greatness to their romantic conception of conservative solidarity. In his opinion "the Holy Alliance was dead," and Prussia should follow a policy of self-centred realism. It should claim the headship of Germany and make alliances with foreign powers against Austria in order to achieve it; it should even ally itself with "the revolution."

During the Crimean War (1854–56) Bismarck feared that Prussia would support Austria or even join the western powers in war against Russia. He reached the conviction that the Balkans and the lower Danube, however vital to Austria, were no concern of Prussia's; and this view did much to shape his later policy. At the end of the war he believed that Russia and France would soon come together in a "revisionist" alliance—Russia to undo the results of the Crimean War, France to expel Austria from Italy—and he urged that Prussia should make a third in this restless combination. He overrated the dynamism of both Russia and France and insisted that Prussia could gain the headship of Germany only as part of a general European upheaval. His greatest state paper dismissed as impossible the limited reordering of German affairs which he himself carried through 14 years later.

Ambassador at St. Petersburg and Paris.—Bismarck grew increasingly critical of Prussia's official policy in his last years at Frankfurt. He was over 40 and seemed to have achieved nothing. In 1858 Frederick William IV became insane and his brother William took his place as regent. This began the short-lived "new era," when Prussian policy took a liberal turn. Bismarck seemed out of place at Frankfurt with his reactionary reputation, and early in 1859 he was sent as ambassador to St. Petersburg—"put in cold storage" was his own phrase.

In Jan. 1861 Frederick William IV died and the prince regent became King William I. A soldier by training and profession, he wished to increase the army in order to be able to train all those liable to military service. This increase would, in addition, enable him to cut down the *Landwehr*, or militia, which all Prussian conservatives regarded as a dangerously democratic institution. The liberal majority in the Prussian parliament was ready to increase the grant for the army, but they defended the *Landwehr* and sought to reduce the period of military service from three to two years. In 1861 parliament authorized the increased grant for one year only. Albrecht von Roon, the minister of war, at once organized new regiments, implying that the grant was permanent. In Nov. 1861 a general election strengthened the more advanced liberals, who were now organized as the Progressive party. Roon urged William to make Bismarck prime minister, but the king was alarmed by Bismarck's advocacy of alliance with France and his plans for sweeping away the German princes.

In March 1862 Bismarck was recalled from St. Petersburg. He expected to be made prime minister (minister president); but though William was running into increasing difficulties with the chamber of deputies, he still shrank from an open breach of the constitution, and Bismarck on his side would not take office until the king could be forced to accept a revolutionary foreign policy. He was therefore sent as ambassador to Paris. There he and Napoleon III dangled before each other the idea of alliance against Austria.

Appointment as Prime Minister.—Meanwhile events in Berlin had reached a crisis. The chamber of deputies would authorize the increased military expenditure only if the period of service was reduced to two years. On Sept. 17 the ministers, including Roon, agreed to this compromise; it was rejected by William, and Roon swung around to his support. Immediately after the meeting of the council Roon sent to Bismarck the famous telegram, *Periculum in mora. Dépêchez-vous* ("There is danger in delay. Hurry up"), meaning that the king's reluctance had been broken. On Sept. 22, 1862, Bismarck arrived in Berlin and was at once made prime minister. It was an uneasy partnership. William wished to defend his independent conduct of military affairs, but still rejected an adventurous foreign policy; Bismarck encouraged the domestic conflict in order that the king should be dependent on him and then be drawn into a foreign policy by no means to his taste.

The constitution laid down that the budget must be agreed upon by the chamber of deputies, the upper house and the king. Bismarck argued that if one of the three rejected the budget, there was "a gap in the constitution" and that the government must collect the existing taxes (and of course spend them) until agreement was reached. This theory served to promote a conflict. He told the chamber in his first speech, "The great questions of our day cannot be solved by speeches and majority votes—that was the great mistake of 1848 and 1849—but by blood and iron." Time and again the liberal majority offered a compromise; but Bismarck knew that this would destroy his hold over the king and always evaded it. Dissolution failed to shake the liberal majority; this, too, was an advantage for Bismarck, for a conservative chamber would have made him unnecessary.

The German Question.—Bismarck's main interest lay elsewhere—in foreign policy. He had long announced his intention of settling the German question. When he took office a conflict had already started on Austrian initiative. The Austrians proposed to the federal diet a delegate conference at Frankfurt to strengthen the confederation. Bismarck answered by proposing the direct election of a German parliament; and he asked the French government what it would do "if things grew hot in Germany." Napoleon III was in a conservative mood and gave a timorous answer. In Feb. 1863 the diet rejected the Austrian proposal and the alarm blew over.

The Polish Revolt of 1863.—Russia and France had worked together with increasing intimacy since the end of the Crimean War. This intimacy was disturbed by a revolt in the part of Poland ruled by Russia, which broke out in Jan. 1863. Napoleon III tried to turn his back on this embarrassing affair and pretended that it was a question of Russian domestic politics. Bismarck, however, sent Graf Gustav von Alvensleben-Erxleben to conclude a convention with Russia (Feb. 8, 1863) for co-operation against the Polish insurgents. Bismarck always regarded Polish national ambitions as the greatest threat to Prussia's existence, and his motive in proposing the Alvensleben convention was principally to silence the advocates of concession to Poland at the Russian court. Certainly the convention did not win Russian gratitude: Prince A. M. Gorchakov, the chief minister, resented the implication that Russia was in any need of help. Moreover, Napoleon III, who was impotent to act against Russia, thought of making a demonstration in favour of Poland by threatening Prussia; and at the beginning of March Bismarck had to ask Gorchakov to allow him to withdraw the convention. Far from being a great stroke of policy, the convention was an impulsive gesture against the Poles which led Bismarck into a position of some danger: he had almost put Prussia as a hostage between Russia and France.

The Frankfurt Meeting of the Princes.—In Aug. 1863 the emperor Francis Joseph invited the German princes to a meeting at Frankfurt to discuss the reform of the confederation. It was the high-water mark of the Austrian attempt to unite Germany by agreement. Its principal element was a "directory" of princes. Bismarck might have been willing to compromise with Austria at the expense of the princes; he would certainly not give the princes authority over Prussia. William I was tempted to attend the Frankfurt meeting, especially when King John of Saxony brought an invitation in person. Bismarck threw all his weight on the other side. It was his first struggle for ascendancy over William and he won it, though at great strain. When the argument was over, Bismarck smashed a large jug of water on the ground and broke into hysterical sobs. William's refusal wrecked the Frankfurt meeting. Though the princes approved the Austrian proposals, they added the proviso that Prussia must approve them too. The princes had, in fact, no interest in German unity and welcomed the conflict between Austria and Prussia as giving them an easy excuse.

In answer to the Austrian policy of working with the princes, Bismarck emphasized his friendship with Russia and with France. In the autumn of 1863 he concluded a commercial treaty with France and imposed this treaty on the *Zollverein*, the German customs union, which Prussia controlled. There was no room for Austria in this arrangement and the economic division of Germany was thus made final, even while the political confederation still existed.

Schleswig-Holstein.—In Nov. 1863 Frederick VII, the last Danish king of the male line, died, and therewith the Schleswig-Holstein question (*q.v.*), which had played a vital part in the German revolution of 1848, was renewed. The two duchies, Schleswig and Holstein, were in personal union with Denmark; Holstein alone was a member of the German confederation, though there was also a German majority in southern Schleswig. In 1848 the German liberals had attempted to "liberate" the two duchies, with the assistance of the Prussian army, but the attempt had been defeated by the protests of the great powers, and the treaty of London (1852) had reaffirmed the personal union. The Danes had subsequently tried to extend their constitution to include the two duchies; and German national sentiment countered by supporting a rival claimant to the duchies, the duke of Augustenburg. Bismarck had no interest in creating another petty German state, particularly on Prussia's border; on the other hand he would not let Austria steal a march on him by appealing to German national feeling.

J. B. von Rechberg-Rothenlöwen, the Austrian foreign minister, was a conservative who hated German liberalism and therefore fell in with Bismarck's plans. On Jan. 16, 1864, he signed a treaty of alliance for war against Denmark, not to liberate the duchies but to enforce personal union as laid down by the treaty of London; German nationalism was repudiated. The Danes were soon defeated and Schleswig overrun. A conference of the great powers then met to try to save the settlement of 1852, but the coalition of non-German powers no longer existed. On May 28 Austria and Prussia repudiated the treaty of London and were able to renew the war against Denmark without intervention or serious protest from any foreign power. In August Denmark made peace, ceding the duchies to Prussia and Austria jointly (the definitive treaty was signed at Vienna on Oct. 30, 1864). Later in August Bismarck and William visited Francis Joseph at Schönbrunn. Rechberg was willing to surrender the duchies to Prussia, but asked in return for a guarantee of Venetia and help in recovering Lombardy from Italy; Francis Joseph also wanted compensation in German territory. The terms were logical enough, but they were too high for Bismarck. He might compromise with Austria; he would hardly go to war with Italy, and perhaps France as well, for Austria's sake. Austria and Prussia therefore agreed to rule the duchies jointly, until something turned up which would make a lasting solution possible.

The Conflict With Austria.—Bismarck still hoped to reach an agreement with the Austrians when their difficulties increased elsewhere—either in Italy or the near east. Instead they concentrated on German affairs and put forward the claim of the duke of Augustenburg to the duchies. On May 29, 1865, a Prussian crown council discussed whether to meet the Austrian challenge by war. The generals favoured war; Bismarck insisted on alliance with France and an appeal to German nationalism, if war were decided on. He said, "If war against Austria in alliance with France is struck out of the vocabulary of diplomacy, it is impossible for Prussia to have a policy." This idea was still too revolutionary for William, and compromise followed once more. By the treaty of Gastein (Aug. 14, 1865) Austria was given the administration of Holstein, Prussia of Schleswig. Bismarck, rewarded with the Prussian title of Graf von Bismarck-Schönhausen (Sept. 1865), soon moved again toward an alliance with France. In October he visited Napoleon III at Biarritz. Hitherto he had assumed that Napoleon would repeat in Germany the policy that he had followed with Cavour in Italy: he would join in the war against Austria and expect to receive a territorial reward for his assistance. At Biarritz Napoleon made it clear that he planned to remain neutral and that his reward should be the cession of Venetia to Italy. The Biarritz bargain was negative: Bismarck would not guarantee Venetia to Austria, and Napoleon would not give Austria support.

After promising not to defend Venetia, it was an easy development to promise it to Italy. This was the essential clause of the alliance with Italy, which Bismarck signed on April 8, 1866; in return Italy promised to join in war against Austria if it broke out

in the next three months. In May there was a last attempt at compromise, organized by the brothers Anton and Ludwig von Gablenz—the one a Prussian, the other an Austrian general. Bismarck would have been satisfied with the military headship of northern Germany. Austria was still unyielding and at the beginning of June repudiated the alliance with Prussia by bringing the question of the duchies before the diet. Prussian troops invaded Holstein, and when a majority of the diet condemned Prussia Bismarck declared the German confederation at an end (June 14). War followed against Austria and those German states which took the Austrian side. (*See* SEVEN WEEKS' WAR.)

The 1866 Settlement.—Two Prussian armies invaded Bohemia, and on July 3 the Austrians were decisively defeated at Sadowa, near Königgrätz (Sadova, near Hradec Kralove). They appealed for French help, but Napoleon III would only mediate. A believer in the national principle, he sympathized with the Prussian purpose and himself urged Bismarck to annex the whole of northern Germany. Bismarck's real struggle was with his own king. William had been gradually taught to believe that the Austrians were the aggressors, and he wished to punish them by annexing some of their territory. Bismarck got his way only after a bitter dispute, in which he called the crown prince to his aid. By the preliminary peace of Nikolsburg (July 26), he excluded Austria altogether from Germany, instead of dividing Germany between Prussia and Austrian zones at the line of the Main as he had proposed before the war broke out. The southern German states were to have "an international independent existence." Bismarck's moderation in 1866 has been much praised; and certainly he wished to preserve Austria as a great power—"we shall need its strength in future for ourselves." But Austria remained intent on revenge until the events of 1870 made it impossible. Moreover, in preserving Austria, Bismarck saddled himself and his successors with "the Austrian problem." The war of 1866 defeated the empire which Metternich had served; but within a few years Bismarck re-created the conservative system of Metternich in a modified form.

The North German Federation.—A general election took place in Prussia on the day of the battle of Sadowa. The Progressive party was much weakened and soon afterward split. The majority formed a new party, the National Liberals, which would support Bismarck in exchange for concessions in home affairs. He agreed to admit that he had acted illegally in collecting the taxes without parliamentary authorization; and the diet passed an act of indemnity.

All the states north of the Main that had fought against Prussia in 1866 were annexed except Saxony; the others had to join a federation under Prussian control. The king of Prussia became its president and commander in chief. Bismarck set up a *Reichstag*, elected by universal suffrage; but he did not propose to allow it any say in the military budget, which was to be written into the constitution; nor was there to be a responsible ministry—the real decisions were to be taken by a federal council, composed of delegates from the states. The National Liberals revolted against this sham and Bismarck met them halfway, perhaps with one eye on liberal feeling in southern Germany. The chancellor became a responsible minister, though the only one; and the military budget was authorized only until the end of 1871. Then, after further dispute, Bismarck agreed in 1874 to authorization only for seven years (the septennate); and this produced a crisis every seven years while he remained in office.

Bismarck and the National Liberals made a genuine compromise. Certainly the chancellor was appointed by the king, or emperor, as the prime minister had been in 18th-century England; but neither Bismarck nor his successors ever infringed the constitution, though Bismarck was often tempted to do so. There was in imperial Germany a true rule of law, and the will of the people could have prevailed if they had known what to will. The *Reichstag* won the essential point of any constitution: it controlled supply for the military forces, though it could exercise this control only every seven years instead of annually, as in a fully liberal country.

The Conflict With France.—At the time of making peace with Austria, the French ministers—though not Napoleon himself—demanded compensation for Prussia's aggrandisement. Bismarck answered with vague talk of Belgium, but when the French asked for an alliance and the cession of German territory on the left bank of the Rhine he evaded them. In Sept. 1866, Napoleon III, who was wiser than his advisers, declared himself content with the new order in Germany, but French public opinion insisted on some concrete satisfaction. Luxembourg seemed the solution. It had been a member of the old confederation and was garrisoned by Prussian troops, but it was ruled by the king of the Netherlands, and Bismarck did not claim it for his new federation. Indeed he advised Napoleon III to buy it from the king of the Netherlands. The French dallied over these negotiations, and the German public began to protest against the loss of this "old German land." Bismarck himself joined in the protest (April 1, 1867), though finally he accepted compromise at an international conference: the Prussian garrison was withdrawn and Luxembourg was neutralized instead of being annexed to France.

The Luxembourg crisis is one of the most disputed episodes in Bismarck's career. Some writers have seen in it a trap by which he meant to involve France in war; others claim that he was surprised by the strength of German feeling and had to go along with it. Certainly the crisis put an end to all hopes of a Franco-Prussian alliance, such as Bismarck had often discussed. On the other hand although Bismarck regarded war with Austria as one of the only two possible alternatives before 1866 he does not seem to have worked deliberately for war with France in the same way. Even in 1869 he suggested that France might acquire Belgium in return for the addition of the southern German states to the federation.

These states were the point about which Bismarck's policy revolved. In 1866 his renunciation of them had been genuine: he did not want to add Roman Catholic states to a predominantly Protestant federation. But he counted on their liberalism to keep them from alliance with either France or Austria. Instead the liberal parties in southern Germany lost ground to clericalists, who were strongly anti-Prussian. Bismarck was faced with a dilemma. If he rallied the southern liberals by proposals of unification, this would strengthen liberalism throughout Germany; if he did nothing, Austrian, and even French troops might soon be on the Main. His solution was to prepare for unification by increasing the prestige of the Prussian monarchy.

One device to achieve this was the proposal, which he put forward unsuccessfully early in 1870, to give the king of Prussia the title of German emperor. Another was to encourage members of the house of Hohenzollern to accept any vacant thrones that might be offered them. In 1866 Prince Charles of Hohenzollern-Sigmaringen went to Rumania on Bismarck's advice. In 1869 his brother Leopold was offered the throne of Spain, vacant after a revolution in 1868. Though Bismarck later established the version that he had no connection with this offer, there is, in fact, no doubt that he repeatedly urged it on the Spaniards until they wore down Leopold's reluctance in June 1870. This does not imply that the Hohenzollern candidature was intended to provoke a war with France. France was to be presented with a *fait accompli*, and Leopold to become king before the French learned of it.

On July 3 the news leaked out prematurely. The French government demanded Leopold's withdrawal; and William, who had always disliked the affair, seconded them. On July 12 Leopold withdrew. Bismarck, though taken by surprise, had wished to reject the French demands and to score a victory of prestige, if not actually to provoke a war. Instead he seemed to have been humiliated. At the last minute he turned the humiliation against the French. He transformed a message which William sent him from Ems from a surrender into a defiance; and the French declared war a week later. Bismarck soon claimed that he had caused the war by means of this "Ems telegram"; but it is likely that the Bonapartists, who dominated Napoleon III, would have insisted on war in any case. (*See* FRANCO-GERMAN WAR.)

The war of 1870, unlike the war against Austria, had no practical purpose; Bismarck asked nothing of France except to be left alone. But from the beginning of the war he accepted the military proposal to annex Alsace-Lorraine. The generals urged the stra-

tegical advantage; Bismarck thought rather of giving German national feeling some concrete symbol of victory and, as well, he was glad to have some cause for lasting estrangement between France and the German liberals. Later he regretted this estrangement and assured the French that he had been opposed to the annexation of Metz. There is no contemporary evidence of this. His diplomacy during the war was limited to preventing the French from finding allies or provoking a European mediation. He was successful, and in Feb. 1871 imposed upon them an indemnity of 5,000,000,000 fr., as well as the loss of the territory. This became the treaty of Frankfurt in May 1871.

The German Empire.—All the southern German states joined the war against France, but they were still reluctant to enter an empire controlled by Prussia. It would have been easy to drive them on by evoking popular feeling, but Bismarck was determined that Germany should not be made by democratic means—it must be made by the princes, not by the *Reichstag*. He gave some political concessions to the southern German states and, more effectively, bribed the king of Bavaria with large sums from his secret fund. The *Reichstag* merely asked William to deign to accept the imperial crown; the actual offer was made by the princes, and William I was proclaimed German emperor on Jan. 18, 1871. Two things stand out in this supreme achievement of Bismarck's life. Germany was made without the German people, almost against them; though Germany was technically united, 8,000,000 German Austrians were excluded from the German national state.

Nevertheless, Bismarck was the hero of the German people in 1871, and he was created prince von Bismarck (March 21, 1871) and appointed imperial chancellor. The National Liberals acted almost as a government party in the *Reichstag*. Bismarck discussed every legislative measure with their leaders before introducing it, and left the conduct of measures through the *Reichstag* to them. In addition, the conservatives also split, and one section, the Free Conservatives, accepted liberal measures so long as Bismarck advocated them. Between 1871 and 1878 Bismarck had a majority in the *Reichstag*, almost in the western parliamentary sense, and he carried through fundamental changes, comparable with the work of the Revolution in France or of the Benthamites in England. Germany was given a common currency and a central bank. A single code of commercial and civil law was created, and a high court of justice set up at Leipzig. The tangle of medieval survivals was swept away in less than a decade, and Germany became the most modern and liberal of states, so far as laws could make it so.

The Kulturkampf.—Distrust of political Roman Catholicism was common doctrine among liberals in the 19th century. Bismarck shared this distrust and it grew stronger in 1871 when a confessional party, the Centre, gained 58 seats in the *Reichstag*. Though the Centre claimed to defend strictly Roman Catholic interests, it drew its support from all the elements which had opposed Bismarck's work; for instance, Protestant Hanoverians supported it, while Bavarian nationalists, though Roman Catholic, did not. Bismarck regarded the empire as his own creation and he branded any opponent of his as a *Reichsfeind* (enemy of the empire). He believed, too, that unity was most easily created if there was some object to attack, and the Centre provided that object when Germany had no foreign enemies. He said of Ludwig Windthorst, leader of the Centre, "Everyone needs somebody to love and somebody to hate. I have my wife to love and Windthorst to hate."

The struggle began over the state control of education. When the Roman Catholics claimed the right to choose and license their own teachers, Bismarck attacked the teaching orders and then insisted that the state should train and license priests. Priests and bishops were imprisoned and sees were left vacant. By 1876, when the struggle reached its height, Bismarck seemed to have committed himself irrevocably to the Liberals; even the Prussian conservatives, though Protestants, were turning against him. It was the climax of the liberal era.

Foreign Policy, 1871–78.—Bismarck assumed in 1871 that, with the defeat of France, a long period of peace would follow. The only danger seemed to be the French desire for revenge. Hence he encouraged republicanism in France, in order to create an ideological gulf between the republic and the two eastern empires. With these empires he revived the conservative partnership of the Holy Alliance in a new form. This was the League of the Three Emperors, or *Dreikaiserbund*, constituted in 1873. Impressive in title, it was never more than a vague expression of monarchical solidarity in fact. The league implied that the three empires, and especially Russia and Austria-Hungary, would settle their disputes peacefully. In reality it held together only so long as there were no disputes.

Its weakness was shown in 1875, even before the eastern question raised its head. Bismarck was on bad terms with the French government whom he accused of patronizing the German Roman Catholics; in addition he was offended at the reorganization of their army. In April a German newspaper published, on Bismarck's instructions, an article entitled "Is War in Sight?" Probably he wished only to shake the French nerve and to underline the Centre's association with the "foreign enemy." The French, however, raised the alarm and appealed to the great powers. Austria-Hungary did not respond—the first open symbol of Vienna's new dependence on Berlin. Both Russia and Great Britain protested in Berlin and Bismarck had to repudiate his own words. The eastern crisis, which began in July 1875, raised more serious difficulties. Germany had no direct interests in the near east, and during the Crimean War Bismarck had been the most emphatic advocate of neutrality, or even of giving Russia diplomatic support. But then the main conflict had been between Russia and the western powers. Now France kept an attitude of reserve; Great Britain took the lead against Russia, and Austria-Hungary showed an increasing inclination to go over to the British side. Bismarck, at first, followed the French example and turned his back on the crisis. In Dec. 1876 he declared that the whole of the near east "was not worth the bones of a Pomeranian grenadier." His only concern was to keep Russia and Austria-Hungary on good terms and he succeeded until the autumn of 1876. Then the Russians foresaw that they would be driven to war against Turkey for the sake of the Balkan Slavs; and they appealed to Bismarck to keep Austria-Hungary neutral, as they claimed (with some exaggeration) to have kept that monarchy neutral in 1870. Bismarck refused: he would not allow either Russia or Austria-Hungary to be destroyed as a great power.

The crisis reached its height in March 1878 when the Russians abandoned their moderate plans and imposed the treaty of San Stefano on the Turks. Great Britain threatened war; Austria-Hungary would not promise peace. Bismarck acted as "honest broker" and brought Russia and Great Britain to a compromise. He could rightly claim to be the main architect of the peaceful settlement between them, which was confirmed by the congress of Berlin (June 1878). He presided and this seemed to symbolize his paramount position as mediator between the great powers. All the same, the congress of Berlin marked the turning point in Bismarck's diplomacy. Hitherto he had believed that Germany could secure peace by keeping out of the combinations of the great powers; after 1878, he tried to achieve the same aim by having a finger in every pie.

The Austro-German Alliance.—The eastern crisis of 1875–78 destroyed Bismarck's faith in monarchical solidarity. In addition it made him regard Russia as too unstable to make a reliable ally. He decided, with great reluctance, to commit himself to the defense of Austria-Hungary. William held out against the alliance with Austria-Hungary until Bismarck forced his hand by threatening his resignation and that of all the Prussian ministers. The alliance followed logically enough from Bismarck's policy in 1866. Then he had refused to destroy the Habsburg monarchy; now, therefore, he had to guarantee it against foreign danger. At the same time he still hoped to keep out of Austria-Hungary's Balkan adventures. The alliance was strictly defensive, limited to a direct attack by Russia, and Bismarck even made out (with some truth) that it brought advantage to Russia, in that Austria-Hungary would no longer be tempted to work with Great Britain. He said to the Russian ambassador, "I wanted to dig a ditch between her and the western powers."

The alliance was something of a conjuring trick: it preserved Austria-Hungary without supporting Austro-Hungarian policies. But suppose Austria-Hungary should take the risk of an aggressive Balkan policy, of which Germany disapproved? This was the insoluble problem which Bismarck left to his successors. Previously alliances had only been concluded as preparation for a war, or on its outbreak; now Bismarck tried to make international relations rigid. He himself regretted this later, and advised his successors not to take their treaty obligations literally; every treaty, he said, contains the unwritten clause, *rebus sic stantibus*.

Breach With the Liberals.—The Austro-German alliance was signed on Oct. 7, 1879. It marked the beginning of a new period of conservatism in Bismarck's foreign policy. The same change had already taken place in his policy at home. Until 1877 he continued to work with the National Liberals. Then fiscal, economic and political factors turned him against them. The existing taxes did not cover the cost of the armed forces; and the deficit had to be met by "matricular contributions" from the states. Bismarck wished to escape this dependence; on the other hand, he did not wish to increase the power of the *Reichstag* by introducing direct taxation in the empire. Indirect taxes were voted for an indefinite period; therefore, once granted, the *Reichstag* would have no more control over the military expenditure than the Prussian parliament had had after 1862. The National Liberals foresaw this danger and they would agree to more indirect taxation only if they received "constitutional guarantees." In Dec. 1877 Bismarck invited Rudolf von Bennigsen, the leader of the National Liberals, to become a Prussian minister and virtually his deputy. Bennigsen insisted that the invitation must be extended to two other National Liberals. Bismarck had planned to take Bennigsen prisoner. Instead the National Liberals threatened to turn Bismarck into the figurehead of a parliamentary ministry. He broke off the negotiations and on Feb. 22, 1878, announced his intention (never in fact achieved) of introducing a tobacco monopoly. This was his first breach with the National Liberal policy, and it ended the plan of giving the German empire a parliamentary ministry.

The breach with the National Liberals soon widened. In June 1878 an attempt was made to assassinate William I. Bismarck at once dissolved the *Reichstag* and launched an anti-Socialist campaign designed to hit the National Liberals on the rebound. They either had to renounce their liberal principles or be branded as the supporters of assassins. They lost 30 seats in the election and then tried to get back into Bismarck's favour by voting for the anti-Socialist bill after all. He was, however, intent on destroying them as a political force. In March 1879 he made his peace with Windthorst, the Centre leader, and at once began to undo the measures against the Roman Catholics, despite his early boast that he would never "go to Canossa" (where the emperor Henry IV submitted to the pope in 1077). His basic reason for the *Kulturkampf* had been to create some target for national resentment. Now the Socialists filled the role even better. Furthermore, the Centre drew its main strength from the peasant-farmers of western Germany. They sympathized neither with liberalism nor—what was more important—with free trade. Reconciliation with the Centre was the preliminary to protection, and this was the essential change which took place in Bismarck's policy in 1879.

The initial impulse was the decline in agricultural prices which hit all Europe at the end of the decade. Bismarck was determined to maintain the predominance of the agrarian classes—primarily of the Prussian Junkers, but also of the land workers who were supposed to make the best soldiers. Agrarian protection could not be carried by itself. Bismarck also introduced tariffs on manufactured goods, particularly on iron and steel. This satisfied the great industrialists of western Germany, who were henceforth ready to accept the Junker landowners as partners. The return to protection in 1879 was more than a change of policy. Hitherto protection had been the defensive weapon of backward countries. Germany, the most progressive industrial nation, took it up for aggressive purposes.

Protection completed the estrangement of the National Liberals. They had always cared more for *laissez-faire* than for individual freedom, and Bismarck challenged them at their most sensitive point. In 1880 the party split, the more advanced members gradually drawing toward the Progressives. The National Liberal remnant became purely an interest group, representing the needs of heavy industry.

Bismarck's maneuver was not altogether successful. He had destroyed the National Liberal majority without putting anything else in its place. The remaining National Liberals were in a minority even when the two Conservative groups joined them. In fact the Centre held the decisive position and it could defeat Bismarck's measures if it voted with the Progressives and the Social Democrats. His *Reichstag* policy between 1879 and 1890 all turned on this point: he had no solid party on which to rely, yet would not accept the open partnership with the Centre that was the only alternative. Hence he had to invent alarm cries, imaginary panics with which to stampede the electorate. The "social peril" had been the cry of 1878; it failed to work satisfactorily in 1881. Bismarck had to call in, first, colonial disputes in 1884 and then foreign dangers in 1887. Both were risky expedients which could not be repeated, and in 1890 Bismarck found himself once more without a majority.

Social Security.—Bismarck did not rely only on repression to defeat the Social Democrats. He was the first statesman in Europe to devise a comprehensive scheme of social security, offering the worker insurance against accident, sickness and old age. This Bismarckian "socialism" later became a model for every other country in Europe. It represented in part the paternalist function of the state which Bismarck, as a conservative, had always held. But no doubt its prime function was as a weapon against the Social Democrats. It is commonly held that it failed of this purpose. The Social Democrats continued to increase despite both persecution and state insurance. Bismarck himself confessed in 1890 that he had failed and wished to establish a military dictatorship in order to crush the Social Democrats. But in a deeper sense he succeeded. The Social Democrats ceased to be a revolutionary party; and, when a mortal crisis came in 1918, they alone preserved the empire as Bismarck had created it. This was his last and most unexpected achievement.

Foreign Policy and the Colonies, 1879–85.—Bismarck had not meant to commit himself exclusively to Austria-Hungary when he made the alliance of 1879. Rather he desired to renew good relations with Russia on a conservative basis. This was not difficult. The Russians asked only for security in the near east; and the Austrians gave up hope of alliance with Great Britain when the Liberals came to power there in 1880. The League of the Three Emperors was renewed (June 1881). This was both a conservative partnership, echoing the phrases of the Holy Alliance, and a pact of practical co-operation in the near east, guaranteeing Russia security at the Straits. Austria-Hungary assented to the league unwillingly: Vienna had a deep distrust of Russia which could never be surmounted and would have preferred an anti-Russian alliance with Italy and Great Britain. Bismarck, to satisfy the Austrians, agreed to a Triple Alliance with Italy (May 1882). This gave Austria-Hungary a guarantee at least of Italian neutrality in the event of war with Russia; in exchange Bismarck had to promise to defend Italy against France. This system of alliances—further extended to Rumania in 1883—was strictly defensive and aimed at preserving the general peace of Europe. But, like the earlier League of the Three Emperors, it depended on Russia and Austria-Hungary remaining pacific and conservative in the Balkans; and it threatened to break down when new difficulties occurred there in 1885.

Bismarck's colonial venture was closely connected with his other policies. He had always repudiated interest in colonies. Pointing to Russia and France, with Germany in the middle, he said, "Here is my map of Africa." In 1884, however, he flung himself into colonial disputes with Great Britain and in the course of a single year acquired for Germany the Cameroons, South-West Africa, east Africa and part of New Guinea. His motives have been much debated. He certainly had close connections with the great trading firms of Hamburg and welcomed an occasion to estrange them from England and English liberal ideas. Moreover,

he needed a cry with which to fight the election of 1884, and hostility to England seemed as good as any. He himself, as he grew older, clung ever more persistently to office. The old emperor could not last much longer; and Bismarck feared that when the crown prince succeeded a liberal ministry would be set up. He was constantly on the watch for this imaginary "German Gladstone ministry" and sought to drive out of public life anyone who might qualify as a member of it. But the crown prince could not himself be driven out; therefore he had to be isolated and preparations had to be made to discredit him. Since he had an English wife, England had to be presented as hostile to Germany.

Colonial ambitions also served the needs of Bismarck's foreign policy. He made a determined effort to be reconciled to France, while the eastern question was quiescent. He would not, of course, return Alsace-Lorraine, though he made misleading apologies for the annexation; but he offered to support the French anywhere else in the world. They suspected, however, that he was pushing them into conflict with Great Britain; and to lull these suspicions Bismarck trumped up disputes of his own with the British, in order to be able to convince the French that he had common interests with them. This policy had a certain success, so long as Jules Ferry, the great advocate of colonial expansion, was prime minister in France. But even Ferry did not intend a permanent reconciliation with Germany, though he used Bismarck's co-operation to further his colonial plans; and the policy broke down altogether when he fell from power on March 31, 1885. Bismarck then patched up his disputes with Great Britain and soon repudiated all interest in colonies. In 1889 he declared, "I am not a colonial man."

The Army Bill.—The calm which had followed the Congress of Berlin was broken in 1886. In the near east a new crisis was caused by the unification of Bulgaria. In France Georges Boulanger appeared as the leader of a patriotic movement agitating for revenge. Bismarck used this crisis both to strengthen his position in the *Reichstag* and to give his foreign "system" a new form. The septennate, passed in 1880, was running out. Bismarck exaggerated the danger from France in order to justify an increased grant; moreover, by emphasizing the French danger, he could distract attention from Russia, which was his real anxiety. Finally he hoped to secure a new *Reichstag* more favourable to himself and thus get additional security against the accession of the crown prince. The parties in the *Reichstag*, including even the Progressives, were ready to agree to the proposed army increases but would grant them only for three years. This gave Bismarck the excuse for a conflict, which he deliberately provoked. In Nov. 1886 the *Reichstag* authorized the army bill for three years only. It was at once dissolved. Bismarck persuaded the Conservatives, the Free Conservatives and the National Liberals to form an electoral cartel on a so-called patriotic basis. Even Bennigsen, who had retired from politics in despair, was induced to return in order to defend the national cause. These tactics were successful. The Progressives lost half their seats, although the Centre was not shaken. The army grant was duly passed for seven years; and Bismarck had a *Reichstag* ready to support him in anything. As soon as the election was over, Bismarck minimized the danger from France and worked to remove the tension which he himself had largely created.

Austria and Russia: the Reinsurance Treaty.—Bismarck's real anxiety was not an attack from France, which Germany could easily defeat, but a conflict between Russia and Austria-Hungary in the near east. He urged the two countries to partition the Balkans, but Austria-Hungary would never agree to this. Bismarck was determined not to fight a war for Austria-Hungary's Balkan interests, let alone for the preservation of Turkey. He therefore provided Vienna with other allies who would bear the responsibility for him. In 1879 he had worked to separate Austria-Hungary from Great Britain; now he worked to bring them together. The two Mediterranean agreements (March and December 1887) between Austria-Hungary, Great Britain and Italy were made under his auspices. By them the three powers agreed to maintain the *status quo*, particularly in the eastern Mediterranean.

Yet at the same time Bismarck himself made a secret agreement with Russia which deprived this coalition of much of its effect. The League of the Three Emperors, renewed for three years in 1884, ran out in 1887. The Russians, on bad terms with Austria-Hungary, would not again renew it. They suggested a new agreement with Germany alone. Bismarck accepted this, but revealed to them the Austro-German treaty of 1879 by which he would have to aid Austria-Hungary if Russia attacked it. The Russians countered by refusing to remain neutral if Germany attacked France. With these two exceptions, a treaty promising neutrality in the event of war was concluded in June 1887. This "Reinsurance" treaty had a further clause by which Germany promised Russia diplomatic support in Bulgaria and at the Straits—the points on which the powers of the Mediterranean agreements were combined against Russia.

The Reinsurance treaty may have made the Russians feel less isolated in the near east and so deterred them from any violent impulse; but there is no good evidence that the Russians ever contemplated war there in 1887. Bismarck later made a much greater claim: the Reinsurance treaty, he insisted, had kept Russia away from France, and the failure to renew it in 1890 caused the Franco-Russian alliance. This was an unjustified exaggeration. The Russians had little confidence in German policy even after the treaty; and it was the French who held back from alliance in 1887. Bismarck's economic policy itself helped to defeat his diplomacy. The rising German tariffs on Russian grain estranged the great Russian landowners; and when Bismarck closed the German market to Russian bonds in Nov. 1887, he drove the Russians to look to Paris for money instead.

Frederick III.—In March 1888 there came the catastrophe which Bismarck had long dreaded: William I died, and the crown prince succeeded as Frederick III. The liberal era seemed to have arrived. But the new emperor was already a dying man, and Bismarck had taken his precautions. Frederick III and his wife were surrounded by Bismarck's creatures, who cut them off from contact with the remaining liberal politicians. Bismarck remained securely in office. Only one reactionary minister, Robert von Puttkamer, was dismissed. Yet Bismarck was not satisfied. He launched a violent press campaign against Alexander of Battenberg, the former prince of Bulgaria, in the quite unfounded belief that the emperor was planning to make him chancellor. Bismarck even appealed to the Russian government, though in vain, to threaten war if Alexander were nominated. These pathological alarms were ended only on June 15 when Frederick III died.

William II and Bismarck's Fall.—Bismarck had taken no precautions to make the new ruler, William II, amenable; on the contrary, he had encouraged him in insubordination, as a preliminary to playing him off against his father. Still, Bismarck's position seemed unshakable. He had no political rivals, and in 1886 had made his son Herbert (born 1849; Graf von Bismarck-Schönhausen from 1871) secretary of state, in order to gain unchecked control of foreign affairs. Herbert had all his father's violence without his skill and encouraged him in the worst courses. Bismarck set out to take William II prisoner, as he had taken William I prisoner in 1862. His only method of governing was to raise the cry, "the *Reich* in danger," and he intended to provoke a crisis so grave that a dictatorship would have to be set up, with himself as dictator and William II as a helpless puppet. But William II was a more skilful politician than his grandfather, and he understood the new Germany better than Bismarck. He was not prepared to be estranged from the mass of his subjects; he believed, not altogether wrongly, that the Social Democrats would cease to be dangerous if they were treated with conciliation. He preached a policy of social reform, including factory legislation and recognition of the trade unions. In his own words, he wanted to be a *roi des gueux* ("beggars' king"). He also advocated a demagogic foreign policy. He repudiated Bismarck's cautious policy of keeping Russian friendship and refusing to support Austria-Hungary. Instead he wanted alliance with Great Britain, unrestricted backing to Austria-Hungary, and a large-scale promotion of German economic interests in the near east. Bismarck did not openly oppose this policy.

The crisis centred on the anti-Socialist laws, which were due

to expire in 1890. The Conservatives wished to renew them without alteration; the National Liberals demanded a slight modification. Bismarck made no attempt to reconcile them. In fact, as he admitted, he wanted the bill to be rejected and then "the waves would mount higher and higher until a catastrophe occurred." The National Liberals insisted on their amendment. The Conservatives thereupon voted against the bill as a whole and it was defeated with the aid of the radical and Social Democratic opposition on Jan. 25, 1890. The *Reichstag* was at once dissolved. The general election of Feb. 20 brought defeat to the Bismarckian parties. The Progressives, the Social Democrats and the Centre together had a strong majority. Bismarck welcomed the crisis. He proposed to carry out a *coup d'état.* The German princes, who had made the empire, should now declare that it was dissolved; and a new constitution should be drafted, abolishing universal suffrage and reducing the powers of the *Reichstag.* William II refused to follow this path; he would not, he said, stain the first years of his reign with the blood of his subjects. Bismarck attempted to isolate the emperor. He revived a royal order of 1852, which forbade the ministers to advise the emperor except in the presence of the prime minister, and he appealed to the ministers to threaten a joint resignation, as they had done in 1879. But times had changed. Bismarck was old, William young, and the ministers had their careers before them. Only Herbert Bismarck stood by his father.

At the last moment Bismarck tried to turn foreign policy to his advantage. He claimed that the Russians were willing to renew the Reinsurance treaty only if he remained in office. William II refused to be taken prisoner. On March 18 he demanded Bismarck's resignation. Bismarck drafted a letter of resignation, emphasizing only the differences in foreign policy and blaming William for the estrangement from Russia. He arranged that this letter should be published on the day of his death.

Last Years.—No one but Herbert went with Bismarck into retirement. Bismarck was an implacable foe. He never forgave an injury, even an imaginary one, and refused to use the personal title of duke of Lauenburg that the emperor conferred on him when he retired. His last years were devoted solely to discrediting William, though the emperor made many efforts at reconciliation. Bismarck used every weapon in this last campaign. In a speech at Leipzig in 1892, he criticized imperial influence and urged the German people to make the empire more democratic, although he had spent his life thwarting their democratic wishes. This demagogic appeal did not work. The German masses rightly regarded Bismarck as their enemy, and the left-wing parties even managed to prevent an address of congratulation to Bismarck from the *Reichstag* on his 80th birthday in 1895. Bismarck then swung back to the extreme right and ended up, as he had begun, as a violent Junker. He emphasized his claim that he had built and maintained good relations with Russia which his successors had destroyed. In 1896 he even published the text of the Reinsurance treaty—a breach of official secrecy for which any lesser man would have been prosecuted.

His main energy in these last years went into the composition of his *Reflections and Reminiscences,* a work of great literary genius though of doubtful historical value. He increased the drama of every event and always presented himself in a favourable light. Bismarck died at Friedrichsruh on July 30, 1898, about three years after the death of his wife. He carried his feud with William II to the grave, for the inscription on his tombstone, which he devised himself, read: "A True German Servant of the Emperor William I."

Herbert Bismarck had entered the *Reichstag* in 1893, where he acted as a member of the extreme right. He advocated high agrarian protection and alliance with Russia, opposed colonial expansion, and became increasingly anti-British. During the South African War he was one of the most unscrupulous pro-Boers. He died in 1904 and with his death the challenge of the "Bismarckians" to William II came to an end.

Estimate.—Bismarck was a political genius of the highest rank, but he lacked one essential quality of the constructive statesman: he had no faith in the future. The revolutions of 1848 convinced him that the old order could not be preserved unchanged, and all his later policy was shaped by this conviction. He went with the modern forces of liberalism and democracy solely to draw their sting. Like Metternich he regarded them as evil; unlike Metternich he turned them to his own purposes. He is sometimes compared with the leaders of the English governing classes, who under Sir Robert Peel also made a compromise with liberalism and democracy. But there was a basic difference. In England there was a genuine compromise; in Germany only a trick. The German people were defrauded, given a shadow instead of the substance.

Bismarck was at his greatest in foreign policy. There he understood, as no one else did, "the art of the possible." He never aspired to dominate Europe; he was content to balance between the great powers. Though he had no moral objection to war, he preferred to get his way by diplomacy and went to war only for limited aims, when it was necessary to his policy. The system of alliances which he built up was designed to secure the peace of Europe; and he played the powers off against each other with matchless skill. In fact, though no believer in eternal peace, he was the principal architect of the halcyon age that gave Europe 30 years of peace after the congress of Berlin.

In domestic affairs his record is less inspiring. He had a lust for power which grew on him with the years. He wanted Prussia to be supreme in Germany. He wanted the king to be supreme in Prussia; but, most of all, he wanted to be supreme over the king. His boasted loyalty to the crown vanished as soon as William II showed signs of independence; but he was equally ruthless, though more subtle, with William I. He spoke contemptuously of the old emperor's intelligence and did not shrink from the most unscrupulous tricks in order to keep his hold. His suspicion of possible rivals was unbounded, and he persecuted them out of public life one after the other. In his latter years all his energies went into the search for the "German Gladstone cabinet," which he was convinced was being prepared against him, a search all the more degrading in that this cabinet was always a creation of his imagination. He battered down any politician who dared to cross him even in trifles, and refused to allow the *Reichstag* to pay a posthumous tribute to Edward Lasker, a sincere National Liberal who had done much for the empire but had shown some independence. Yet Bismarck himself changed course whenever it suited him. He repudiated old friends and old policies without scruple and often showed the disloyalty which he denounced in others. He lived in the age of democracy and German power, and he devoted his life to making these two forces as harmless as possible. Despite his ringing, self-confident phrases, he was at heart a despairing conservative, caring only for the past, dreading the future and trying to retard its arrival. Gladstone said of him, "He made Germany great and Germans small."

See GERMANY: *History; see* also Index references under "Bismarck, Otto" in the Index volume.

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BISMARCK, the capital of North Dakota, U.S., and the seat of Burleigh county, on the east bank of the Missouri river in the south central part of the state.

The present townsite, named for the then German chancellor Otto von Bismarck was laid out by the Lake Superior and Puget Sound company in 1873 when the Northern Pacific railroad laid rails as far as the Missouri. It remained the western terminus of that railroad until 1879 and a river steamboat port until commercial navigation ceased on the upper Missouri.

In 1883 the capital of Dakota Territory was moved from Yankton to Bismarck. When the territory was divided and became two states in 1889 Bismarck became the capital of the northern state. The city has retained a governmental and political aspect, and more than one-fourth of the working population is employed by county, state and federal governments.

Situated in a spring-wheat area and ranching country, Bismarck is a centre for the distribution of grain and the marketing of livestock. Many oil companies and firms serving the industry established offices in the city following the discovery of oil in the Williston basin in 1951.

In addition to the public and parochial school systems in Bismarck there are a junior college, a commercial college and an aviation school. It is a regional medical centre with several clinics and hospitals. The local public library, the medical libraries of the clinics, the state law library, State Library commission and State Historical Society library provide service to residents of the city and state.

Points of interest include the skyscraper capitol completed in 1933, the State museum and old Camp Hancock, now a museum. South of Bismarck are "new" Ft. Lincoln and the Annunciation priory. Across the Missouri is Ft. Abraham Lincoln, former headquarters of George A. Custer and the U.S. 7th cavalry.

For comparative population figures *see* table in NORTH DAKOTA: *Population*. (MA. RO.)

BISMARCK ARCHIPELAGO, a group of islands northeast of (and forming part of) the Australian Trust Territory of New Guinea (*see* NEW GUINEA: *History*). Area 19,173 sq.mi. Native pop. (1954 est.) 144,075. Most of the area and population are comprised in the two islands New Britain and New Ireland. The islands are in general of volcanics or raised coral limestone, and are heavily forested. The main economic resource is copra, with some lumbering and in recent years an important development (largely in native hands) of cocoa. This has taken place especially on the Gazelle peninsula (northeast New Britain), which, with New Ireland, is by far the most developed area. Rabaul, on the drowned volcanic caldera of Blanche bay (Gazelle peninsula), is the chief town. The archipelago, with the northeast of the mainland New Guinea, was annexed by Germany in 1884, and occupied (after token resistance at Rabaul) by Australian forces in Sept. 1914. The area was the scene of a military and naval campaign during World War II leading to the reduction of Rabaul, a Japanese stronghold. (O. H. K. S.)

BISMUTH is the elementary substance of the highest atomic weight in Group V of the periodic table; the other members of the group are nitrogen, phosphorus, arsenic and antimony. Bismuth is the most metallic of the group in both physical and chemical properties and is a coarsely crystalline, brittle metal having a high metallic lustre and is tin white in colour with a slightly pinkish sheen which readily distinguishes it from antimony.

HISTORY

This element, though not abundant, was described in writings attributed to Basil Valentine, who supposedly lived in the 15th century (*see* ANTIMONY) and on account of its brittleness it was regarded as a half metal. Georgius Agricola in the 16th century regarded it as a true metal and distinct from metals such as tin, lead and antimony. J. H. Pott (1739) first demonstrated the characteristic properties of bismuth, and its reactions were later studied by S. F. Geoffrey (1753) and by T. Bergman (1780). The name bismuth is supposed to be derived from the German *Weissmuth*, "white matter."

PHYSICAL AND CHEMICAL PROPERTIES

The symbol of bismuth is Bi, atomic number 83, atomic weight 209. The usual valence is $+3$ and $+5$. Its crystals belong to the rhombohedral division of the hexagonal system. The constant physical and chemical properties of bismuth are given in Table I.

TABLE I.—*Properties of Bismuth*

Atomic number	83
Atomic weight	209.00
Boiling point	1,477° C. (2,691° F.)
Crystal structure	Rhombohedral hexagonal
Density at 20° C. (68° F.)	
g./cc.	9.80
lbs./cu.in.	0.354
g./cc. (molten)	10.007
Electrical resistivity (microhm-cm.)	
(solid) 0° C. (32° F.)	106.8
(liquid) 300° C. (572° F.)	128.9
(liquid) 750° C. (1,382° F.)	153.5
Electrochemical equivalent	
Bi^{+++++} (mg./coulomb)	0.43316
Electrode reduction potential	
Bi^{+++} (H_2 = 0.0 v.)	0.22
Latent heat of fusion (cal./g.)	12.5
Latent heat of vapourization (cal./g.)	204.3
Linear coefficient of thermal expansion/° C.	13.3×10^{-6}
Mechanical properties	
Brinell hardness	7.0
Modulus of elasticity, p.s.i.	4,000,000
Melting point	271.3° C. (520.3° F.)
Nuclear data	
Stable Isotopes (209)	1
Thermal neutron cross section (2,200 m/s)	
Absorption (barns)	0.032
Scattering (barns)	9±1
Solidification expansion	3.32%
Specific heat (cal./g./° C.)	
(solid) 20° C.	0.0294
(liquid) 271° C.–400° C.	0.0340
Specific volume (cc./g.)	
20° C. (68° F.)	0.102
Surface tension (dynes/cm.)	
300° C. (572° F.)	376
500° C. (932° F.)	363
Thermal conductivity (cal./sq.cm./cm./° C./sec.)	
20° C.	0.020
300° C.	0.041
700° C.	0.037
Valence	3, 5
Vapour pressure (mm. hg.)	
917° C. (1,684° F.)	1.0
1,200° C. (2,192° F.)	100
1,400° C. (2,552° F.)	400
1,477° C. (2,691° F.)	760

There are 19 recognized isotopes of bismuth ranging in mass numbers from less than 198 to 215. Bismuth as commercially used is isotope 209. Although listed as a stable isotope, it is thought to be a radioactive alpha emitter of extremely long half life (3×10^{17} years). The isotopes from 210 to 214 are members of radioactive decay chains. The natural isotopes 210, 211, 212 and 214 occur in natural chains as shown in Table II. The isotope 213 is a member of the Neptunium series. Its half life is 46 min., major radiation: Alpha 5.9 Mev, Beta 1.2 Mev.

Bismuth is one of the few elements which expand (3.32%) during solidification. It is also the most diamagnetic of all metals. The electrical resistance increases with pressure and decreases with tension. The metal does not become a superconductor at the temperature of liquid helium. The thermal conductivity of solid bismuth is less than that of any other metal except mercury.

Reactions.—Bismuth oxidizes superficially on exposure to moist air, but if heated to high temperature it burns forming Bi_2O_3. Bismuth decomposes steam at a red heat but it is not affected by cold air-free water. The metal unites directly with the halogens fluorine, chlorine, bromine and iodine, and with sulfur. The halides of arsenic, antimony and bismuth are isomorphous. It does not

TABLE II.—*Natural Isotopes of Bismuth*

Series	Commonly named	Half life	Major radiation Mev
Uranium series:			
Bismuth-214	RaC	19.7 min.	Alpha (α) 5.5 Beta (β) 3.15 Gamma (γ) 1.8
Bismuth-210	RaE	4.97 days	Beta 1.17
Thorium series:			
Bismuth-212	ThC	60.5 min.	Alpha 6.05 Beta 2.2 Gamma γ
Actinium series:			
Bismuth-211	AcC	2.16 min.	Alpha 6.62 Beta β^- Gamma .35

form a hydrogen compound whereas antimony and arsenic form trihydrides. Bismuth is readily attacked by dilute and concentrated nitric acid forming bismuth nitrate $Bi(NO_3)_3$. It is sparingly soluble in hot sulfuric acid forming bismuth sulfate $Bi_2(SO_4)_3$ and sulfur dioxide, and also is but slightly attacked by hydrochloric acid.

The photometer is extensively used for determination of bismuth, whereby thiourea is added to nitric acid solutions of bismuth producing a yellow colour. The method is very accurate for determination of low bismuth values. The spectrograph also serves as a very sensitive means for determination of bismuth and is very accurate for values under .05%. For spectrographic work the lines 3,067.716Å and 2,897.975Å are used for accurate readings.

The analytical separation of bismuth in a complex mixture can be made by precipitation of the bismuth in an acid solution by means of hydrogen sulfide whereby bismuth, copper, lead, arsenic, antimony and tin are precipitated as sulfides.

By means of using an alkaline sulfide the bismuth, copper and lead are precipitated and separated from arsenic, antimony and tin which are removed in solution. The solubility in nitric acid separates it from mercury and subsequent additions of sulfuric acid precipitates any lead present. The bismuth can be precipitated as an oxychloride in the presence of lead by adding hydrochloric acid or salt to a weak nitric acid solution of bismuth. The oxychloride is washed, dried and weighed as the oxychloride and the determination calculated.

The bismuth oxychloride method is used for accurate determination of bismuth in excess of .2%. In determination of bismuth in lead bullions, generally the lead buttons are scorified in order to remove the impurities followed by the oxychloride precipitation method eliminating the use of the sulfide separation.

USES

Pharmaceuticals.—Bismuth is an essential ingredient in many pharmaceutical compounds. Bismuth subgallate is used for skin injuries and infections, bismuth subsalicylate is used for alimentary disorders and bismuth subcarbonate is used to treat intestinal fermentation and irritation. This same compound is used for outlining the alimentary canal for X-ray examination.

Alloys.—Another important use of bismuth is in the manufacture of solder and alloys having low melting points (*see* SOLDERING).

In addition to the alloys shown in Table III there is an infinite number of combinations of bismuth with one or more of the metals which may vary in melting range and physical properties.

Prior to 1930 the major use of bismuth alloys was as a low melting point alloy in automatic sprinkler heads and fire door release lines, and as the fusible element in safety plugs for compressed gas cylinders and fire-detection and temperature-control equipment.

Since the early 1930s many applications have been made in industry, such as anchoring complex punches and dies, and producing accurate patterns and intricate shapes and parts that are not efficiently or accurately producible by other means. Electroformed articles whose internal dimensions must be extremely accurate and of high surface finish, require cores, or mandrels, with properties like those possessed by certain alloys of bismuth, that can be melted out after the electroforming process is complete.

The addition of small amounts of metallic bismuth to molten iron, both gray and white iron, is made in order to produce cleaner castings. Small amounts of bismuth are added to corrosion-resistant steels to produce castings of greatly improved machinability.

Bismuth-cadmium alloys have been widely used as the counter-electrode in selenium rectifiers. The alloy is sprayed on the selenium surface and the interface between the selenium and bismuth-cadmium alloy is the locus of rectification and its constitution mainly controls the properties of the rectifier.

Magnets.—A new magnetic material, a chemical compound of manganese and bismuth having the formula MnBi, is reported to have ten times the resistance to demagnetization of that of most of its rivals. This resistance, coming from a magnetic property called high coercive force prevents MnBi magnets from being adversely affected by external magnetic fields, suggesting their use in electric meters. It also makes possible a whole assortment of permanent magnets having novel shapes. (*See* also MAGNETISM: *Permanent Magnets.*)

Tellurium-bismuth-antimony alloys containing small amounts of silver, selenium, etc. have been developed for air conditioning and refrigeration installations, brought about by the so-called Peltier effect, which is a reversal of the thermoelectric phenomenon wherein instead of measuring temperature by the electromotive force developed, direct current is applied to the alloy to produce a cooling effect. This type of alloy may be used in converting solar energy directly into electrical form.

Atomic Energy.—With the advent of the nuclear age, great strides have been made in new uses for bismuth. In the solid state, bismuth is used in the nuclear field because of its high attenuation for gamma rays and its low capture cross section for thermal neutrons. These characteristics permit its use as windows in nuclear reactors when it is desired to bombard external samples or treat patients with neutrons from the core. This is particularly applicable for neutron radiation in medical reactors.

In the liquid state, bismuth retains its low neutron characteristics. Uranium dissolves in liquid bismuth, thus providing the basis for a critical reactor. One of the concepts being developed was the use of bismuth in the Liquid Metal Fuel reactor (L.M.F.R.) whereby bismuth in liquid form acts as the carrier of uranium-235 and as the coolant. The fuel is a .1% solution of uranium-235 or -233 in liquid bismuth. The reactor is moderated with unclad graphite and operated at approximately 500° C. The design is

TABLE III.—*Bismuth Alloys of Low Melting Point*

Components, %					Melting point, °C.
Bismuth	Lead	Tin	Cadmium	Indium	
44.70	22.60	8.30	5.30	19.1	47°
40.00	18.00	12.00	—	21.00	58°
50.00	26.70	13.30	10.00	—	70°
57.00	—	17.00	—	26.00	79°
51.05	40.20	—	8.15	—	91.5°
52.50	32.00	15.50	—	—	95.0°
53.00	—	23.00	20.30	—	102.5°
55.50	44.5	—	—	—	124.5°
58.00	—	42.00	—	—	138°
60.00	—	—	40.00	—	144°

such that when the solvent (bismuth) containing the solute (uranium) is pumped through the graphite moderator, the fission of U^{235} or U^{233} reaches criticality and is therefore self-sustained. The heat generated by these fission reactions is transmitted to the liquid bismuth which is pumped through heat exchangers to produce steam. The fission products which interfere with the self-sustained fission reaction can be removed by continuous processing. The uranium lost in fission is replaced by converting thorium to uranium-233 by neutron capture. The reactor therefore produces its own fuel. (*See* also NUCLEAR ENGINEERING.)

OCCURRENCE

Bismuth ores are found over a wide area of the world, the early deposits being located in Saxony and Bohemia and the British Isles. In the second half of the 20th century the chief sources of bismuth ores are Korea, China, Bolivia, Argentina, South-West Africa, Union of South Africa, Uganda and Mozambique.

Some minor deposits are found in Mexico and the United States. All of these ores can be classified as sulfide, carbonate or oxide, with the bismuth sulfide ores being in greater supply. It is only on rare occasions that pure bismuth sulfide or oxide ores are available commercially; so-called commercial bismuth ores usually contain from 15% to 40% bismuth, and depending on the source of supply, the usual impurities contained are gold, silver, lead, copper, arsenic, antimony, tin, tungsten and selenium.

The supply of bismuth from commercial ore is relatively small as compared with the bismuth which is recovered from copper and lead ores. There are a number of lead-bismuth ores, copper-bismuth ores and mixed lead-and-copper-bismuth ores; however, in general the bismuth is present in copper and lead ores as bismuth sulfide. (See *Extraction,* below.)

During the reverberatory smelting of copper concentrates the bismuth and lead are collected in the copper matte. During the subsequent copper converting treatment of the copper matte for production of blister copper, the major portion of the bismuth and lead is fumed off and collected as dust in either baghouses or electrical precipitators. The dusts are then transferred to plants smelting lead ores and thus the bismuth from copper ores becomes commingled with bismuth in lead ores and is recovered as an impurity in lead bullion during the lead smelting operations. The bismuth produced by Yugoslavia, Germany, Italy, Sweden, France, Japan and substantially all the bismuth produced in the western hemisphere, which together constitutes the major portion of the world bismuth production, for the most part originates in either lead or copper ores.

EXTRACTION

Recovery From Bismuth Ores.—Bismuth may be concentrated from bismuth ores by means of hydrometallurgical or pyrometallurgical processes. When bismuth is present as an oxide or carbonate, hydrochloric acid and a limited amount of water is employed to dissolve the bismuth in the finely crushed ore, followed by dilution with water whereby the bismuth precipitates as the white bismuth oxychloride. After washing, redissolving in hydrochloric acid and reprecipitation, the bismuth oxychloride is filtered, dried and smelted with lime and carbon to metallic bismuth. Bismuth produced by this method usually contains small amounts of lead, silver and other impurities which can be removed by further refining. (*See* also *Bismuth Refining,* below.)

The bismuth sulfide ores may be roasted in order to remove the sulfur content, followed by smelting with carbon in crucibles or reverberatory type furnaces. Lime, soda ash or salt cake or fluorspar can be used to give further slags, and metallic iron is added to break up any bismuth sulfides. The products of smelting are metallic bismuth, matte or speiss and slag. The matte or speiss is reworked for recovery of occluded bismuth and the bismuth metal is impure and requires further refining.

In more modern installations the finely crushed bismuth sulfide is charged with caustic soda into suitable pots of two or three tons capacity which are externally heated and the molten bismuth is collected in the bottom of the pots, the sulfur reacting with the caustic forming soda mattes which are treated for any entrained bismuth. The impure bismuth again requires further refining.

BY COURTESY OF T. D. JONES

BISMUTH CRYSTAL

Recovery of Bismuth from Lead Bullion.—With the exception of lead bullions produced from smelting lead ores from the Tri-State district (Missouri, Kansas, Oklahoma) and a portion of the Coeur d'Alene ore of Idaho in the United States, and Australian lead ores, in general all other lead bullions require debismuthizing in order to meet the bismuth specifications for fully refined lead.

Several debismuthizing processes have been employed over the years since 1900. In 1901 the Betts electrolytic lead process was developed, followed by the Betterton-Kroll alkaline-earth process (calcium plus magnesium) in 1930 and more recently the Jollivet Penarroya process (potassium plus magnesium), developed in France.

Betts Electrolytic Lead Process.—Lead bullion which may contain gold, silver, bismuth, copper, arsenic, antimony and other impurities such as selenium, tellurium, etc. are cast into anode form for electrolyzing. If excess copper and tin are present, these impurities are removed to low limits before anode casting takes place. Excess copper causes drossy lead and complicates the treatment of slimes, and tin will deposit on the cathode with the lead.

The impurities in the lead anodes are insoluble and remain on the anode as a slime blanket. When the corroded anodes have been removed from the electrolytic cells the slimes are removed by scraping, the hardness of the slimes depending on the amount of impurity in the bullion. The slimes are centrifuged and washed free of entrained electrolyte and are partially dried and melted in an oil or gas fired reverberatory furnace. A portion of the arsenic and antimony is removed in the smelting slag and the balance oxidized by blowing the bath with air; the fumes are collected in a baghouse.

When the bath is free of arsenic and antimony, it is transferred to a cupel type furnace where cupellation takes place by blowing air over the surface of the bath and the copper, lead and bismuth are oxidized and removed as a litharge slag, the *doré* metal (crude silver) remaining in the furnace for the production of gold and silver.

The bismuth-rich cupel slags are then transferred to a second reverberatory furnace and the copper removed either as a copper-antimony speiss or the crushed cupel slags are mixed with sulfur and reduced with carbon to produce copper matte.

The lead-bismuth alloy is then transferred to the bismuth department for production of refined bismuth.

Betterton-Kroll Process.—The Betterton-Kroll, or ASARCO, process has been used extensively since the 1930s for bismuth re-

moval from lead bullion by those plants not favoured with cheap power rates. The lead bullion is first softened, desilverized and dezinced by conventional methods and after dezincing, any zinc and antimony remaining in the lead bath is removed by the use of caustic soda.

The ASARCO process is based on the fact that calcium and magnesium form the higher melting compounds calcium bismuthide (Ca_3Bi_2) and magnesium bismuthide (Mg_3Bi_2), which are removed from the lead bath in the form of a dross. The calcium is added to the molten bath in the form of a 3% to 4% calcium alloy and the magnesium is added in the form of pure magnesium ingots.

The calcium and magnesium are added to the bath in equal amounts and range from 1.2 lb. per ton for 0.1% bismuth in the lead to 3.1 lb. per ton when the bismuth is 1%. In actual practice, blocks of dross skimmed from the previous charge are added to the bath at 790° F., melted and mechanically stirred for a short period and thus become enriched and are skimmed off for the recovery of bismuth and transferred to a second kettle for further enrichment by removal of calcium and magnesium and entrained lead and made available for the bismuth refining operations. Following this operation the required magnesium is charged into a perforated basket and submerged beneath the surface of the bath and is slowly alloyed with the molten lead by impinging a stream of lead from a pump on the submerged magnesium. At the same time, the calcium alloy is added to the bath in the form of blocks and allowed to melt. These blocks, because of a lower specific gravity than lead, float on the surface of the bath.

After melting of both calcium and magnesium takes place, the basket is removed and a mechanical mixer is placed in position and the bath at 700° F. is stirred for 30 minutes and the mixer removed. The dross formed is skimmed to blocks and is used as first blocks on the succeeding charge. The metal bath is cooled to the freezing point and all dross removed. At this stage the bismuth in the lead has been removed to the desired limit, and the bath is treated for removal of residual calcium and magnesium.

Jollivet Penarroya Process.—This process is used at one plant in France and is based on the fact that potassium and magnesium form a compound with bismuth ($Bi_7Mg_6K_9$) which can be removed from the molten lead bath as a dross.

The reagent potassium (K) is made in a reactor composed of five compartments whereby sodium lead (NaPb) is introduced at one end and KOH at the opposite end. By counterflow, potassium lead and NaOH emerge at opposite ends of the apparatus. In actual practice the lead bullion previously fully refined, with the exception of bismuth removal, flows to a divider where one portion flows to a kettle for alloying with magnesium; the second portion flows to the five-compartment apparatus named above for production of KPb.

The MgPb and KPb then converge with the third portion from the divider in a separate debismuthizing kettle equipped with a sealed cover, and progressive cooling begins. The dross formed rises to the surface and enters a hinged basket inside the cover. As the cover is raised, the dross is transferred to a second kettle and is treated with KOH formed in the process. A bismuth alloy containing approximately 16% is obtained and transferred for the recovery of bismuth.

BISMUTH REFINING

The alkaline earth bismuth-recovery processes will produce alloys containing from 16% to 40% bismuth and the slimes metal recovered in the Betts electrolytic process contains about 75% bismuth. Alloys recovered from smelting bismuth ores will contain bismuth in direct proportion to the bismuth content of the ore. Final steps in the bismuth refining process are fairly standard regardless of the origin of the bismuth.

The impure bismuth is melted in kettles which may have a capacity of two to ten tons of bismuth and treated with repeated additions of caustic soda and nitre to remove such impurities as arsenic, antimony, tin, selenium and tellurium. All of these impurities are removed to .0001% or less and in most cases to the fifth decimal place. If copper is present in unusual amounts it is removed by sulfur additions and the bath cooled and copper removed to approximately .02%.

TABLE IV.—*Typical Analysis of Drossed Lead Blast-Furnace Bullions at Various Smelters*

Constituent	Selby smelter, Selby, Calif.	Chihuahua smelter, Chihuahua, Mex.	Cerro de Pasco Copper Corp., Oroya, Peru	Consolidated Mining and Smelting Co., Trail, B.C.
Gold (oz./ton)	1.35	0.32	0.11	0.057
Silver (oz./ton)	117.02	115.0	90.0	64.9
Lead	95.855%	98.58%	96.8%	98.250%
Copper	0.020%	0.019%	0.04%	0.04%
Arseoic	0.09%	0.267%	0.135%	0.26%
Antimony	3.27%	0.400%	2.07%	1.17%
Tin	0.11%	0.0166%	0.0012%	0.004%
Nickel and cobalt	nil	nil	nil	nil
Bismuth	0.25%	0.320%	0.65%	0.054%

The above procedure is followed by zinc additions for the removal of gold, silver and remaining copper, and the number of zinc additions depends on the *doré* content of the bismuth metal. The desilverizing operation is very similar to desilverizing lead bullion, although on a much smaller scale. The bath is heated to approximately 900° F. and the calculated amount of zinc is added and stirred in by a mechanical mixer. The zinc drosses formed during the successive stages of cooling are skimmed off until the bath becomes frozen. If the bath is high in *doré* content then two zinc additions may be necessary. In this case the zinc skimmings from the second addition are usually added as first zinc for the next batch or lot of impure bismuth. After a thorough job of desilverizing the bath contains substantially only bismuth, lead and approximately .6% zinc.

The modern practice calls for chlorination of the zinc and lead in the molten bath, and the chlorine first combines with the zinc to form zinc chloride which is skimmed off. Continued chlorine additions are made to form lead chloride until the lead has been reduced to low limits. An operator usually knows when the lead has been removed as the chlorine begins to react with the bismuth forming bismuth chloride, which evolves from the bath as a dense fog of fume.

The deleaded bismuth is transferred to a very clean kettle where the bath is again refined with caustic and cast into shapes for market. This method of refining produces bismuth 99.99% pure and in most cases 99.999% pure.

See also Index references under "Bismuth" in the Index volume.

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BISON, any member of the oxlike genus *Bison* of the family Bovidae. The bison differs from typical cattle or oxen by being larger and by having a convex forehead, larger legs, a pronounced hump at the shoulders and 14 pairs of ribs instead of 13. The fur is coarse and especially long on the head, neck and shoulders (the shoulders in winter only in the European species), forming a sort of cape. The head is carried low and cannot be raised to shoulder level. Both sexes bear heavy, curved horns, those of the cows being smaller. Bison are large, powerful beasts; a mature bull stands 6 ft. tall at the shoulder and weighs more than 2,000 lbs.; a female is about 5 ft. tall and weighs about 700 lb. The coat is a sombre dark brown in colour but on rare occasions a white animal is born. White buffaloes were once honoured, and even worshiped, by American Indians; their hides became valued tribal possessions.

Bison are long-lived animals; a breeding life of 40 years is common in females. They live in herds, the basic unit of which is a female, several generations of her descendants and one or more bulls. Bulls seldom live alone. Cows usually give birth to a single calf in May after a gestation of nine to nine and one-half months. All members of the band protect the young. Bison will eat tree twigs and leaves, although they prefer grass. They

JOHN H. GERARD
AMERICAN BISON (BISON BISON)

feed in early morning and late afternoon, resting during midday and at night. The herd may remain in one location for several days and then, for no apparent reason, move in a purposeful manner to a new locality. At other times the herd may move more or less constantly in a seemingly aimless fashion. The usual gait is a plodding walk. They also trot, canter in a stiff-legged manner or run with a rolling motion. In spite of their bulk they are surprisingly agile and fast; they have been clocked at 40 m.p.h. Bison are unpredictable animals. Sometimes they can be approached closely without evincing alarm. At other times they stampede with the least provocation. It is never safe to approach them too closely.

There are two living species. The European species, *Bison bonasus* (wisent), sometimes erroneously called the aurochs (*q.v.*), became rare by the 16th century and in the early 1960s only a few wild specimens existed in eastern Poland and Lithuania. It differs from the American species by living in woods, being slightly larger, having thicker, shorter and blunter horns and displaying different skull features. In historic times it lived in small bands in many forests of Asia and Europe including England. The young are born in seclusion in a dense part of the forest. The wisent is also known from Pliocene deposits of India and Java.

The American bison (*B. bison*), commonly called buffalo or plains buffalo, once occurred in great numbers over most of North America; a conservative estimate of their number when the white man arrived is 60,000,000, probably the greatest aggregation of large animals ever known to civilized man. The buffalo formed the mainstay of the economy of the Plains Indians, providing them with meat and hides for food, clothing and shelter. With the westward movement of civilization the "buffalo" was slaughtered with a wantonness seldom matched. First killed for meat and hides, then only for hides, sport and sometimes only for the tongue, they were soon decimated. One hunter alone, William F. Cody (*q.v.*), killed 4,280 animals in 17 months while supplying the beeflike buffalo meat for railroad construction crews and won the name of "Buffalo Bill." Much of the hostility between the Indians and the white man resulted from the depletion of the buffalo. The low point was reached around 1900 when the animals neared extinction. Concerted action by cattlemen and conservationists led by William T. Hornaday resulted in their protection on government preserves. The future of the buffalo now seems secure. The present managed herds now comprise several thousand animals.

The extinct *B. latifrons* occurred contemporaneously with early man in North America at the end of the Ice Age.

See also Index references under "Bison" in the Index volume.

(K. R. Kn.)

BISSEXT (Bissextus), the intercalary day in February added every fourth year under the calendar reform of Julius Caesar (46 B.C.), to compensate for the three six-hour periods omitted during the three years of 365 days (the Julian year contains 365.25 days). The 24th day of February, at that time the sixth day before the kalends (or 1st) of March, was designated as *ante diem sextum kalendas Martias;* the intercalation resulted every fourth year in the repetition of this sixth day, *ante diem bis sextum kalendas Martias.* The ecclesiastical calendar preserves the Roman method of intercalation. The gradual acceptance, in medieval Europe, of the numbering of the days of a month in a continuous sequence, up to 30 or 31, led to Latin or vernacular designation equivalent to "the 29th day of February"; the extra day at the end of February became the bissext ("leap") day in bissextile ("leap") years. *See* Calendar; Leap Year. (A. Po.)

BISSOLATI-BERGAMASCHI, LEONIDA (1857–1920), Italian Socialist and statesman, was born at Cremona on Feb. 20, 1857. He was an active member of the Italian Socialist party from its foundation in 1892 and exercised considerable influence as a journalist, editing the party's official organ *Avanti!* He entered parliament in 1897 and threw himself into the obstructionist tactics by which the Socialists opposed the antidemocratic legislation of Luigi Pelloux (1898). In 1902 he became a leader of the reformist group which criticized his party's abstention from government and wished to see the workers' organizations integrated with the fabric of the state. In 1911 he came into conflict with the party over his support of the war against Turkey and was expelled for refusing to oppose the military credits, whereupon he founded the Reformist Socialist group (1912). At the outbreak of World War I, when the official Socialist party was neutral, Bissolati declared himself an interventionist because he believed that the war would emancipate the subject nations. At the age of 58 he enrolled as a volunteer and was seriously wounded. He entered Paolo Boselli's national cabinet as minister without portfolio in June 1916 and became minister for war aid and pensions in Orlando's government (1917). He resigned in Dec. 1917 because of disagreement over the treaty of London. During the war Bissolati had advocated agreements with the subject nations under Austria; and after the armistice, on the Wilsonian principle of ethnic rights, he opposed the annexation of the Alto Adige and northern Dalmatia while he supported the annexation of Fiume (Rijeka) as a preponderantly Italian town. His attitude on the Tirolese and Dalmatian questions lost him much of his popularity, but his death, in Rome on May 6, 1920, was regretted as that of a true patriot.

See Ivanoe Bonomi, *Leonida Bissolati e il movimento socialista in Italia* (1945). (N. S. J.)

BITHUR, a former town in Kanpur district, Uttar Pradesh, India, lies on the Ganges 13 mi. N.N.W. of Lucknow, and though now ruined is still notable as a Hindu holy place. Pop. (1951) 2,577. The chief object of worship is a footmark held to be that of Brahma. There also is the Balmiki *ashram* or retreat, believed locally to have sheltered the saintly author of the epic *Ramayana.*

Deposed by the British in 1819, Baji Rao, peshwa (ruler) of the Marathas, kept court-in-exile at Bithur with about 15,000 retainers. But in retaliation for the part played by his adopted son Nana Rao Peshwa in the 1857 revolt (*see* Indian Mutiny), the British largely destroyed the town in 1858, blowing up its chief temple and palaces. (B. St.)

BITHYNIA, an ancient region of northwestern Asia Minor, comprising part of modern Turkey, adjoining the Sea of Marmora, the Bosporus and the Black sea. On the east it bordered on Paphlagonia, on the west Mysia, and on the south Phrygia and Galatia. The country was divided into two roughly equal parts by the Sangarius (Sakarya) river, the less mountainous western half being the more populated. About the end of the 2nd millennium the region had been settled by Thracian tribes that had crossed from Europe. One of these tribes, the Bithyni, gave the country its name. Greek colonies were later established at various points on the coast, the Thracian peoples continuing in occupation of the interior. The Bithyni of historical times were a warlike people who frequently attacked the Greek settlers and harried the representatives of the Persian king, whose nominal subjects they became in the 6th century. They also became notorious for piratical activities. They were led by tribal chiefs who later, in the 3rd century, took the title of king in imitation of Hellenistic practice. This dynasty ruled with considerable success over their small but powerful kingdom until Bithynia became a Roman province in 74 B.C.

Bithynia never submitted to Alexander the Great. When Lysimachus attempted to subdue it he was defeated by Zipoetes (327–*c.* 279 B.C.), who then assumed the royal title (298); later he won a victory over the Seleucid king Antiochus I. After Zipoetes' death his successors, Nicomedes I (*c.* 279–*c.* 255), Ziaëlas (*c.* 255–230) and Prusias I (*c.* 230–182), using the methods of war and diplomacy, built up the kingdom into a considerable power. To help him in a family quarrel Nicomedes I in 277 brought over from Europe the Celtic marauders who caused havoc to Asia Minor in the ensuing decades. For Bithynia, however, they served as a useful shield against the Seleucid empire. Zipoetes' assumption of the royal title had been the signal that Bithynia had grown beyond the stage of tribal organization and that her

rulers aspired to take part in international politics. This was shown clearly when Nicomedes I entered into alliance with Ptolemy II of Egypt and with the independent Greek cities of Heraclea Pontica on the southern coast of the Black sea and Chalcedon at the southern entrance to the Bosporus. Later he named Ptolemy and Antigonus Gonatas of Macedonia among the guardians of his heir, Ziaëlas. The latter also professed friendship for the Greek cities. But the next king, Prusias I, made war on Byzantium and annexed the cities of Cius and Myrleia (on the Gulf of Cius; modern Gemlik), which Philip V of Macedonia (whose sister Apama he married) had destroyed in 202; he also took much inland territory from Heraclea. In a war with Pergamum he seized Mysia, and, after the defeat by the Romans of the Seleucid king Antiochus III at Magnesia in Lydia in 190 B.C., he gave refuge to the Carthaginian general Hannibal. He was, nevertheless, astute enough to abandon in time his defiance of Roman policy: Mysia was handed back to Eumenes II of Pergamum and Hannibal had to commit suicide (183). Under this king Bithynia attained to its greatest extent, an area estimated at 18,000 sq.mi. Later the power of the kingdom began to decline under less capable rulers, Prusias II (d. 149 B.C.), Nicomedes II (d. *c.* 127) and Nicomedes III (d. *c.* 94).

The last king, Nicomedes IV (*c.* 94–74), allowed himself to be used as a Roman pawn in the struggle between the Romans and Mithradates VI of Pontus. Twice driven from his throne, in 91 and 88, he was finally reinstated by L. Cornelius Sulla in 84, and on his death in 74 he followed the example of Attalus III of Pergamum by bequeathing his kingdom to the Romans. The Roman senate accepted the bequest, and after further conflicts with Mithradates the country was organized as a province. Its later history was comparatively uneventful. The Roman emperor Trajan sent Pliny the Younger to the province *c.* A.D. 111 as a special legate to check the mismanagement of their affairs by the self-governing Greek cities.

The land was richly wooded in its eastern part, and fertile and well populated in certain western districts. The Bithynian kings founded Nicomedia (modern Izmit) on the coast and Prusa (Bursa) at the northern foot of Mt. Olympus. Under the Romans the limits of the province were frequently varied, and it was often united for administrative purposes with the province of Pontus.

See A. H. M. Jones, *Cities of the Eastern Roman Provinces* (1937); D. Magie, *Roman Rule in Asia Minor* (1950). (R. H. St.)

BITLIS, the chief town of the *il* (province) of Bitlis in southeastern Turkey, lies 4,700 ft. above sea level and 16 mi. S.W. of Lake Van, in the narrow valley of the Bitlis cay, a tributary of the Tigris. Pop. (1960) 16,562. At the close of the 19th century the population exceeded 30,000, but because of the troubled years of World War I, the Russian occupation and the riots on the part of the Armenian minority it decreased to about 9,000 by 1922, when the Turkish War of Independence ended.

The climate is healthful but snowfalls are heavy, and narrow streets may be blocked for five months in the year. The main part of the town and the bazaars are crowded alongside the stream, while suburbs of scattered houses among orchards and gardens extend up the hillsides along two tributary streams. These houses are solidly built of a soft volcanic tufa. In the centre of the town is an old castle, partly ruined, which, according to local tradition, occupies the site of a fortress built by Alexander the Great. It is apparently an Arab building, since the walls carry Arabic inscriptions, and from its position on the main highway between the Van plateau and the Mesopotamian plain it must have been of strategic importance. Some fine old mosques and madrasahs (mosque schools) still exist. Roads link the town northward with Mus and Erzurum, eastward with Van, and southward with the railway at Misric (Kurtalan) (40 mi. S.W.).

Bitlis *il* (area 3,415 sq.mi.; pop. [1960] 129,125) includes the eastern corner of the Mus plain and the plateau west of Lake Van, and contains wild mountain country on either side of Bitlis town. Fruit is plentiful and there are vineyards. Tobacco of an inferior quality is grown and manna and gum-tragacanth are collected. The mountains have been little explored but are believed to be rich in minerals; iron, lead, copper, traces of gold and many mineral springs are known to exist. The chief industries are the weaving of a coarse red cloth and the production of leather goods.

(N. Tu.; S. Er.; E. Tu.)

BITOLA (Bitolj, Monastir), the southernmost town in Yugoslavia, lies below Mt. Perister on an upland plain 2,019 ft. above sea level. The swift mountain Dragor river runs through the town. Pop. (1961) 49,101, including Macedonians, Vlachs and some Albanians. Up to World War II the largest Jewish community in Macedonia existed there. Bitola itself has been identified with the ancient Heraclea Lyncestis, a Roman city on the Via Egnatia. The military advantages of its position led the Turks, about 1820, to make Bitola the headquarters of an army corps, which greatly increased its general and commercial importance. Its population reached 50,000. In the Balkan Wars (1912–13), Bitola was taken from the Turks by the Serbs and was assigned to Serbia by the treaty of Bucharest (1913). Thus Bitola became a border town, cut off from its natural environs. During World War II the town suffered greatly and declined in commerce and population. In 1941 it was occupied by Bulgaria. In 1945, upon the re-establishment and reorganization of the Yugoslav government, Bitola became one of the largest towns in the People's Republic of Macedonia, one of the six Yugoslav republics. It is linked by railway to the main Balkan railway from Belgrade to Salonika, Greece. The plain in which it lies affords excellent pasturage for cattle, and wheat, maize (corn), tobacco, madder and the poppy are cultivated; a part of the population of Bitola is actively engaged in agriculture. The chief industries are rubber, tanning and the manufacture of ribbons, carpets and stockings. The old crafts of metalwork, woodwork, needlework and carpet-making still flourish. (V. De.)

BITONTO, an Italian town and episcopal see in the province of Bari, lies 18 km. (11 mi.) S.W. of Bari. Pop. (1957 est.) 37,143 (commune). The old town, with narrow, irregular, arcaded streets, contains remains of Norman and Angevin walls and monuments, a Norman castle, a Romanesque cathedral (1175–1200) which is a fine example of medieval Apulian architecture, and several Renaissance buildings. In the modern town, with its wide streets, are the two Palazzi Gentile, one of which is the community centre and public library. Educational establishments include agricultural institutes. The commune is an agricultural one, its principal crops being olives, vines and almonds.

Bitonto (ancient Butuntum, Botontum and other forms) has nearly always had juridical autonomy. Many coins have been found dating from the 6th to the 3rd centuries B.C. It was a Roman municipality and the seat of *marchesi.* (D. A. De C.)

BITTERFELD, a regional capital in the German Democratic Republic in the district of Halle, lies about 40 km. (25 mi.) N.E. of Halle and the same distance N. of Leipzig. Pop. (1959 est.) 31,968. The Zwickauer Mulde, a tributary of the Mulde, flows north of the town which is in the northern part of the central German brown-coal (lignite) area and its industry is determined by that raw material. The largest enterprise is the nationally owned electrochemical complex, one of the largest enterprises in east Germany, the products of which include polyvinylchloride and synthetic jewels. In addition there are several brown-coal opencast mines, metal processing plants, a large power station and potteries. Bitterfeld originated in 1150 as a settlement of Flemish colonists. Some time later it became known for its clothmaking craftsmanship and a brick-kiln provided work for the population. The electrochemical industry had its beginning there about 1900. Bitterfeld is a railway junction for the Berlin-Leipzig, Berlin-Halle and Dessau-Leipzig lines.

BITTERLING (*Rhodeus sericeus*), a little carplike fish, native of central Europe, belonging to the Cyprinid family. In it we have a remarkable instance of symbiosis. The genital papilla of the female acquires a great development during the breeding season and becomes produced into a tube nearly as long as the fish itself; this acts as an ovipositor by means of which the comparatively few and large eggs (3 millimetres in diameter) are introduced through the gaping valves between the gills of pond mussels (*Unio* and *Anodonta*). After being inseminated, the fertile eggs undergo their development and the fry leave their host about a

month later. As the young fish swim away, the mussel throws off its embryos on the fish, in the skin of which they remain encysted for some time. Thus both the bitterling and the host mussels benefit from this unusual arrangement.

BITTERN, generally, the name for wading birds of the subfamily Botaurinae, allied to the heron (*q.v.*), but with shorter neck, stouter body, variegated brown colours and streaked neck. Bitterns are solitary, nocturnal inhabitants of wet meadows, marshes and reedy swamps, where they skilfully spear frogs, small fish, meadow mice, crayfish and other animals.

The true bittern (*Botaurus*) escapes detection by standing upright among reeds, bill pointed upward, camouflaged by its dark streaks. It is well known for its "thunderpumping," or booming during the breeding season. During courtship it erects two tufts of feathers in the shoulder region. Four species occur: *B. stellaris* breeds in temperate Europe and Asia and in South Africa; *B. lentiginosus* in Canada and northern and western U.S., wintering south to Guatemala; *B. pinnatus* from Colombia to southeastern Brazil; and *B. poiciloptilus* in Australia and New Zealand.

PAUL POPPER LTD.

EURASIAN BITTERN (BOTAURUS STELLARIS) WITH YOUNG

The much smaller least bittern (*Ixobrychus exilis*), which builds a nest of reeds smaller than but similar to the nests of other bitterns, lays 4 or 5 eggs more bluish-white than the olive-buff of the larger bittern; it ranges from southern Canada to Paraguay. The little bittern (*I. minutus*) occurs over the old world, while other species are found in South America (*I. involucris*), Africa (*I. sturmii*), China to India and the Malays (*I. cinnamomeus*), central Asia to Japan (*I. eurhythmus*), and eastern Asia and Japan to the Philippines, Guam and Truk (*I. sinensis*).

The South American *Zebrilus undulatus* occurs from the Guianas to central Brazil, while *Dupetor flavicollis* is found in southeastern Asia, the Malays, Australia and Guadalcanal. (G. F. Ss.)

BITTERROOT (*Lewisia rediviva*), a North American plant of the purslane family (Portulacaceae; *q.v.*), native to mountain regions from Montana to British Columbia and southward to Colorado, Arizona and southern California. Crowning its stout root is a thick perennial rootstock from which rise small fleshy leaves and short, jointed stalks, each bearing a beautiful rose-red, cactuslike flower, two inches or more across. In early spring the flowers bloom in immense numbers in stony soil on ridges and in alpine valleys. The large starchy tap root was highly esteemed for food by the Indians.

ERNST C. PETERSON

BITTERROOT (LEWISIA REDIVIVA)

The plant became known to science from specimens collected by Meriwether Lewis, of the Lewis and Clark expedition (1806–07), and the botanical genus *Lewisia* was named in his honour by Frederick Pursh.

The Bitterroot river and the Bitterroot mountains in Montana are named after this plant, which is the Montana state flower.

BITTERROOT MOUNTAINS, a linear Rocky mountain range extending about 300 mi. along the middle border of Idaho and Montana. Peaks average about 9,000 ft.; passes, or saddles, about 7,000. The highest peak is Scott, at 11,393 ft. The upper levels of the range are strongly glaciated with many cirques and U-shaped valleys. The abrupt east slope, a fault scarp, is difficult of access and few main roads cross the range. The forest, which covers all but the highest peaks, includes ponderosa pine on the lower slopes, lodgepole pine, white pine, larch, grand fir and Douglas fir. The range drains to the Columbia river via the Clark Fork river on the east and the Clearwater and Salmon rivers on the west. (S. N. D.)

BITTERS, aromatized and often alcoholic beverages and medicines containing a bitter substance or substances (chiefly alkaloids, glycosides or complexes), used as tonics, appetizers or digestives. The bitterness is imparted by such substances as bitter orange peel, gentian root, rhubarb root, hop flowers, quassia wood chips, cascarilla, cinchona bark and quinine. The aroma is provided by juniper, cinnamon, caraway, anise, nutmeg, camomile, cloves and other flavouring agents.

Bitters are prepared by (1) simple maceration and subsequent filtration; (2) single or multiple percolation; (3) extraction and condensation by a large-scale extractor; and (4) shaking out of a volatile solvent after extraction. Rectification, sometimes required after extraction, is accomplished by fractional distillation and produces a superior product. Alcohol or sugar, or both, may be added.

Early Hebrew history recorded the addition of sweet-scented or bitter herbs to wine in order to improve and give variety to its flavour. The preparation of aromatic liqueurs originated in France around 1533, and their use spread quickly throughout the world.

Bitters are usually sold under the name of the substance that has been used to give the predominant flavour, such as orange or peach bitters. The alcoholic strength of bitters varies but is generally about 40% of alcohol.

Most bitters have no medicinal effect and may be regarded as beverages pure and simple. Medicinal bitters, which are few in number and of minor therapeutical value, include compound tinctures of absinthe and of aloes. (F. A. C.)

BITTERSWEET, a name for the woody nightshade (*Solanum dulcamara*). (*See* NIGHTSHADE.) Also applied in the United States to *Celastrus scandens*, a woody vine, called more properly climbing bittersweet (*q.v.*).

BITUMEN, the name applied by the Romans to the various types of natural hydrocarbons, the word petroleum not being used in classical Latin. Classical and biblical references to bitumen are of frequent occurrence, as in Gen. xi, 3, where reference is made to its use as mortar, and Gen. xiv, 10, where the bitumen pits in the vale of Siddim are noted.

In the modern use of the word, largely because of its commercial application, there is a tendency to restrict its popular meaning to the solid or semisolid hydrocarbons, although in its widest sense it includes all the natural hydrocarbons. In the generally accepted classification, however, gaseous hydrocarbons are excluded.

The solid bitumens are characterized by being fusible and largely soluble in carbon disulfide. Allied to but distinct from the bi-

Bitumens	Liquid petroleum	Paraffin base	
		Mixed base	
		Asphaltic base	
	Native mineral waxes	Ozocerite (called ceresine when refined)	
		Montan wax (extracted from peat)	
	Native asphalts	Vary from a pure solid bitumen to an impure bitumen containing a high percentage of sand, clay, etc.	
	Asphaltites	Gilsonite	Characterized by a higher fusing point than the asphalts
		Glance pitch	
		Grahamite	
Pyrobitumens	Asphaltic pyrobitumens	Elaterite	Infusible and insoluble, derived from petroleum
		Wurtzilite	
		Albertite	
		Impsonite	
		Oil shale	
	Nonasphaltic pyrobitumens	Peat	Infusible and insoluble, derived from vegetable matter
		Lignite	
		Bituminous coal	
		Anthracite coal	
		Lignitic and coal shales	

tumens are the pyrobitumens, a group of solid substances that are characterized by being infusible and insoluble, but that, on heating, generate or become transformed into bodies resembling bitumens in their solubility and physical properties.

In its various forms bitumen is one of the most widely distributed of substances. It occurs, though sometimes only in small quantities, in almost every part of the globe and throughout the whole range of geological strata, from the Laurentian rocks of the Pre-Cambrian, or most ancient, era to the members of the Quaternary, or recent, period.

All the asphalts, asphaltites and asphaltic pyrobitumens, with the exception of oil shale, have probably been derived from liquid petroleum, either by the evaporation of the lighter fraction under atmospheric conditions or by deeper-seated metamorphism. A range of products similar to many of the native solid bitumens is obtained as residues on the distillation of various types of crude petroleum, these forming many of the "asphalts" and "bitumens" of commerce. *See* also ASPHALT; GILSONITE; OZOCERITE.

(J. R.)

BITUMINOUS COAL: *see* COAL AND COAL MINING.

BITURIGES, a Celtic tribe that about 600 B.C. was the most powerful in Gaul. By the middle of the 1st century B.C. they were divided into two groups: the Cubi, clients of the Aedui with a capital at Avaricum (Bourges), in the region later known as Berry; and the Vivisci, west of the Gironde estuary. Against the advice of Vercingetorix, the Cubi insisted on defending Avaricum in the Gallic revolt of 52 B.C., with the result that Julius Caesar stormed the town, captured large stores and massacred the inhabitants. The Cubi were included with Aquitania under Augustus (about 27 B.C.) and became a *civitas libera* ("free state"). They developed both iron mining and the manufacture of linen. The Vivisci, also a free state, possessed the great port of Burdigala (Bordeaux), and the vineyards behind it were already in production in Roman times.

See T. Rice Holmes, *Caesar's Conquest of Gaul,* 2nd ed. (1911).

(G. E. F. C.)

BITZIUS, ALBERT (1797–1854), Swiss pastor and novelist, better known by his pseudonym JEREMIAS GOTTHELF, was an outstanding narrative writer. Born at Morat, Fribourg, Oct. 4, 1797, he came of an old Bernese family and was the son of a pastor. During his school days and later as a theological student at Berne and Göttingen he held liberal views and subsequently took part in the political activities which brought to an end the rule of the aristocracy in Berne. After becoming pastor of Lützelflüh, Emmental, in 1832, he made great efforts to enlighten the country people and tried to bring about universal education. He also founded an institution for the neglected.

When radical tendencies began to appear in Swiss liberalism Bitzius became more conservative. His desire to preserve Christian beliefs in a world threatened by materialism stimulated him to begin writing. His *Der Bauernspiegel* (1837) was followed by other works dealing with country people, including *Leiden und Freuden eines Schulmeisters* (2 vol., 1838; Eng. trans., *The Joys and Sufferings of a Schoolmaster,* 1864), *Die Armennot* (1840) and *Uli der Knecht* (1841; Eng. trans. *Ulric the Farm Servant,* 1888). Although his purpose was didactic, he showed exceptional literary talent. His 13 novels and more than 50 shorter stories reveal not only his genius as an epic writer and poetic gifts but also his intense interest in people. Psychological observation, imagination and creative power of language enabled him to achieve vivid portraits. His material was drawn from the world of the Bernese country people. Bitzius believed that the constructive forces of mankind were to be found in an undogmatic Christianity centred in family and community life. He died at Lützelflüh, Oct. 22, 1854.

The complete works of Bitzius, in 24 volumes, were edited by R. Hunziker and H. Bloesch, with supplementary volumes of letters, sermons, political writings and *juvenilia* (1911–).

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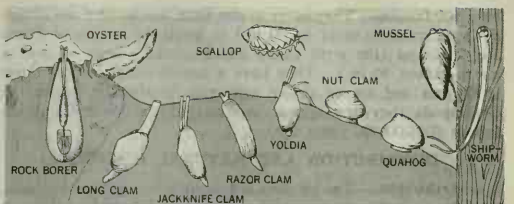
BIVALVE, a common name for certain molluscan shellfish, such as the oyster, mussel, scallop, clam, etc., that have a calcareous shell composed of two hinged pieces (valves). Scientifically, bivalves comprise the class Lamellibranchia, or Pelecypoda, the former term referring to the thin, platelike gills and the latter to the hatchetlike foot of some of these aquatic invertebrates; the term Bivalvia is also used for the class.



FROM T. I. STORER AND R. L. USINGER, "GENERAL ZOOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1957)

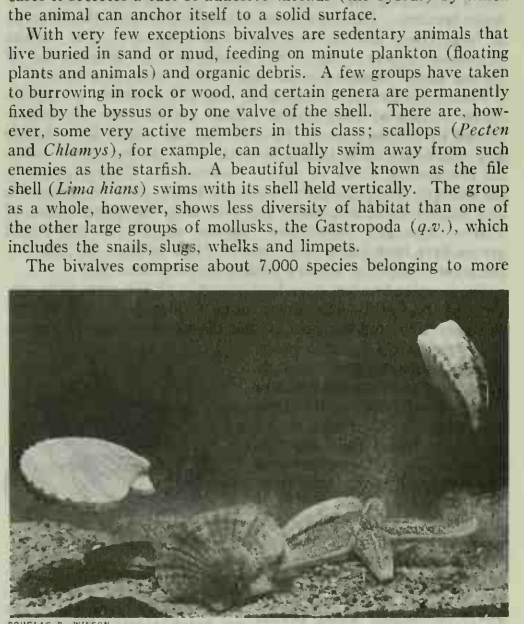
FIG. 1.—MARINE BIVALVES IN THEIR CHARACTERISTIC HABITATS. ROCK BORER (PHOLAS); OYSTER (OSTREA); LONG CLAM (MYA); JACKKNIFE CLAM (TAGELUS); RAZOR CLAM (ENSIS); YOLDIA; SCALLOP (PECTEN); NUT CLAM (NUCULA); QUAHOG (VENUS); MUSSEL (MYTILUS); SHIPWORM (TEREDO)

The majority of the bivalves live in the sea, but a few families of the group have penetrated into brackish and fresh water; some, such as the fingernail clams (Sphaeriidae), can tolerate conditions in woods pools that dry up for periods of the year.

Bivalves are internally and externally symmetrical and are distinguished from other mollusks by the possession of a shell formed in two equal, or nearly equal, valves that are joined by a tough, cuticular ligament and, in most cases, also by a system of interlocking teeth. They are further distinguished by the rudimentary development of the head and the presence of two symmetrical gills. Aside from their normal respiratory function, the gills are used in feeding and in reproduction (they often serve to house and provide oxygen for the developing eggs). The foot is usually well developed and modified for burrowing in sand and mud; in many cases it secretes a tuft of adhesive threads (the byssus) by which the animal can anchor itself to a solid surface.

With very few exceptions bivalves are sedentary animals that live buried in sand or mud, feeding on minute plankton (floating plants and animals) and organic debris. A few groups have taken to burrowing in rock or wood, and certain genera are permanently fixed by the byssus or by one valve of the shell. There are, however, some very active members in this class; scallops (*Pecten* and *Chlamys*), for example, can actually swim away from such enemies as the starfish. A beautiful bivalve known as the file shell (*Lima hians*) swims with its shell held vertically. The group as a whole, however, shows less diversity of habitat than one of the other large groups of mollusks, the Gastropoda (*q.v.*), which includes the snails, slugs, whelks and limpets.

The bivalves comprise about 7,000 species belonging to more



DOUGLAS P. WILSON

FIG. 2.—QUEEN SCALLOPS (CHLAMYS OPERCULARIS) SWIMMING AWAY FROM PREDATORY STARFISH

than 100 families. They range in size from species of *Condylocardia* a millimetre (about 4/100 in.) in length to species of *Pinna* and *Tridacna* (the giant clam) which attain lengths of over a metre (about 40 in.). They have a considerable vertical range in the sea and are of almost universal distribution. Like the Gastropoda they first appear in strata of the lower Cambrian (about 500,000,000 years ago).

DISTRIBUTION AND NATURAL HISTORY

Distribution.—The bivalves are essentially a group of aquatic animals; no authentic record of a permanent terrestrial habitat is known among them. As mentioned above many fingernail clams are occasionally found out of the water; they may survive in soil for as long as several months. This habit, which also occurs among other tropical fresh-water bivalves, appears to be a fortuitous adaptation to the drying up of the temporary ponds and woods pools in which the mollusk lives.

"LIFE" PHOTO BY FRITZ GORO

FIG. 3.—GIANT CLAM (TRIDACNA), SPECIMENS OF WHICH MAY WEIGH OVER 500 LB., WEDGED IN CORAL OF GREAT BARRIER REEF, AUSTRALIA

The majority of bivalves live in the sea, and the subgroups Protobranchia and the specialized Septibranchia are almost exclusively marine in distribution. Among the Filibranchia, *Scaphula* lives in the rivers of India, and among the Eulamellibranchia the Unioniacea, Sphaeriacea and a few isolated genera such as the aloidid *Erodona* and the mytilid *Sinomytilus* are inhabitants of fresh water. The Unionidae, which are a large family of fresh-water mussels, are most plentiful in North America and have a very extensive range there.

There are, in addition, a certain number of forms that constitute a population intermediate between the truly marine and fresh-water bivalves. These are found in brackish water in the estuaries of large rivers and in tidal ditches and lagoons. The cockles (*Cardium*) appear to thrive in a salinity midway between that of the sea and of fresh water and are usually found in estuaries.

Marine bivalves are found in all seas and at almost all depths. As in the case of other marine animals certain areas are characterized by certain genera. For example, the clams *Mya*, *Yoldia* and *Astarte* are found largely in arctic seas. As regards the vertical distribution, *Solen* (a clam), *Cardium* and *Ostrea* (oysters), for example, live principally in shallow water. The Septibranchia as a whole inhabit deep water and with them are found species of *Pecten*, *Abra* and *Callocardia*. Species of the two last-named genera have been found at a depth of 2,900 fathoms (17,400 ft.), the greatest depth at which a bivalve has been recorded.

Fresh-water bivalves have been found in all the great river systems of the world. The larger forms (Unionidae) tend to keep to rivers, lakes and large ponds; but the smaller forms (*Pisidium*, *Sphaerium*, etc.) occur in pools, ditches, streams and marshes. The dispersal of marine bivalves is mainly effected in the free-swimming larval stage during which the larvae drift about in currents. Such fresh-water forms as are parasitic in the larval stage (Unionidae) no doubt owe their dispersal to the fish on which they live. Although it is doubtful that fresh-water mussels are carried from one river or lake to another by birds (H. van der Schalie, 1945), birds and water beetles may carry clams such as *Sphaerium* and *Pisidium*, which have been found clinging by their valves to the legs of those animals (*see* fig. 4).

FROM W. S. W. KEW, "DISPERSAL OF SHELLS" (KEGAN PAUL, TRENCH TRUBNER & CO., LTD.)

FIG. 4.—FINGERNAIL CLAM (SPHAERIUM CORNEUM) ATTACHED TO LEG OF WATER BEETLE, ILLUSTRATING ONE WAY BY WHICH THESE CLAMS ARE DISTRIBUTED

RALPH BUCHSBAUM

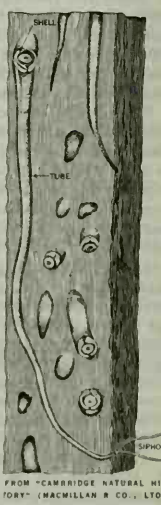
FIG. 5.—RAZOR CLAM (SILIQUA PATULA) OF THE AMERICAN PACIFIC COAST, WITH SIPHONS EXTENDED

The habitats of the individual species of a genus tend either to be more or less distinct or to overlap to some extent. However, we are far from knowing with certainty to what extent the individual members of a species occupy identical habitats over the whole of their range.

Habits, Food, etc.—C. M. Yonge defined the habits of the Lamellibranchia as follows:

> The bivalve molluscs are primitively inhabitants of soft substrata and we shall find them in varied and rich abundance in sand and mud. The broad foot of the snail is an admirable organ for slow progression over a rocky surface or for attachment to this. The laterally flattened foot of a bivalve is as well fitted for movement through sand or mud but not for gripping a hard surface. Hence those bivalves that live between tide marks on rocky shores are attached in other ways, either by cementation as in oysters, or, more usually, by means of tough threads which constitute the *byssus*. In the former case the animal is incapable of movement, but not necessarily in the latter where the foot is not lost although it may be reduced. (C. M. Yonge, *The Sea Shore*, p. 132, William Collins Sons & Co., Ltd., London [1949].)

Most burrowing forms keep within a few inches or less of the surface, the distance to which they burrow being largely determined by the lengths of the siphons, for, as a rule, the openings of both the dorsal (excurrent or exhalant) and ventral (incurrent or inhalant) siphons are kept more or less at the surface. Thus the soft-shelled clam *Mya arenaria*, which has rather long siphons, lives about six or eight inches below the surface. F. Weymouth states that the pismo clam (*Tivela stultorum*) of California usually lies with the hinge line directed toward the oncoming surf and the open edge of the valves toward land. Forms that cannot readily orientate themselves in the unstable bottom of the open beach are found in situations where the substratum is more solid and they can form a semi-permanent burrow. Such conditions are realized in the quieter reaches of slow estuaries or in deep bays where the mud is less liable to disturbance. It is here that *Mya*, *Scrobicularia*, *Cardium* and *Macoma* are found in the northern hemisphere.



FROM "CAMBRIDGE NATURAL HISTORY" (MACMILLAN & CO., LTD.)

FIG. 6.—SHIPWORMS (TEREDO NAVALIS) SHOWN IN PASSAGES THAT THEY BORE IN TIMBER

There are a good many bivalves that burrow into hard substrates and become adapted to this existence. *Pholas*, *Lithodomus*, *Saxicava* and *Clavagella* live in holes formed either by the chemical action of acid secretions or by the mechanical action of the shell. In certain places on the southern coast of England the flat slabs of chalk debris at the foot of cliffs are riddled by the holes made by the rock borer *Pholas*. *Teredo* and *Xylotrya*, worm-like clams called shipworms, burrow in submerged timber in which they excavate long passages; such wood may often be honeycombed with these holes. (*See* TEREDO.)

Bivalves live almost exclusively upon

plankton and particles of organic debris that float in the water. The mode of feeding characteristic of this group is described below under *Digestive System.* It is probable that the larger proportion of the food is vegetable matter, but minute animals and the eggs and larvae of larger forms occurring in the plankton are also eaten. Yonge found that the stomach contents of clams of the genus *Mya* may contain diatoms, Foraminifera, minute (probably larval) bivalves and ostracods and other small Crustacea, spores and eggs of various kinds, sponge spicules and a large mass of small sand grains. There may also be fragments of organic debris; *e.g.,* strips of algae.

The Septibranchia are usually regarded as carnivores. Living at great depths from which plants are normally excluded by the absence of sunlight, the septibranchs obviously cannot obtain living plant tissue for food. The great modification of their gills deprives them of the apparatus for fine sorting found in other classes of bivalves. Furthermore their intestine is very short and of a carnivorous type. As a matter of fact, they must subsist very largely on animal plankton and coarse particles of animal carrion, though in all probability a good deal of vegetable debris finds its way at least into the less profound depths of the oceanic abyss. Among those bivalves that bore into the solid material the shipworm has been shown to be practically independent of plankton for food and to live upon the wood into which it bores.

The chief defenses of bivalves against their enemies are the valves of the shell and the burrowing habit. Without these adaptations such slow-moving animals with no weapons of active defense would be entirely at the mercy of more aggressive enemies. As it is, bivalves are preyed upon by a great variety of animals, some of which rely almost entirely on them for food and have developed special modes of attack. Various whelks drill holes through the valves by means of an acid secretion and the filelike radula and by the aid of the extensible proboscis feed on the soft animal inside. *Scaphander* and other Gastropoda, which have gizzards armed with masticatory plates, swallow small bivalves whole and crunch them up in the gizzard. Birds, fish and other aquatic animals deal with them in the same way. Walruses feed on clams of various kinds which they are said to dig up with their tusks.

Fishery investigations have emphasized the importance of bivalves as an element in the food of edible fishes. The work of F. M. Davis (1923) in England on the bottom fauna of the Dogger Bank, where the small clams *Spisula subtruncata* and *Mactra stultorum* exceed in number all other large invertebrate animals of the sea bottom, shows how in a particular area the bivalves are the most important constituent of the food. Davis has shown that *Spisula subtruncata* occupies rather local patches on the south end of the Dogger Bank. These are of vast extent and dense population.

It is stated that certain carnivorous Gastropoda use the spines of teeth situated on the shell opening for forcing apart the valves of lamellibranchs. Thus a species of *Murex* is said to grasp the clam *Arca* with its foot and to drive one of its spines between the valves of the clam. *Sycotypus* is said to use the edge of its own shell for this purpose.

Bivalves are often exposed to other dangers. The special risks run by forms living in sand on open coasts are apparent. Freshwater forms in most areas are regularly exposed to the dangers of low or high temperature. In some cases the water in which they live may freeze, or may be dried up by excessive heat. Bivalves may meet these dangers by drastically reducing all activities, that is, by hibernating (in cold climates) or estivating (in warm, dry climates). The bivalves are probably as tenacious of life as the Gastropoda although less is known concerning them in this respect. An Australian pond mussel is recorded as having lived for nearly 500 days out of water.

Commensalism, or the food-sharing association of one nonparasitic animal with another, is of rather common occurrence among bivalves. *Lepton squamosum* lives thus in the burrows of Crustacea and marine worms. *Jousseaumiella* inhabits the chamber of wormlike sipunculids, and species of *Montacuta* and *Scioberetia* live attached to echinoderms (starfish and their allies). Other bivalves are more closely embedded in the test (cuticular outer coverings) of sea squirts (ascidians); *Modiolus* is found in the tissues of sponges; *Entovalva* is parasitic in *Synapta,* an echinoderm.

The age to which these animals live varies considerably. The mussel *Mytilus* and the cockle *Cardium* may attain their full size in a year, the common oyster in five years. The oyster is said to live as long as ten years under cultivated conditions. The giant clam (*Tridacna gigas*) lives for eight years (probably a very low estimate). The swan mussel (*Anodonta*) is recorded as attaining an age of 20 to 30 years, and Weymouth has calculated that the pismo clam (*Tivela stultorum*) lives as long as 26 years. The European fresh-water mussel *Margaritana* (or *Unio*) *margaritifera,* which lives in soft waters, is estimated to live 60 to 100 years.

ECONOMIC IMPORTANCE

Like the gastropods, among other mollusks, the bivalves have supplied man with food since a very early stage in his evolution. Oysters, cockles, mussels and clams have been found in large quantities in Paleolithic and Neolithic kitchen middens in Europe and elsewhere. The oyster was cultivated during the time of the Roman republic, the celebrated beds in the Lucrine lake being established about 100 B.C. During the Roman empire British oysters, which were very much in favour, were brought from Rutupiae (modern Richborough), where there apparently was a fishery. At the present time oysters are cultivated in many countries (*see* J. H. Orton, *Oyster Biology and Oyster Culture,* 1937).

The cockle, scallop and mussel are caught for human consumption mainly in European countries, and a variety of other forms (including those of fresh water) are eaten in most parts of the world. In the Gulf of Naples, *Psammobia, Solen* and *Donax* are fished for the market. The importance of bivalves as food for edible fishes has already been discussed.

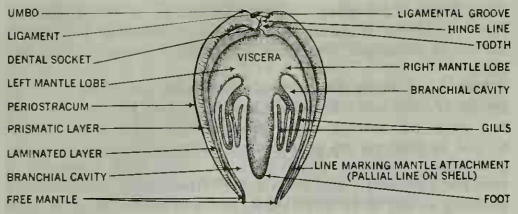
The shells of certain genera are regularly cultivated for mother-of-pearl, which is used for inlaying and for various kinds of ornaments, knife handles, buttons, etc. The oriental pearl oyster, *Meleagrina* (or *Pinctada*) *margaritifera,* is fished for mother-of-pearl and for the occasional pearls obtained from it. The most important pearl fisheries are in Ceylon, Australia and Japan. In Japan pearls are also produced artificially in the pearl oyster by a grafting operation (*see* PEARL). From Roman times onward the pearls of the European fresh-water mussel, *Margaritana* (or *Unio*) *margaritifera,* were sought especially in Scotland, although this industry no longer exists. The large river mussels (Unionidae) of the United States were largely cultivated in connection with button making.

Shell money is made from clams in various parts of the world and the "wampum" of the eastern North American Indians consisted largely of beads made from the shell of *Venus* (or *Mercenaria*) *mercenaria.* In southern India and parts of China the "window-pane oyster," *Placuna placenta,* is still used for glazing the windows of houses. The byssus of a large species of *Pinna* was at one time used as a substitute for silk in southern Italy.

Bivalves have also proved themselves obnoxious to man in two ways: (1) In the past the cultivation of oysters and cockles in unsanitary situations near sewage outfalls has led to serious epidemics of typhoid fever, although better cultivation has practically eliminated this danger in England and the United States. (2) The shipworm *Teredo* and its allies have been from time immemorial a source of considerable loss through their destruction of the timber of ships, piers, jetties, etc.

ANATOMY AND PHYSIOLOGY

General Body Form.—The body of a bivalve is divisible into three main areas—the visceral mass, the mantle and the foot (fig. 7). There is no specially differentiated head such as is found in other mollusks. The animal is bilaterally symmetrical; the main axis is occupied by the visceral mass and the valves of the shell enclose the animal on the sides. The mouth is situated at the anterior end of the visceral mass and, though it is provided with lips that are generally continued on each side as lobes (labial



FROM R. SHROCK AND W. TWENHOFEL, "PRINCIPLES OF INVERTEBRATE PALEONTOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1953)

FIG. 7.—SECTION THROUGH A REPRESENTATIVE BIVALVE, SHOWING GENERAL BODY PLAN AND RELATION OF SHELLS TO VISCERA

palps), they are not marked off from the rest of the body. Except in *Nucula* and *Poromya,* the mouth is not furnished with sense organs and tentacles.

The visceral mass is covered over by a fleshy sheath, the mantle, which hangs down on either side like the skirt of a coat. The area lying between the mantle and the visceral mass is the mantle cavity. The foot projects as a highly muscular prominence from the underside of the visceral mass.

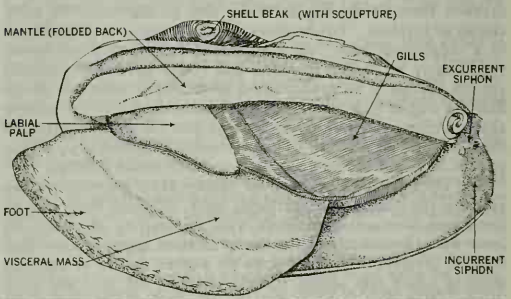
The mantle (and its derivatives) is in a sense the most important feature of bivalve organization, and as such its role is comparable with that of the mantle of the squid, cuttlefish and other decapod Cephalopoda (*q.v.*). Not only does the mantle secrete the shell, but it also forms its edges into inhalant and exhalant siphons; the gills are mantle derivatives that perform respiratory, nutritional and incubatory functions.

The shell first appears in the embryo as a single structure, the prodissoconch. In the course of subsequent development two separate calcified plates are secreted by the right and left areas of the shell gland. With very few exceptions these valves are joined together by a series of interlocking teeth that project from the inner dorsal border of the valves (hinge line) (*see* fig. 8).

The arrangement, shape and development of these teeth are variously differentiated and afford a basis of classification. The two valves are also fastened by an elastic ligament that is a persistent rudiment of the larval shell. The action of the ligament is to pull the top edges of the two valves together so that the lower edges gape and expose the animal within.

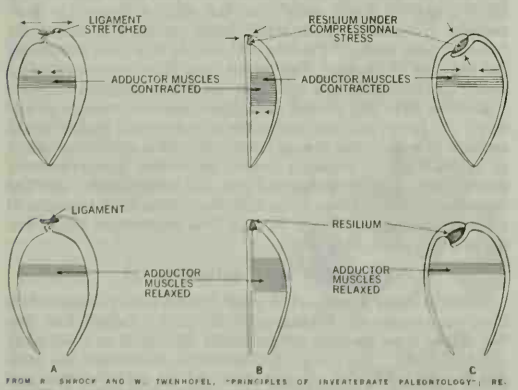
The gaping of the valves is counteracted and the valves closed by the contraction of strong adductor muscles. These muscles, which are usually two in number (anterior and posterior adductors), are developed from the mantle. Their fibres are disposed transversely to the main axis of the body, and they join the mantle lobes to the valves on either side, leaving scars on the inner shell where these muscles attach. As long as the valves are closed, the muscles are in a state of tonus; when the muscles relax the valves are separated by the resiliency of the ligament along the hinge. At times the anterior adductor is reduced in size or may disappear entirely in the adult. In such cases the posterior adductor then enlarges and becomes more central to produce shell forms known as monomyarian (the shell of *Pecten,* for example).

The shell varies quite considerably in shape. In some genera the two valves are somewhat unequal in size and of a different shape (*Pecten, Ostrea*), and some forms are permanently fixed on the sea bottom by the adhesion of one valve (*Chama, Spondylus*). In certain species of *Pinna, Anodonta,* etc., the valves are fused along the hinge line. In *Ensis* and *Siliqua* the shell is long and tubular; in *Brechites* and *Teredo* it is reduced to a rudiment.



(ABOVE) BY COURTESY OF HENRY VAN DER SCHALIE; (BELOW) LYNWOOD M. CHACE FROM NATIONAL AUDUBON SOCIETY

FIG. 9.—FRESH-WATER MUSSEL (ANODONTA): (ABOVE) WITH ONE VALVE REMOVED TO SHOW INTERNAL MORPHOLOGY; (BELOW) LIVING ANIMAL WITH FOOT EXTENDED FOR LOCOMOTION



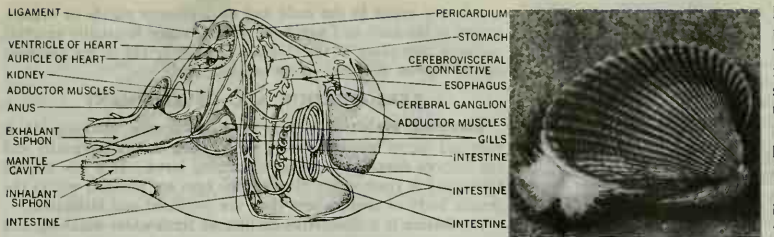
FROM R. SHROCK AND W. TWENHOFEL, "PRINCIPLES OF INVERTEBRATE PALEONTOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1953)

FIG. 8.—DIAGRAM SHOWING (TOP) THE CLOSING AND (BOTTOM) OPENING OF VALVES IN (A) QUAHOG (VENUS); (B) SCALLOP (PECTEN); (C) LONG CLAM (MYA)

A variety of ornamentation is formed by the interruption of the growth lines of the shell by ribs radiating from the umbo (apex of the dorsal border) and by development of spines and scales. As in the Gastropoda the mantle may become reflected over the surface of the shell (Galeommatidae) and finally in *Scioberetia* and a few other genera it completely covers the shell.

The mantle hangs down on either side of the visceral mass as two loose folds. In the most primitive bivalves the ventral edges of the folds are entirely free and unattached (*Nucula, Arca,* etc.); in all other members of the class the two lobes of the mantle are united with each other at one or more points below the ventral surface of the visceral mass.

In a large number of the latter group of bivalves there is one junction only, at the posterior end of the animal, and it forms an opening adjacent to the anus. This is known as the exhalant opening and serves for the passage of feces and stale water from the mantle cavity to the exterior. Among a second large group of families there is a second junction close to the first, forming a median inhalant opening through which water is drawn into the mantle cavity. Three openings are thus formed in the mantle edge: the posterior exhalant opening; a median inhalant opening; and the remaining larger anterior pedal opening from which the foot projects. A fourth opening is produced in certain species of



(LEFT) FROM J. JOHNSTONE IN "LIVERPOOL MARINE BIOLOGICAL COMMITTEE MEMOIR" (UNIVERSITY PRESS OF LIVERPOOL); (RIGHT) RALPH BUCHSBAUM

FIG. 10.—COCKLE (CARDIUM): (LEFT) SECTION SHOWING INTERNAL ANATOMY; (RIGHT) LIVING ANIMAL WITH VALVES CLOSED AND SIPHONS EXTENDED

the family Solenidae by a third fusion of the mantle edges. The exhalant and inhalant openings are in many genera prolonged as tubes, or siphons. The elongate siphons characteristic of burrowing forms enable the mollusk, when burrowing below the surface, to maintain communication with the water upon which it depends for food and oxygen and for elimination of its waste products. Forms like *Cumingia*, *Pholas*, *Psammobia* and *Mactra* have very long siphons, two or three times as long as the shell. In *Teredo* the siphons, which form the larger part of the total bulk, secrete a calcareous tube.

The gills, which are an even more distinctive feature of bivalve organization, are described below.

The foot is usually very muscular and in some primitive forms (*Yoldia*, *Solemya*) among the Protobranchia it has a flat sole which allows a creeping mode of locomotion. This flat type of foot, is, however, of rare occurrence, and in *Nucula* (an otherwise primitively organized protobranch) K. Hirasaka has shown that the foot is, as in most other bivalves, a burrowing organ. The foot of certain more specialized genera, *e.g.*, *Lepton* and species of *Erycina*, has a creeping surface. Usually, however, it is laterally compressed and its lower edge is keeled so that the whole foot is somewhat like the blade of a hatchet.

In the middle line of the surface of the foot is an opening corresponding to the ventral pedal pore of the Gastropoda. This leads into a cavity in which is secreted, in the form of long bristles or hairs, a substance called conchiolin, which constitutes the organic matrix in the shell. This mass of conchiolin is gradually pushed to the exterior, where it hardens on contact with water and serves to attach the animal to rocks, stones and masses of sand. This anchoring structure, the byssus, is of considerable importance to forms that live on open beaches. It is imperfectly developed in the Protobranchia and is large and highly efficient in *Anomia* (in which it is calcified and passes through a hole in the right valve), *Arca*, *Mytilus*, etc.

Digestive System.—The mouth has already been described. It leads through a short esophagus directly into the stomach. Only in the Nuculidae (Protobranchia) is there any special expansion of a pharyngeal nature. In the embryo of *Cardium*, S. Lovén observed a small protuberance in the stomodaeal wall that may be a vestige of a radular caecum. This observation has never been recorded in other bivalves, and in no adult representative of this class is there a radula (the rasping tongue characteristic of the rest of the Mollusca).

The stomach is thin walled and lined with a hard cuticle. It has a well-marked pyloric caecum that in some forms communicates with the initial part of the intestine by a longitudinal slit, as in certain Gastropoda. This caecum secretes the crystalline style, a gelatinous rod that contains a digestive enzyme.

The physiological action of the style has been studied by several workers. In *Mya* C. M. Yonge shows that it secretes enzymes that digest starch and glycogen. A cellulose-splitting function is recognized in some species.

The liver is bilobed and usually communicates with the stomach by several openings. It contains, in *Mya*, amylolytic, proteolytic and lipolytic enzymes and is the principal organ of digestion. It seems also to have an absorptive function. The intestine, usually long and provided with a longitudinal fold, the typhlosole, traverses the ventricle of the heart in most cases, but in *Nucula* and some Filibranchia it passes below the ventricle.

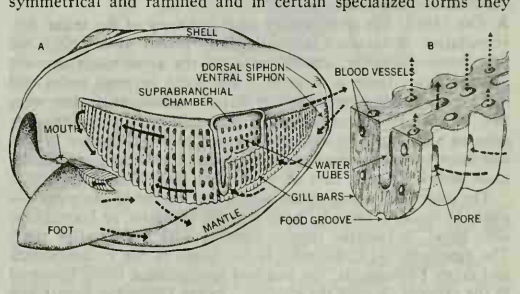
Tracts of cilia on the gills and palps are an important adjunct to the digestive system. By their beating, the cilia sort out food particles drawn into the mantle cavity when water is taken in and drive them toward the palps from which they are passed to the mouth. The intricacy of the ciliary mechanism in sorting and straining food has been shown in studies by Yonge, J. H. Orton, D. Atkins and others.

Circulatory System.—The blood in many bivalves is colourless, but the red pigment hemoglobin is found in several forms that live in sand and mud (Arcidae, *Solen*, etc.) and the blue hemocyanin in some others (species of *Venus* and *Cardium*). The blood is contained in vessels that are usually capacious cavities (sinuses). The heart, situated dorsally, consists of a median ventricle, lying within the pericardial cavity, and two lateral auricles. In most bivalves there are two aortae (anterior and posterior) which carry the blood to the tissues via smaller vessels. The blood, ultimately collected in certain large sinuses, then passes to the gills, where it is oxygenated. After oxygenation it is carried from the gills to the auricles of the heart. As J. E. Morton indicates, the blood in bivalves serves also as a "fluid skeleton" which, with muscular action, changes the shape of the animal, thus aiding in various methods of locomotion.

Gills.—There are two gills in all bivalves except the Septibranchia, and they are situated one on either side of the body as prolongations from the upper surface of the mantle cavity. Each gill is, in its primitive form, comparable with those of other mollusks in that it is composed of a central vascular axis carrying on its opposite sides a series of filaments. From this simple, featherlike structure, found in the Protobranchia, are evolved a number of types of gills that show progressive complexity and remarkable divergences.

The role of the gills in providing an incubatory chamber is discussed in *Breeding Habits* below.

Coelom and Excretory Organs.—In the Protobranchia, in which the primitive connection between the pericardial cavity and the gonadal coelom is retained, the reproductive organs open into the renopericardial canals. In the Filibranchia, such as *Pecten*, the generative ducts open into the kidneys, and in the Eulamellibranchia they have separate openings. The kidneys are symmetrical and ramified and in certain specialized forms they

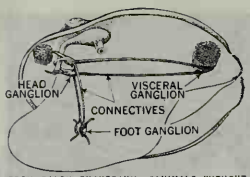


FROM T. I. STORER AND R. L. USINGER, "GENERAL ZOOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1957)

FIG. 11.—GILL STRUCTURE OF FRESH-WATER MUSSEL (FAMILY UNIONIDAE): (LEFT) WITH OUTER HALF OF GILL PARTLY CUT AWAY TO SHOW INTERNAL STRUCTURE, (RIGHT) SECTION OF GILL ENLARGED

communicate with each other. The excretion of hippuric acid is carried out by the pericardial glands.

Most marine bivalves are unable to osmoregulate, that is, regulate the flow of water to and from tissues, at lower salinities; in order to prevent excessive loss of salts they therefore remain tightly closed during such unfavourable periods.



FROM RALPH BUCHSBAUM, "ANIMALS WITHOUT BACKBONES," THE UNIVERSITY OF CHICAGO PRESS. COPYRIGHT 1948 BY THE UNIVERSITY OF CHICAGO

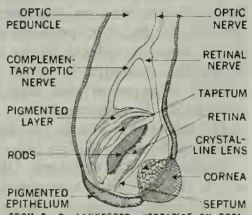
FIG. 12.—GENERALIZED NERVOUS SYSTEM OF A CLAM

Nervous System.—The nervous system consists of pairs of ganglia (connected by commissures), nerve cords and sense organs. With one exception the ganglia are separate from each other; the general fusion of the nervous system, a condition present in Gastropoda and Cephalopoda, is not found.

In the Protobranchia the pleural, cerebral, pedal and visceral ganglia are all distinct. In all other bivalves the cerebral and pleural ganglia are fused and the pedal ganglia are close together. The visceral commissure is always long. The visceral ganglia are usually placed on the surface of the posterior adductor muscle and in most Eulamellibranchia are more or less attached to each other. There is no stomatogastric system such as is found in the Gastropoda, the alimentary canal being innervated from the visceral commissure.

Sense organs consist of eyes, statocysts (balance organs), osphradia (taste and smell indicators) and tactile organs. In a very few genera are eyes found in the head region (*e.g.*, in the Mytilidae); they are, however, found on the siphons and the edge of the mantle. In their simplest form the eyes are merely pigment spots. In certain groups they are more complex; in *Pecten* and *Spondylus* they attain maximum complexity, consisting of a cornea, conjunctiva, lens, retina, deep pigment layer and tapetum.

The optic nerve divides into two branches just below the optic cup and one branch passes around the latter to enter the retina. The extremities of the retinal cells (rods) are turned toward the interior of the optic globe (*i.e.*, away from the direction in which the light rays enter the eye).



FROM E. R. LANKESTER, "TREATISE ON ZOOLOGY" (A. & C. BLACK, LTD.)

FIG. 13.—SECTION THROUGH THE PALLIAL EYE OF A SCALLOP (PECTEN)

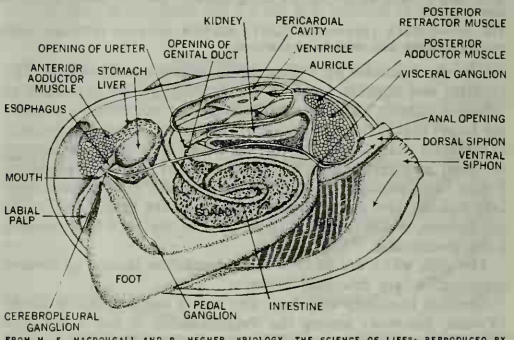
Reproductive Organs.—The sexes are usually separate, but some groups are hermaphroditic, or bisexual, *e.g.*, *Poromya, Kellya* and the parasitic genera, as well as individual species of *Ostrea, Cardium* and the Cyrenidae. W. R. Coe (1943) has given a very good summary of the sexual differentiation in bivalves in which many grades of sexuality are described. However, among some of the fresh-water mussels (Lampsilinae) there is so great a difference between males and females that they were named as distinct species when they were first described. Generally sexual dimorphism is very little developed and is usually evident only as a slight difference of size and shape between males and females. In *Astarte* the border of the male shell is smooth, that of the female shell is undulating.

The reproductive organs are simple and consist of the gonads—ovary in females, testis in males and the ovotestis, or hermaphroditic gland, in bisexual forms—together with a generative duct. The generative duct, however, is not found in the Protobranchia and many Filibranchia, the ova and spermatozoa being liberated to the exterior through the kidneys. In the Lucinidae, *Ostrea* and *Sphaerium* the gonads and kidneys open into a common cloaca. In some bivalves the gonads open to the exterior by a genital duct, which is situated either together with the renal duct on a common papilla or in close proximity to the renal duct. In certain hermaphroditic forms the ovary and testis are completely separate from each other and open by separate ducts. There is no copulatory organ in the male and no accessory glands or organs, except in the male of *Cuspidaria*. Fertilization is usually external but may take place in the cloacal chamber or (as in the common oyster, *Ostrea vulgaris*) in the oviduct itself.

REPRODUCTION AND DEVELOPMENT

Breeding Habits.—Marine bivalves usually discharge their eggs and sperm into the water; fertilization occurs externally and the embryo develops as a free-swimming larva. In a few marine forms and in fresh-water bivalves the eggs are retained within the female body or shell, where they are fertilized and incubated.

Incubation is a distinctive feature of fresh-water bivalves, and



FROM M. S. MACDOUGALL AND R. HEGNER, "BIOLOGY, THE SCIENCE OF LIFE"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1943)

FIG. 14.—INTERNAL ANATOMY OF A FRESH-WATER MUSSEL (FAMILY UNIONIDAE)

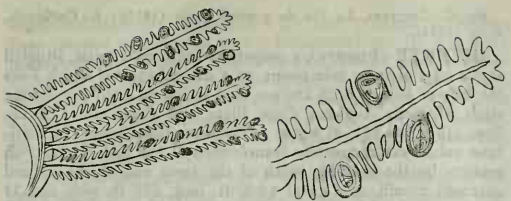
attains a far greater development in this class than in any other molluscan group. In incubatory forms the eggs are retained after fertilization usually in the spaces between the gill lamellae, which are often modified to serve as brood chambers (Unionidae and Sphaeriidae). It has been observed that the embryos eat the epithelial cells of the maternal gills during incubation. In certain species of *Ostrea* the embryos are incubated in the mantle cavity outside the gills. There is not much doubt but that marine bivalves that live in cold seas are more likely to adopt some form of incubation than those inhabiting warm or temperate seas.

Development.—The development of a bivalve is best known from J. Meisenheimer's study of the fresh-water mussel *Dreissena polymorpha*. With two important exceptions (Protobranchia and Unionidae) the course of development in such other forms as have been studied is more or less similar. In *Dreissena* the first two cleavage divisions produce four cells called macromeres of which one is very much larger than the rest. Successive divisions of the macromeres yield "quartettes" of smaller cells called micromeres; the micromeres continue to divide until they form a cap overlying the macromeres. This type of cleavage is spiral, like that found in Gastropoda, but the radial symmetry resulting from cleavage is modified very early in development.

The mass of cells thus formed gives rise to a free-swimming embryo that has now assumed the characteristic form of the molluscan larva known as the trochophore. Among mollusks the trochophore usually develops a special swimming organ, the velum, consisting of a band of heavily ciliated tissue; hence the name veliger for the later stage of the trochophore larva. Most marine mollusks produce such a free-swimming veliger larva, but of the fresh-water forms *Dreissena* is the only one known to have a free-swimming veliger.

During the veliger stage the nervous system, musculature, statocysts, gills and foot of the adult are laid down. The larva rapidly changes into the adult. The cells of the velum are cast off, the larval musculature disintegrates and the area of the larval mouth shrinks to the proportion characteristic of the adult.

One of the most notable modifications of this developmental



FROM KORSCHELT, ON "PERLEN" IN "FORTSCHITTE DER NATURWISSENSCHAFTLICHEN FORSCHUNG" (URBAN & SCHWARZENBERG)

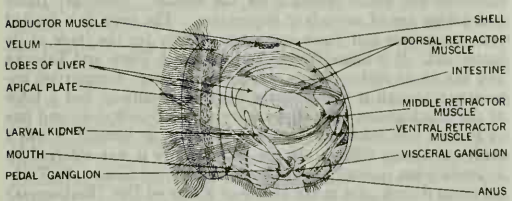
FIG. 15.—(LEFT) GLOCHIDIA, BEFORE RELEASE FROM THE PARENT, DEVELOPING ON GILL FILAMENTS OF FRESH-WATER MUSSEL (MARGARITANA); (RIGHT) GILL FILAMENT AND GLOCHIDIA GREATLY ENLARGED

history occurs in the Protobranchia in which the veliger has a disproportionately large velum consisting of rows of large ciliated cells giving the larva a barrel-shaped appearance.

The development of the Unionidae is remarkable in that part of the embryonic life is parasitic. After incubation in the brood chambers the embryos, which have developed into special larvae known as glochidia (sing. glochidium), are ejected into the water. Each glochidium has a minute bivalved shell that may be furnished with teeth or hooks. If the glochidium comes into contact with a specific fish, it may succeed in fixing itself to the gills or fins. Once lodged on the fish, the larva encysts and lives as a parasite in the tissues of the fish. During this phase the glochidium develops into a miniature adult and subsequently escapes from its host by the rupture of the cyst.

EVOLUTION AND PALEONTOLOGY

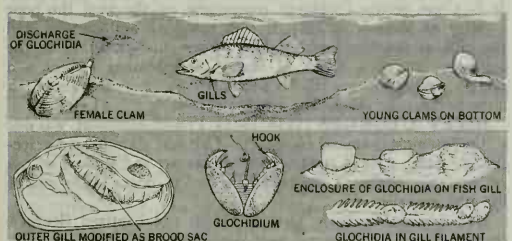
The recognition of bivalves in the oldest fossiliferous rocks is



FROM E. W. MACBRIDE, "TEXT-BOOK OF EMBRYOLOGY" (MACMILLAN & CO., LTD.)

FIG. 16.—YOUNG VELIGER LARVA OF A FRESH-WATER MUSSEL (DREISSENA POLYMORPHA)

somewhat difficult owing to their unsatisfactory preservation and the similarity of shells between certain bivalves and ostracod crustaceans. *Glyptarca*, which occurs in upper Cambrian strata, is certainly a bivalve; but the exact position of *Fordilla* and *Modioloides* (lower Cambrian), which have been referred to this class, is uncertain. In the Ordovician period, *Ctenodonta* and *Modiolopsis* are recognizable as representatives of the Protobranchia and



FROM T. I. STORER AND R. L. USINGER, "GENERAL ZOOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1957)

FIG. 17.—LIFE CYCLE OF FRESH-WATER MUSSEL, FAMILY UNIONIDAE

(Above) Three stages of the cycle: release of larvae (glochidia) from brood chambers of clam, attachment of glochidia to gills of fish, young clams after leaving host. (Below) detail enlargements of (left) clam brood chamber, (centre) glochidium with hook, (right) methods of glochidia attachment to fish

Filibranchia, but the class is not well represented at this epoch. In the Silurian, however, there is a rich bivalve fauna containing representatives of all the chief orders except the Septibranchia, and the modern Aviculidae are recognizable. In the lake beds of Devonian age (Old Red Sandstone) are found shells that resemble those of modern fresh-water mussels and are referred to the genus *Archanodon*. These forms and apparently brackish water bivalves are well developed in the Carboniferous, and a good many marine genera represented at the present time are recognizable at this period; *e.g.*, *Trigonia*, *Astarte* and *Lucina*.

A marked alteration of the class took place in Triassic and Jurassic times. Many Palaeozoic genera died out and were replaced by other genera that have persisted to the present time (*Anatina*, *Isocardia* and *Perna*). The ostreids dominated the late Mesozoic.

Reef-building forms such as *Chama*, the Rudistae and the large genus *Inoceramus* are characteristic of the Cretaceous fauna. In the Tertiary a fauna very much like that of modern times is found. The Rudistae and other secondary families have disappeared and the Anisomyaria (*Avicula*, *Pinna*, etc.) shows retrogressive tendencies. Specialized genera such as *Pholas*, *Clavagella* and *Gastrochaena* make their appearance; the evolution of the present fauna is clearly foreshadowed both in the representative genera and in the distribution of these specialized forms.

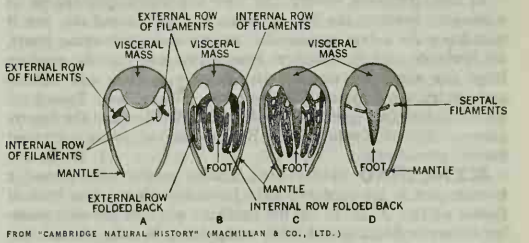
Because of the lack of well authenticated and satisfactorily preserved lamellibranch fossils in Cambrian strata, it is difficult to determine the origin of the class and the relationships of the more primitive members.

CLASSIFICATION

Some classifications have united the Lamellibranchia with the Gastropoda and Scaphopoda. This association, however, seems to exaggerate resemblances and to attach too little importance to the very marked specialization of these groups of mollusks. Specialization is apparent even in the most primitive members of the bivalves, which seems to suggest very early divergence from the rest of the Mollusca.

One of the outstanding features of the bivalves is the structural uniformity found in many of their internal and external parts. This has made it peculiarly difficult to distinguish satisfactory subdivisions of the group, and its classification has, as a result, been a source of much controversy in the past. Paleontologists and students of living mollusks have differed as to the basis upon which the main subdivisions should be established.

The main groups recognized by zoologists depend upon the struc-



FROM "CAMBRIDGE NATURAL HISTORY" (MACMILLAN & CO., LTD.)

FIG. 18.—STRUCTURE OF GILL FILAMENTS IN BIVALVES, CROSS SECTIONS (SHELLS NOT SHOWN): (A) PROTOBRANCHIA; (B) FILIBRANCHIA; (C) EULAMELLIBRANCHIA; (D) SEPTIBRANCHIA

ture of the gills. The latter are not preserved in fossil remains; thus, the paleontologist has had recourse only to the shell and its essential features, such as the hinge line and hinge teeth.

P. Pelseneer's classification (1906), which recognized five orders—Protobranchia, Filibranchia, Pseudolamellibranchia, Eulamellibranchia and Septibranchia—was based primarily upon the structure of the gills. In order to include an ecological aspect as well as a structural and paleontological one J. E. Morton (1958) adopted H. Douvillé's classification (1912) which includes: (1) a normal free-living group; (2) a sessile group; (3) a deep burrowing group. A simplified arrangement of the class follows:

LAMELLIBRANCHIA (BIVALVIA, PELECYPODA)

Subclass 1. (Filibranchia + Pseudolamellibranchia)
Order 1. Protobranchia
" 2. Taxodonta
" 3. Anisomyaria
Subclass 2. (Eulamellibranchia)
Order 1. Schizodonta
" 2. Heterodonta
" 3. Adapedonta
" 4. Anomalodesmata (including Septibranchia)

See also representative bivalves, as COCKLE; MUSSEL; OYSTER.

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(G. C. R.; H. v. D. S.)

BIWA-KO, largest fresh-water lake in Japan (area 268 sq.mi., circumference 146 mi.) located in central western Honshu in Shiga prefecture. Long (about 40 mi.) from north to south, the lake derives its name from the *biwa,* a Japanese musical instrument that its shape resembles. The lake occupies a structural depression and is fed by small rivers flowing from encircling mountains. Although mountains closely parallel the west coast, the east coast has generous alluvial plains that are expanding into the lake. A sole outlet, the Yodo river, flows from Biwa's southern tip past Seta southwest to Osaka bay. Deepest water is in the northwest corner (315 ft.), with depths of over 197 ft. common among the west coast. However, the silting east coast deepens gradually from about 33 ft. near the shore. Biwa's surface rises as much as 10 ft. in spring due to snow melt and spring rains and in the autumn from typhoon rains. Summer brings high water and winter low water.

In early Japanese history, the lake was a principal avenue of movement between the Sea of Japan and the Inland sea, but it now has only a few commercial, fishing and sight-seeing boats. Its lowlands, rich in historical associations and legends, produce large rice surpluses, support such centres as Otsu and Hikone and are traversed by the Tokaido trunk railway line. Famed for its scenic beauties, splendid temples atop Mt. Hiei and the nearby cultural city of Kyoto (*q.v.*), Biwa is one of Japan's greatest tourist attractions. (J. D. EE.)

BIXIO, NINO (1821–1873), Italian patriot who played a notable part in his country's fight for independence, was born at Genoa on Oct. 2, 1821. In his youth he went to sea and, meeting Giuseppe Mazzini and other compatriots in exile abroad, was won over to the cause of Italian unity. In the war of 1848–49 he fought first in the Sardinian army and then in Giuseppe Garibaldi's Italian legion in Rome. After spending several more years at sea, he was at Garibaldi's side again in the Alpine campaign of 1859. In the expedition to Sicily in 1860, leading a battalion, he distinguished himself in action at Calatafimi and was wounded during the capture of Palermo and at the siege of Reggio. The tactical qualities that he displayed at the battle of Volturno brought him promotion to the rank of lieutenant general. In 1861 he was elected deputy for Genoa in the first Italian parliament and tried to reconcile Garibaldi and Cavour. Created a senator in 1870, he commanded a division in the attack on Rome. He died of cholera at Achin bay, Sumatra, on Dec. 16, 1873, on a commercial expedition.

See G. Guerzoni, *La Vie du général Bixio* (1877); A. Codignola, *Bixio* (1948).

BIZERTE (BIZERTA), a seaport of northern Tunisia, situated at the edge of rainy lake plains, on a natural channel which links the lake of Bizerte with the sea, and facing an open bay on the strait of Sicily, between Cape Blanc and Cape (Ras) Zebib. Pop. (1956) 44,681, of whom 12,808 were Europeans. Its maritime value was completely transformed at the end of the 19th century by the opening, south of the town and of the natural channel's mouth, of a canal 4,920 ft. long, 787 ft. wide and 32 ft. deep. The lake became a fine roadstead, with depths of 32 ft. as far as the naval port and arsenal of Sidi Abdallah and Ferryville (now Menzel-Bourguiba) at its southwestern end, and depths of more than 29 ft. over half its area. There is a protected outer harbour at the sea end of the canal. The new roadstead and arsenal made Bizerte an important French military base, and the commercial port was established in the bay of Sebra.

The old native town stands at the channel's former sea entrance, which was not filled in and serves as a fishing harbour. On the north side of this is the kasbah. Dredgings from the new canal were used to fill up the old channel and to form building sites on the north side of the canal where the new town now extends. The central point of the modern town is a square, where stand the hôtel de ville (town hall) and the modern church of Notre Dame de France. There are a Franco-Arab school south of the old harbour and a *lycée* to the west of the town. The exodus from the countryside after World War II added some poor quarters to its outskirts. The commercial port has little trade: it exports iron ore from Duaria, lead from local mines smelted in a small foundry, and part of the cement produced in a modern factory, but the grains of the interior go almost entirely to Tunis. Imports are confined mainly to fuels (especially liquid), building materials and metal products for the arsenal. Passenger traffic and fishing are of secondary importance. The town is a limited regional market and Tunis competes strongly for the trade of its hinterland. It is linked by rail and road with Tunis and Tabarka and has an airport. Bizerte was never of great commercial importance, though it was an early Phoenician outpost and a town of the Carthaginian era (Hippo Zarytus, or Diarrhytus) and one of Rome's first colonies. In medieval times, as Benzert, it was a mediocre fishing village. In the 16th century it was enlarged by an Andalusian quarter of Muslim refugees from Spain. In Turkish times it took part in the piracy of Khair ed-Din (Barbarossa) and was occupied by the Spanish in 1535, and later suffered various bombardments by European fleets. At the time of the French protectorate (1881) it had barely 6,000 inhabitants. It was occupied by the Germans in Nov. 1942 and liberated by the Allies on May 7, 1943. The town and port, severely damaged by the Tunisian campaign, have been reconstructed. In 1961 there were violent clashes between French troops and Tunisians in the wake of a Tunisian demand for French evacuation of the base. An agreement was signed on Sept. 29 whereby the French withdrew to positions they held before fighting broke out on July 19.

The governorate of Bizerte had a population (1956) of 258,544. It is a wet region (Satfura) comprising on the west the poor country of Mogod, an area of cork oak bush and pasture, and the hills of the Hedil and Bejawa (grain and pasture); to the south are the rich plains of Bizerte and Mateur (wheat and cattle); on the east is a thickly populated area including about ten large villages, established in market gardening. (J.-J. Ds.)

BIZET, GEORGES (1838–1875), French composer, was one of the foremost dramatic composers of his age, combining a graceful and fluent style in the tradition of Mozart and Rossini with a realism that influenced the *verismo* school of opera at the end of the 19th century.

He was born in Paris, Oct. 25, 1838, and baptized Georges, though his registered names were Alexandre César Léopold. His father, a hairdresser, married a sister of the gifted but eccentric singing teacher F. A. Delsarte, and set up in the same profession. Bizet, their only child, showed precocious musical gifts. He studied at the Paris Conservatoire from 1848 under Antoine Marmontel (piano), Pierre Zimmerman (counterpoint) and

Fromental Halévy (composition), and also received instruction from Gounod, whose music greatly influenced him. He won many prizes, culminating in the Prix de Rome (with his cantata *Clovis et Clotilde*) in 1857. His delightfully fresh Symphony in C major, discovered and first performed in 1935, was written in 1855 within a month of his 17th birthday. His first stage work was the one-act operetta *Le Docteur Miracle*, produced at the Théâtre des Bouffes-Parisiens in 1857.

During his years in Rome (1857–60) Bizet composed the lively *opera buffa Don Procopio* (Monte Carlo, 1906) and the ode-symphony *Vasco de Gama*, and planned a number of other works, including the symphony known as *Roma* (performed 1869). On his return to Paris he supported himself by teaching, scoring dance music and making piano transcriptions, etc. He was a superb pianist who won the admiration of Liszt but shrank from the career of a virtuoso.

In 1862–63 he composed the grand opera *Ivan le Terrible*, probably for the theatre at Baden-Baden, but put it aside when Léon Carvalho, director of the Théâtre-Lyrique in Paris, offered him the libretto of *Les Pêcheurs de Perles*. This opera, produced in 1863, shows the influence of Gounod, Meyerbeer and Verdi, but contains much charming and original music. In 1865 a revised version of *Ivan le Terrible* was rejected by the Théâtre-Lyrique and the Opéra. The surviving score—probably that of 1862–63—was first produced at Mühringen castle, Württemberg, 1946. In this and other works Bizet made the mistake of attempting the grandiose, to which his talents were unsuited. *La Jolie Fille de Perth* (Théâtre-Lyrique, 1867) shows an advance in dramatic skill and orchestration but is hampered by a feeble libretto. During the years 1865–68 Bizet wrote many songs, a few with the vitality of his best dramatic music, and some piano pieces, of which the best is the experimental *Variations chromatiques de concert*.

Bizet's discouragement during the 1860s is reflected in the numerous operas he left unfinished, and in the constant self-doubts and suspicions, amounting almost to persecution mania, expressed in his letters. When in 1868 the Opéra offered a prize for a setting of *La Coupe du Roi de Thulé*, a libretto with a remarkable likeness to that of Carmen, he submitted an entry; but on failing to win the prize strove to conceal the fact. His score, which survives only in fragments, shows high promise. On June 3, 1869, he married Geneviève Halévy, daughter of his old master. In the same year he completed Halévy's opera *Noé* and eagerly accepted the invitation of Camille du Locle, the new joint director of the Opéra-Comique, to "change the genre of *opéra-comique*." But his career was interrupted by the Franco-German War, during which he served in the national guard throughout the siege of Paris, and in 1871 *Grisélidis* was refused by the Opéra-Comique on the grounds of expense.

The compositions of Bizet's last four years are nearly all masterpieces. The suite for piano duet, *Jeux d'Enfants* (1871), shows a rare mastery of miniature forms and an insight into the child's mind; the one-act *Djamileh* (1872), though again marred by a weak libretto, contains some of his most seductive music in an oriental idiom; and the incidental music to Alphonse Daudet's *L'Arlésienne* (1872), in which he collaborated closely with the dramatist, is a *locus classicus* for the marriage of music and the spoken word. The last two were both failures; but the orchestral suite (No. 1) from *L'Arlésienne* won great success as a concert piece. Two further orchestral works were the *Petite Suite* adapted from *Jeux d'Enfants* (1873) and the overture *Patrie* (1874).

Bizet's last and finest work, *Carmen*, with libretto by H. Meilhac and Ludovic Halévy, based on a tale by Prosper Mérimée, was produced at the Opéra-Comique, March 3, 1875. It was received with indifference by the public and with hostility by much of the press; only after a world-wide triumph did it come into its own in Paris. Here for the first time Bizet set an excellent libretto (the subject was his own choice and he helped shape the words), and the music reveals all his qualities as a musician—vitality, rich colour, abundant and varied melody, masterly orchestration and, above all, a rare insight into the dramatic manipulation of character. Bizet's best music is spontaneous and exuberant, as was the man himself. In opera he penetrated to the deeper emotions that govern human behaviour, especially jealousy; he observed them with detachment and expressed them through a refined musical craftsmanship. He revitalized *opéra-comique*, but did not live to exploit his success. His last years were darkened by domestic unhappiness and declining health. Soon after the production of *Carmen* he was taken ill with an infection of the throat, from which he had suffered chronically since childhood, and died suddenly at Bougival, near Paris, June 3, 1875.

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BJERKNES, VILHELM FRIMANN KOREN (1862–1951), Norwegian physicist and meteorologist, was one of the founders of the modern science of weather forecasting. He was born in Oslo on March 14, 1862. As a student he assisted his father, Carl Anton Bjerknes, professor of mathematics in Oslo, with experimental verifications of hydrodynamic action at a distance, a field which he generalized and clarified in later years. Under Heinrich Hertz (1890–91) he made a comprehensive study of electrical resonance which was decisive in the development of radio. In 1897, then professor of mathematical physics at the University of Stockholm, Bjerknes discovered his famous circulation theorems. These led him to a synthesis of hydro- and thermodynamics, a physical hydrodynamics, applicable to large-scale motions in the atmosphere and the ocean. In 1904 he presented a farsighted program for physical weather prediction based on the fundamental dynamic principles of physics. Supported by the Carnegie institution in this program, Bjerknes was able to employ a long line of talented "Carnegie assistants," thus founding his "schools" in Leipzig and Bergen. His influence as an inspiring teacher was perhaps as great as his scientific achievements. During the period from 1895 to 1932 he held teaching positions at the universities of Stockholm, Oslo and Leipzig and at the Bergen Geophysical institute. He died in Oslo on April 9, 1951.

Jakob Bjerknes (1897–), his son, was among his young collaborators in Bergen who in 1919 discovered that cyclones originate as waves in sloping frontal surfaces which separate different air masses, the first great success of the elder Bjerknes' program. Its full potentialities are unfolding in modern numerical weather predictions. *See* also Meteorology: *History;* Weather Forecasting.

A comprehensive bibliography of Bjerknes' writing is contained in his book, *Physikalische Hydrodynamik* (1933). (Jn. H.)

BJÖRNEBORG: *see* Pori.

BJØRNSON, BJØRNSTJERNE MARTINIUS (1832–1910), Norwegian poet, novelist, dramatist and Nobel prizewinner (1903) who refashioned the *drame bourgeois* of his day into a serious realistic drama which inspired Henrik Ibsen (*q.v.*). Bjørnson was also a brilliant journalist and used his rigorous personality to further the causes of radicalism and Norwegian nationalism and to assist oppressed minorities overseas. Born at Bjørgan parsonage, Kvikne (Østerdal), Dec. 8, 1832, he spent most of his childhood—a happy one—in Nesset (Romsdal), where his father was appointed pastor in 1837. In 1848 he went to Christiania (now Oslo) to prepare for the university at a school which Ibsen also attended, but having matriculated in 1852 he left the university in 1854 to become a dramatic critic. He published his first stories and became editor of a small paper in 1856, publishing *Synnøve Solbakken* (Eng. trans. 1870, 1895) in 1857. This, written during a visit to Copenhagen, was the first of his peasant tales (*bonde-fortaellinger*) in which he is unsurpassed in Norwegian literature. His other peasant tales included *Arne* (1858; Eng. trans. 1890), *En glad Gut* (1860; Eng. trans., *A Happy Boy*, 1896), *Fiskerjenten* (1868; Eng. trans., *The Fisher Lassie*, 1896) and *Brudeslåtten* (1873; Eng. trans., *The Bridal March*, 1893).

Bjørnson wished to create a new saga of peasant life, not only in prose fiction but also in popular plays (*folke-stykker*), the first of which was *Mellem Slagene* ("Between the Battles") a one-act historical drama performed in 1857. Later that year he succeeded Ibsen (with whom he was friendly at the time) as director of the Bergen theatre, but left in 1859 to return to journalism in Chris-

tiania. Awarded a government grant in 1860, he traveled widely in Europe until 1863. His early historical plays were produced at this period—*Halte-Hulda* (1858) and *Kong Sverre* (1861), the trilogy *Sigurd Slembe* (1862, performed 1865; Eng. trans. 1888) and *Marie Stuart i Skotland* (1864, performed 1867; Eng. trans. 1912), which made him famous as a dramatist. In 1865, when his comedy *De Nygifte* (Eng. trans., *The Newly Married Couple* in *Three Comedies*, 1912) was produced, he was appointed artistic director of the Christiania theatre but later resigned (1867) to become editor-in-chief of *Norsk Folkeblad*, which he made the main organ of Norwegian radicalism.

In the 1860s his political activities increased. He toured Norway agitating for more independence for his country—as well as for some kind of Pan-Scandinavian union: he also favoured Pan-Germanism in later years. Though an admirer of Danish culture, Bjørnson as a fervent nationalist wrote a distinctly Norwegian Danish. Nevertheless, he opposed the full-scale introduction of the synthetic *landsmål* (*see* NORWEGIAN LANGUAGE).

In 1870 he published a collection of *Digte og sange* (4th ed. 1903; Eng. trans., *Poems and Songs*, 1915) including *Ja, vi elsker dette landet*, which was set to music by his cousin R. Nordraak and is now the Norwegian national anthem. In 1874 Bjørnson settled at Aulestad, Gausdal (Oppland) and began a fresh period of creative activity. In the late 1870s he passed through a religious crisis, finally abandoning his Christian beliefs, and began to preach a code of nonreligious ethics. His three plays *Redaktøren* (1875; Eng. trans., *The Editor*), *En Fallit* (1875; Eng. trans., *The Bankrupt*) and *Kongen* (1877; Eng. trans., *The King:* all trans. in *Three Dramas*, 1914) are realistic works, reflecting his political views, but have become dated and are not well constructed, though *En Fallit*—which strongly influenced Ibsen's *Samfundets stötter* (1877; Eng. trans., *The Pillars of Society*)—earned him a European reputation. In 1883 he published *En Handske* (Eng. trans., *A Gauntlet* in *Three Comedies*, 1912), a drama attacking sexual moral duplicity. This was followed by his two most powerful plays —*Over Aevne: første stykke* (1883; Eng. trans., *Pastor Sang*, 1893, and *Beyond Our Power* in *Plays*, 1913), an attack—like his striking short story "Støv" (1882; Eng. trans., "Dust" with *Magnhild*, 1897)—on dogmatic religious belief, which was not performed until 1899, and *Paul Lange og Tora Parsberg* (1898; Eng. trans. 1899), a masterly psychological study of weakness, which was founded on the career of a Norwegian politician of the day. In 1889 the comedy *Geografi og Kjaerlighed* (Eng. trans., *Love and Geography* in *Plays*, 2nd series, 1914) had been published and became a great favourite in Norway. Bjørnson treated the *Over Aevne* theme twice, setting *Over Aevne: andet stykke* (1895; Eng. trans., *Beyond Human Might*, 1914), against the background of a strike, and continued to publish novels—*Det Flager i byen og paa Havnen* (1884; Eng. trans., *The Heritage of the Kurts*, 1892), a long chronicle novel, and *Paa Guds Veje* (1889; Eng. trans., *In God's Way*, 2 vol., 1907–08).

His later plays included *Når den ny Vin blomstrer* (1909; Eng. trans., *When the New Wine Blooms, Poët Lore*, vol. xxii. pp. 1–78, 1922), a delightful comedy. A positive, confident personality, Bjørnson wrote much that is less significant than anything Ibsen did, but he was far more typically Norwegian than the other was. Bjørnson died in Paris, April 26, 1910.

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BJÖRNSSON, SVEINN (1881–1952), first president of Iceland, was born in Copenhagen, Den., on Feb. 27, 1881. After going to school in Iceland, he received the degree of bachelor of law from Copenhagen university in 1907. He lived in Reykjavik from 1907 until 1920 and was very active both in local and national affairs. He was a member of the *althing* for Reykjavik for several years, chairman of Reykjavik city council 1918–20, advocate in the high court and supreme court of Iceland until 1920, and a leading spirit in the foundation of many important companies and institutions. Appointed Icelandic envoy to Copenhagen in 1920, he remained there until 1940, except for the years 1924–26, when he was recalled to Reykjavik.

After Iceland became a self-governing kingdom in personal union with Denmark (Dec. 1, 1918), the Danes conducted Iceland's foreign affairs until the beginning of World War II. Then, on May 10, 1940, the day after the German occupation of Denmark, the *althing* decided to delegate to the Icelandic cabinet the powers of the king and to rescind the Danish government's commission to conduct Iceland's foreign affairs. In pursuance of these temporary measures the *althing* in 1941 elected Björnsson to be regent of Iceland, to which office he was re-elected in 1942 and 1943. On the inauguration of the republic of Iceland (June 17, 1944) he was chosen by the *althing* to be Iceland's first president for one year, but when a plebiscite was held for the presidential office in 1945 he was returned unopposed, as also in 1949. He had acquired his people's trust and affection by his labours over the previous decades for them and their good. He died on Jan. 26, 1952. His memoirs were published in 1957. (T. J.)

BLACK, ADAM (1784–1874), Scottish publisher, founder of the firm of Adam and Charles Black, was born in Edinburgh on Feb. 20, 1784. On leaving school he was for five years apprenticed to an Edinburgh bookseller, afterward spending two years in London. Returning to Edinburgh, he opened his own bookshop (1807) and subsequently began publishing. His business flourished and after some years he took his nephew Charles into partnership. In 1827 the copyright of the *Encyclopædia Britannica* passed into the hands of Adam Black and a few friends (whose interest he shortly acquired) and it was under his direction that its 7th, 8th and 9th editions were published. In 1851 the firm bought the copyright and stock of Sir Walter Scott's Waverley novels for £27,000; and in 1861 they became the proprietors of De Quincey's works. Black was twice lord provost of Edinburgh and represented the city in parliament from 1856 to 1865. He died in Edinburgh on Jan. 24, 1874, and was succeeded by his three sons, who in 1890 moved their business to London.

See *Adam & Charles Black, 1807–1957: Some Chapters in the History of a Publishing House* (1957).

BLACK, DAVIDSON (1884–1934), Canadian discoverer of Peking man (*Pithecanthropus pekinensis*), was born at Toronto on July 25, 1884. A graduate of the University of Toronto, he taught at Western Reserve university, Cleveland, O., which he left to join the Canadian army medical corps in 1917. While visiting Manchester, Eng., to study comparative anatomy with G. Elliot Smith, at that time working on the Piltdown material, his interest was deeply aroused by the problems of man's origin. After World War I he became, and remained until his death, professor of neurology and embryology at Peking Union medical college and subsequently honorary director of the Cenozoic Research laboratory of the Geological survey of China. In the search for early man he worked without success first in Jehol (north China), then in Thailand. After some pieces of quartz, not of local origin, and some apparently hominid teeth had been found at Chou-k'ou-tien, he instigated a thorough investigation of the site, which culminated in the discovery of Peking man (*see* MAN, EVOLUTION OF: *Pithecanthropus*). The phylogenetic importance of this fossil was immediately recognized by Black who, when only a single molar tooth had been recovered, gave it a new generic name to indicate that it represented a distinct form of early man. Later discoveries of skulls and other fossil bones, by himself and after his death by Franz Weidenreich (*q.v.*), proved the accuracy of his judgment. Black died at Peking on March 15, 1934. (D. F. R.)

BLACK, GEORGE (1890–1945), English manager and producer of entertainments and a pioneer of the motion-picture business, is chiefly remembered as the originator of the brilliant and long-lived "Crazy Gang" revues at the London Palladium and later at the Victoria Palace, London. Born in Birmingham, April 20,

1890, he helped his father establish the first permanent motion-picture theatres in Great Britain. Later he became proprietor of a circuit of theatres and music halls on the northeast coast. He moved to London in 1928 and became general manager of various music halls there and in Brighton. In 1933 he took over the active management of Moss Empires theatres (extending all over Great Britain) and became joint managing director in 1938. The "Crazy Shows" began at the London Palladium in 1935 with *Life Begins at Oxford Circus*, and continued as an annual event that World War II interrupted only intermittently. He died on March 4, 1945. (A. H. D.)

BLACK, JEREMIAH SULLIVAN (1810–1883), U.S. lawyer and cabinet officer, was born Jan. 10, 1810, in Somerset county, Pa. He attended several schools but was largely self-educated. After three years of study under Chauncey Forward, a prominent Somerset attorney, he was admitted to the bar in 1830. Appointed a judge of the district court in 1842, he was elected to the state supreme court in 1851 and re-elected three years later. In 1857 Pres. James Buchanan appointed Black attorney general of the United States. In his most significant action he successfully challenged questionable Mexican land grants in California.

After Abraham Lincoln's election Black advised Buchanan to garrison southern forts to protect federal property from the secessionists. His pro-Union influence upon Buchanan increased after he became secretary of state on Dec. 17, 1860. He drafted instructions to U.S. diplomatic representatives to warn foreign governments against recognition of the Confederacy.

When Lincoln was inaugurated, Black retired from office to a lucrative law practice. After the American Civil War he represented opponents of radical Republican reconstruction before the Supreme Court. He capped his career there in the famous Slaughterhouse cases when his arguments led the court to interpret narrowly the rights conferred upon citizens by the 14th amendment. He continued to practise law until his death Aug. 19, 1883, at Brockie, Pa. (R. J. Ro.)

BLACK, JOSEPH (1728–1799), Scottish chemist and physicist, is best known for his enunciation of the concept of latent heat and the rediscovery of "fixed air" (carbon dioxide). He was born on April 16, 1728, at Bordeaux, Fr., where his father—a native of Belfast but of Scottish descent—was engaged in the wine trade. He was educated at Belfast, and in medicine and natural sciences at Glasgow university. There he had William Cullen (1712–90) for his instructor in chemistry, and the relation between the two soon became that of professor and assistant rather than of master and pupil.

In 1751 Black transferred to Edinburgh to complete his medical studies. In the thesis *De humore acido a cibis orto, et magnesia alba*, which he presented for his doctor's degree in 1754, he described his investigations in the heating of magnesia alba (magnesium carbonate) and anticipated Antoine Lavoisier and modern chemistry by indicating the existence of a gas distinct from common air, which he detected by using the balance. This gas was carbon dioxide, first described by Jan van Helmont (1577–1644) as "gas sylvestre." A fuller account of Black's studies was published in 1756 as *Experiments Upon Magnesia Alba, Quicklime, and Some Other Alcaline Substances*. In this he proved that the mild alkalies (carbonates) are causticized (become more alkaline) when they lose carbon dioxide and that the absorption of this material converts the caustic alkalies again to mild alkalies. (*See* also CHEMISTRY: *History of Chemistry.*)

It is curious that Black left to others the detailed study of "fixed air." Probably the explanation is pressure of other work. He, however, had found that it behaves as an acid, that it is produced by fermentation, respiration and the burning of charcoal, and inferred its presence in the atmosphere. His only other important chemical discovery was that of the bicarbonates.

In 1756 he succeeded Cullen as lecturer in chemistry at Glasgow, and was also appointed professor of anatomy, though he exchanged that post for the chair of medicine. He also practised as a physician. Moreover, his attention was engaged on studies which ultimately led to his doctrine of latent heat. (*See* also HEAT: *Change of State.*) He noticed that when ice melts it takes up a quantity of heat without undergoing any change of temperature, and he argued that this heat must have combined with the particles of ice and thus become latent in its substance. This hypothesis he verified quantitatively by experiments performed at the end of 1761. In 1764, with the aid of his assistant, William Irvine (1743–87), he further measured the latent heat of steam, though not very accurately. This doctrine of latent heat he taught in his lectures from 1761 onward, and in April 1762 he described his work to a literary society in Glasgow. But he never published any detailed account of it, so that others, such as J. A. Deluc, were able to claim the credit for his results. His friend and student, James Watt, doubtless was influenced by these ideas in his revolutionary construction of the condensing steam engine. In the course of his inquiries Black also noticed that different bodies in equal masses require different amounts of heat to raise them to the same temperature, and so founded the doctrine of specific heats. He also showed that equal additions or removals of heat produced equal variations of bulk in the liquid of his thermometers. In 1766 he succeeded Cullen in the chair of chemistry in Edinburgh. Black died in Edinburgh on Nov. 10, 1799 (not on Nov. 26 as stated in Robison's life).

Apart from the work already mentioned he published only two papers during his lifetime—"The Supposed Effect of Boiling on Water, in Disposing It to Freeze More Readily," *Phil. Trans.* (1775), and "An Analysis of the Waters of the Hot Springs in Iceland," *Trans. Roy. Soc. Edinburgh* (1794). After his death his lectures were written out from his own notes, supplemented by those of some of his pupils, and published with a biographical preface by his friend and colleague, John Robison (1739–1805), in 1803 as *Lectures on the Elements of Chemistry, Delivered in the University of Edinburgh.*

See W. Ramsay's biography, *Life and Letters of J. Black* (1928); J. R. Partington, *A Short History of Chemistry*, 3rd ed. (1960). (R. E. O.; X.)

BLACKBERRY (BRAMBLE), prickly, fruit-bearing bushes of the genus *Rubus* (family Rosaceae; *q.v.*), natives chiefly of the north temperate regions of the old and new world. They are particularly abundant in the eastern part and the Pacific coast of North America and in the British Isles and western Europe as copse and hedge plants. The bush is characterized by its usually biennial, prickly, erect, semierect or trailing stems, leaves with usually three or five oval, coarsely toothed, stalked leaflets, many of which persist through the winter; white, pink or red flowers in terminal clusters; and black or red-purple fruits, each consisting of numerous drupelets adhering to a juicy core. It is a most variable plant, exhibiting many more or less distinct forms. In Europe evidence indicates that the Ice Age brought together two widely different species groups, the northern and southern. When they hybridized, the thousands of pseudogamic blackberries of Europe that come true to seed originated. Because of coming

(LEFT) ROCHE PHOTOGRAPHY, (RIGHT) JOHN H. GERARD

BLOSSOMS AND FRUIT OF A CULTIVATED BLACKBERRY

exactly true to seed, they have reproduced themselves down through hundreds and thousands of years and in some cases have become widely distributed. There are relatively few good species. The Evergreen and Himalaya are varieties of European origin that are cultivated in the United States. This type is a pest over large areas of Australia, New Zealand, Chile and other countries.

In North America there are two groups, the Pacific coast trailing one, native from southern California to British Columbia, and the eastern group, both erect and trailing, native from southern Florida to Canada and west to the Great Plains. The Pacific coast group consists of only three to five trailing species that have very high flavour. Species of the eastern group have hybridized freely.

Originally there were probably some 20 species; now there are tens of thousands of hybrids and segregates of various types. Most cultivated erect-growing varieties have been derived from *Rubus alleghenienſis, R. argutus* and *R. frondosus*. In the United States there are about 10,000 ac. under blackberry cultivation. In Oregon and Washington, Thornless Evergreen, Logan and Boysen are the chief varieties; in California Olallie, Boysen and Logan; in eastern states Eldorado, Early Harvest, Early Wonder and Lawton blackberries and Lucretia dewberry are the chief varieties.

The erect varieties are propagated by suckers and root cuttings, the trailing and semitrailing varieties by both tip layers (the tips being covered in late summer) and root cuttings (except Thornless Evergreen). The plants are usually set in early spring, the erect-caned varieties four by eight feet, the dewberries five by five feet or five by eight feet, and the Himalaya and Thornless Evergreen 16 by 8 ft. The canes of the dewberries and the Himalaya and Thornless Evergreen are commonly trained to a one-, two- or four-wire trellis, though the dewberry is often trained to stakes set about five feet by five feet. Virus diseases, the orange rust, leaf spots and anthracnose are common diseases. The cane borer and red berry mite are serious insect pests.

About 1,000 ac. of the blackberry are raised in Great Britain and a small quantity on the continent. The Logan (loganberry), Bedford Giant, Himalaya (Theodor Reimers), Evergreen (parsley-leaved or cut-leaf) and John Innes are the principal varieties and are grown chiefly in Kent and Worcestershire. Thornless sports of the Logan and Evergreen are available; they are as productive as the thorny and are preferred. Propagation of all these varieties is by tip layers.

The Boysen, similar to the Logan in habit, has been introduced into France and is well liked there. Logan and Boysen are set about 8 ft. apart in rows 8 ft. distant, the others 12 ft. to 15 ft. in the row and the rows 8 ft. to 10 ft. distant. The canes are trained to three-wire trellises with wires three feet, four feet and five feet high.

See "Blackberry and Raspberry Improvement" in U.S. Department of Agriculture *Yearbook 1937*, p. 496; *Farmers' Bulletin 1095*, U.S. Department of Agriculture; *Cane Fruits*, Bulletin 156, British Ministry of Agriculture and Fisheries. (G. M. D.)

BLACKBIRD, a name given to several different perching birds of predominantly black plumage. In North America several birds of the family of Icteridae are called blackbirds: the red-winged blackbird (*Agelaius phoeniceus*); the yellow-headed blackbird (*Xanthocephalus xanthocephalus*); and the grackles (*q.v.*).

The European blackbird (*Turdus merula*) is a member of the thrush (*q.v.*) family and a close relative of the American robin. It is one of the commonest of British birds. The males are recognizable by their black plumage and orange bill. The females are more thrushlike, being a dusky brown and the beak is also dark.

The European blackbird is an early nester, often beginning to lay in February, and raises two broods in the year. The nest, usually placed in bushes or hedgerows, is made of hay and coarse grass, neatly interwoven and lined with hair and fine grass. The eggs, three to five in number, are pale blue-green, mottled with brown. The young resemble the female in colour. Its food consists of fruits, buds, insects, worms, snails, etc. The song is mellow and flutelike. The blackbird is widely distributed over Europe and Asia, and, despite occasional raids on fruit trees, is, on the whole, a beneficial species. (G. F. Ss.; X.)

BLACK BODY, in physics, a theoretically perfect absorber and emitter of radiation, invisible as well as visible. The black body has been of great importance in theoretical studies and research, although its practical applications have been limited. Black-body radiation has been employed by physicists to study the fundamental nature of matter, and out of such studies have evolved the wave theory of light and quantum mechanics.

The term black is commonly applied to any substance, such as coal or pitch, that absorbs nearly all the light falling on it and reflects very little. Lampblack or smoke black consisting of very fine particles of carbon is usually taken as a typical example of a black substance. The majority of black substances owe their blackness to the presence of particles of carbon embedded in a binding medium; but even black substances reflect some light at the surface when smooth or polished. For scientific experiments in which complete absorption of the incident light is required, reflection at the surface must be avoided as far as possible. For this reason the internal surfaces of optical instruments, such as telescopes and cameras, are coated with a dead-black varnish having a matte surface to eliminate internal reflections that would obscure or fog the image.

In the case of visible radiation (light), a very small amount can be detected by eye, but the visible rays form a very small proportion of the total radiation from any source of artificial light and are completely absent in radiation from any radiator at a temperature below a red heat. It cannot be assumed that surfaces which appear black to the eye and are practically perfect absorbers of visible light are equally perfect absorbers of the invisible rays. Instruments for detecting or measuring radiation, such as the thermopile or bolometer, depend for their accuracy on the completeness of the absorption of all radiation over a range of wave length about 100 times greater than that of visible light. The sensitive receiving surfaces of such instruments are necessarily metallic and would be very poor absorbers of radiation. They are accordingly coated with a film of smoke black or platinum black to make the absorption as complete as practicable.

An absorption equivalent to 98% of the incident radiation may thus be obtained under favourable conditions, but it is very difficult to estimate the percentage defect and to make sure that it is the same for all wave lengths. Some allowance is usually made for incomplete absorption in modern experiments, but it remains one of the chief sources of uncertainty in accurate measurements. Complete absorption cannot be attained except by the adoption of the black body principle.

The theory of the black body as a perfect absorber is extremely simple. The apparatus consists merely of a chamber or box that is light-tight except for an aperture in one side; the inside of the enclosure is blackened. Any radiation entering through the hole is scattered and absorbed by repeated reflection so that only an infinitesimal fraction can possibly escape.

An example of near-perfect blackness can be seen by removing the lens from a box camera and covering part of the aperture with a card painted with the best dead black. The uncovered part of the aperture will appear of a much higher order of blackness than the most perfect dead-black coating procurable. The advantage of the method lies in the fact that the blackness thus secured is equally perfect for all wavelengths because of the complete elimination of surface reflection at the aperture.

The practical application of the principle to the construction of a perfect absorber of radiation is not quite as easy. With a simple chamber as above described, the radiation entering through the aperture would be scattered over the inner surface and could not easily be collected and measured. The experimental difficulties of this problem cannot be discussed here but are illustrated in the article on HEAT. The application of the same principle to the construction of sources of radiation, also termed "black bodies," is described in the same article, but it will be well to explain here how the apparent misnomer "black" has come to be applied to a body emitting radiation.

It follows from the theoretical reasoning of Balfour Stewart (1858) and G. R. Kirchhoff (1859), based on the equilibrium of temperature, that a body capable of absorbing radiation perfectly

at any temperature must be equally perfect in the emission of radiation. Further it follows that the intensity of radiation inside a hollow chamber at a uniform temperature depends only on the temperature, is the maximum possible at the given temperature, and is independent of the shape of the chamber or of the materials of which it is composed. Chambers of this kind, provided with suitable heating appliances and with apertures for the emission of the internal radiation, are commonly termed black bodies and are employed as sources of radiation of definite quality and intensity. The radiation they emit is the same as that of a perfectly black surface at the same temperature and is often called "black" radiation. The black-body temperature of a source like the sun is the temperature at which a black body would emit radiation of the same intensity.

See HEAT: *"Full" and Selective Radiation; Absolute Measurement of Radiation;* PLANCK, MAX KARL ERNST LUDWIG; QUANTUM MECHANICS: *Black-Body Radiation;* THERMOMETRY: *Optical and Radiation Thermometry;* WIEN, WILHELM.

(H. L. C.)

BLACK BUCK (*Antilope cervicapra*), the Indian antelope, the sole species of its genus. An adult male stands about 32 in. high at the shoulder. The general colour is brown deepening with age to black; the chest, belly and inner sides of limbs are pure white, as are the muzzle and chin and an area round the eyes. The doe is smaller and yellowish-fawn above. Horns present in males—and occasionally found in aged females—are long, ringed and form spirals with three to five turns. These fast-moving animals, formerly found in herds in grassy districts, are now so scarce that they are protected by law. *See* also ANTELOPE.

BLACKBURN, GIDEON (1772–1838), U.S. Presbyterian clergyman and Indian missionary, was born in Augusta county, Va., on Aug. 27, 1772. Sometime before 1790 his family settled in Washington county, Tenn. (then North Carolina). There Blackburn was educated at Martin academy (later Washington college). About 1794 he became a Presbyterian minister stationed at a military post which later became Maryville, Tenn. Following the Great Revival of 1800–03, in which he took an active part, he went to the general assembly of the Presbyterian Church to plead for the evangelization of the Cherokee Indians. During the next seven years he worked among the Cherokee, preaching, establishing schools and introducing better agricultural methods and new handicrafts.

When his health began to fail he took up schoolteaching near Nashville, Tenn. There he formed a friendship with Andrew Jackson that continued until his death. In 1823 he became pastor of the Presbyterian Church at Louisville, Ky., and four years later president of Centre college, Danville, Ky. Blackburn was not successful as an administrator. Moreover, he was a strong supporter of the so-called New School wing of Presbyterianism while labouring in quite strongly Old School territory. In 1830 he left Centre and in 1833 became a fund raiser for the new, decidedly New School, Illinois college. In 1835, turning to the founding of a theological seminary in Illinois, he built up an endowment of 16,656 ac. of land near Carlinville from payment for his services to persons seeking Illinois public lands. He died on Aug. 23, 1838.

(L. J. T.)

BLACKBURN, HELEN (1842–1903), British pioneer in the movement for the emancipation of women, was born on Valencia Island, Ireland, on May 25, 1842. She was the daughter of Bewicke Blackburn (d. 1897), a well-known civil engineer. The family moved in 1859 to London, where Helen Blackburn soon became interested in the movement for women's suffrage. When, in 1874, a National Society for Women's Suffrage was formed, she became its secretary. She was also editor of *The Englishwoman's Review* from 1881 to 1890. In 1895 however, she gave up most of her public work to look after her father. One of the first to recognize the significance of women in industry, she published on this subject *The Condition of Working Women* (1896) and *Women Under the Factory Acts* (1903). She also wrote *Women's Suffrage: a Record of the Movement in the British Isles* (1902). She died in London on Jan. 11, 1903.

(M. A. H.)

BLACKBURN, JOSEPH (*c.* 1700–1774), English-born portrait painter, who had no important competitor during his stay in New England from 1753 to 1763. Research has yielded some authentic information about him, replacing earlier errors. In 1752–53 he painted 17 known portraits in Bermuda. For his American stay about 100 examples are listed. He was back in England by 1764 and the last recorded fact is the payment to him for two portraits in 1774.

Blackburn's manner is English rococo, probably out of Thomas Hudson, and it proved popular with the American colonials desirous of being fashionable. An occasional male portrait, such as that of "Theodore Atkinson" (museum, Worcester, Mass.), manifests some individuality in the features; but the majority, especially of women, emphasize pose and costume at the expense of characterization. More than once a design is repeated even to details of costume and jewelry; an instance of this occurs with the "Margaret Sylvester Chesebrough" (Metropolitan Museum of Art, New York city) and the "Mary Browne Greenleaf" (privately owned). Nevertheless, Blackburn's formula was still superior to those of other workmen at the time in drawing and handling of pigment. These relative merits, together with Blackburn's animated posing and placement of his subjects, exerted an influence upon the youthful John Singleton Copley so strong as to constitute a distinct though brief stage in the latter's development into the more monumental style of his maturity.

See L. Park, *Joseph Blackburn, a Colonial Portrait Painter* (1923); J. H. Morgan and H. W. Foote, *An Extension of Lawrence Park's Descriptive List* (1937).

(VL. B.)

BLACKBURN, a municipal, county and parliamentary borough of Lancashire, Eng., 10 mi. E. of Preston. Pop. (1961) 106,114. Area 12.6 sq.mi. It lies in the valley of a stream called in early times the Blackburn. For some time the chief town of an area called Blackburnshire, Blackburn was a flourishing market town of about 2,000 inhabitants during the reign of Elizabeth I. Its weaving tradition had beginnings in the 13th-century wool trade; from Elizabeth I's time flax from Ireland was used for making the blue and white "Blackburn checks" cloth, which, in turn, was superseded by a linen-and-cotton fabric known as "Blackburn greys." But expansion did not come until the spinning jenny, invented by James Hargreaves about 1764 at nearby Stanhill, and other textile machinery speeded up cotton spinning. The Leeds-Blackburn-Liverpool canal, completed 1816, helped transport and was a useful source of water, as is shown by the many mills lining it. Coal, lime and building materials abounding in the neighbourhood also helped expansion.

Though about a quarter of the working population is engaged in textiles, especially weaving, there is a variety of other trades, including the making of engineering and electrical equipment, paper, vehicles, beer, animal products and lubricants. Five cattle and horse fairs are held yearly, the oldest dating to 1583. There are many markets. The grammar school (1567) is housed in a 19th-century building. Blackburn diocese was carved out of Manchester in 1926 when the parish church of St. Mary was made the cathedral and extensions were started, the foundation stone being laid in 1938.

Of interest are the Lewis textile museum and the public library, museum and art gallery, which has a collection of Lancashire birds. In 1954 a new municipal technical college was opened. Corporation park (60 ac.) and Witton park belong, with several others, to the corporation. A few miles west-northwest is Samlesbury airfield and to the north is Stonyhurst college, a Roman Catholic boys' school. Blackburn, incorporated in 1851, sends one member to parliament.

BLACKCAP (*Sylvia atricapilla*), a small warbler (*q.v.*), notable for the beautiful song and black cap of the male, the female having the top of the head brown. The rest of the plumage in both sexes is gray. The blackcap is a summer resident in northern Europe and the British Isles, but lives the year round in southern Europe, northwest Africa and nearby islands. The male often helps to incubate the eggs and may betray the nest by singing while sitting.

(G. F. Ss.)

BLACKCOCK, male of the black grouse (*Lyrurus tetrix*), the female of which is called grayhen. One of the largest members

of the family Tetraonidae, which includes many notable upland gamebirds, it is about 21 in. in length and has glossy blue-black plumage with white under tail coverts and white wing bar. Its appearance is much enhanced by a lyre-shaped tail and conspicuous scarlet wattles above the eyes. The female is much smaller than the male, measuring about 16 in. and weighing only 2 lb., and has reddish brown plumage, irregularly barred with black.

PAUL POPPER

BLACKCOCK (LYRURUS TETRIX) IN COURTSHIP DISPLAY

The species is widely distributed in England, Europe and northern Asia. A smaller, related species, the Georgian black grouse (*L. mlokosiewiczi*), is restricted to the Caucasus mountains at altitudes of 5,000–9,000 ft.

Little is known of the habits of the black grouse, but the Eurasian species frequents wet woodlands, moors and rocky hillsides, and feeds principally on vegetable matter. Blackcocks are polygamous, and in spring perform remarkable communal dances on special display grounds called leks for the benefit of the assembled grayhens.

The courtship performances begin at dawn and sometimes are continued at intervals through the day. There is much strutting, posturing and jumping accompanied by loud vocalization that includes slurred, wheezing and gobblerlike notes that attract females from a distance. Fighting is largely formalized, but fierce combat sometimes occurs, and victorious cocks are accepted by an ever-changing harem. Eggs of black grouse are yellowish-white, scantily marked with brown, and usually six to ten in number. The nest is a hollow scraped in the ground by the female. Females of other species, especially red grouse (*Lagopus scoticus*) and capercaillie (*Tetrao urogallus*), may also be attracted to the display ground, where random matings with blackcocks have produced the well-known intergeneric hybrids that are often seen. (E. R. BE.)

BLACK COUNTRY, THE, an industrial area containing about 20 towns of the English midlands west and northwest of Birmingham. The towns included are: (in Staffordshire) Aldridge, Walsall, Willenhall, Wednesfield, Wolverhampton, Tettenhall, Sedgley, Coseley, Bilston, Darlaston, Wednesbury, West Bromwich, Tipton, Brierley Hill, Rowley Regis, Smethwick; (in Worcestershire) Dudley, Oldbury, Stourbridge, Halesowen. The name is derived from the murk produced by the collieries, blast furnaces, foundries, etc., set up there during the Industrial Revolution because of the presence of the south Staffordshire coal field with its coal, iron ore, fireclays and limestone. Coal mining had almost ceased by the 1960s, iron ore was no longer worked and the dense network of canals was mostly derelict. Grass grew on old tip-heaps and quarries had been laid out as public parks. However, the Black Country remains intensely industrial.

BLACK DEATH, the name later given to the plague which ravaged Europe between 1347 and 1351 and which proved to be the greatest catastrophe experienced by the western world up to that time. It was also the first widespread epidemic of which sufficient documentary evidence is extant for its course to be tracked and its severity and consequences assessed with any degree of accuracy.

Origin and Incidence.—The Black Death came from Asia, where it had already wrought havoc in China and in Turkistan. It decimated the army of the Kipchak khan Janibeg, while he was besieging the Genoese trading port of Kaffa (now Feodosiya) in the Crimea (1347), and by catapulting plague-infested corpses into the town the khan contrived to infect his enemies. From Kaffa Genoese ships carried the epidemic westward to the Mediterranean ports, whence it spread inland, halted neither by prayer nor by physic, nor even by mass burnings of Jews, who were popularly held to have spread the disease by poisoning the wells. Sicily suffered in 1347; North Africa, Corsica, Sardinia, Italy, Spain and France in 1348; Austria, Hungary, Switzerland, southern Germany, the Rhine valley and the Low Countries in 1349. A ship from Calais carried the plague to Melcombe Regis, Dorset, in Aug. 1348; it reached Bristol almost immediately and spread rapidly throughout the southwestern counties of England. London suffered most violently between Feb. and May 1349, East Anglia and Yorkshire during that summer. The Black Death reached the extreme north of England, Scotland, Scandinavia and the countries round the Baltic sea during 1350.

Contemporary descriptions, especially that of Boccaccio in the introduction to his *Decameron,* suggest that the Black Death was probably bubonic plague (*see* PLAGUE). The rate of mortality varied from place to place: whereas some districts, such as the duchy of Milan, Flanders and Béarn, seem to have escaped comparatively lightly, others, such as Tuscany, Aragon, Catalonia and Languedoc were very hard hit. Towns, where the danger of contagion was greater, were more affected than the countryside; and within the towns the monastic communities provided most victims. Neither the great nor the powerful were immune: among royalty, Eleanor, queen of Peter IV of Aragon, and King Alfonso XI of Castile, succumbed, and Joan, daughter of the English king Edward III, died at Bordeaux on the way to her wedding with Alfonso's son. Canterbury lost two successive archbishops, John de Stratford and Thomas Bradwardine; Petrarch lost not only Laura, who inspired so many of his poems, but also his patron, Giovanni Cardinal Colonna. Four of the five councilors of Barcelona died and the staff of the papal court at Avignon was reduced by one-fourth. There also died so vast a multitude of labourers and artisans that enlargement of the cemeteries became an urgent necessity. Whole communities and families were sometimes annihilated; such a fate befell certain Dominican friaries in Tuscany and Languedoc, and the young Francesco di Marco Datini, afterward a merchant in Prato, lost almost his entire family.

The study of contemporary archives suggests a mortality varying in the different regions between one-eighth and two-thirds of the population, and Jean Froissart's statement that about one-third of the world's population died in the epidemic seems a fairly accurate average. A toll so heavy has been taken by no other plague or war.

Consequences.—The consequences of this violent catastrophe were many, and varied from region to region. Some, such as the cessation of wars and the sudden slump in trade, followed immediately but were of only short duration. Many of the more serious economic consequences, the reduction of tillage, the decline in rents, the ruin of the landowning classes and the general rise in wages, proved the more lasting since there were many recurrences of the plague, notably during the years 1361–63, 1369–71, 1374–75, 1390 and 1400. The psychological damage was also great, insecurity and a constant fear of death leading many into curious excesses of mysticism or to an unhealthy morbidity. Some events can be directly attributed to the plague: the Nestorian Christian communities of central Asia, for instance, were almost wiped out; and a turning-point was reached in the fortunes of Catalonia, since its military and economic expansion had depended entirely on a rising birth rate. The expanding economy of Siena received a decisive check; the population, indeed, was so diminished that the citizens abandoned the project of enlarging their cathedral; and the death of many great painters such as Ambrogio and Pietro Lorenzetti, brought the development of the first Sienese school to a premature end. The Dominicans suffered so severely that they were driven to receive postulants of little education or culture; thus the quality of an order, which had constituted the intellectual elite of Christendom, had seriously declined by the end of the 14th century, a fact certainly not unconnected with the subsequent increase in superstitious practice and with the growth of various heresies. In England the immediate effects of the epidemic of 1348–49 seem to have been of short duration, and the economic decline which reached its nadir in the mid-15th century should probably be attributed rather to the pandemic recurrence of the plague. Tendencies and movements already discernible were increased and accelerated. The population, estimated at 2,500,000–4,000,000 in about 1300, had already begun to decline by 1348. In 1400, however, it was perhaps half what it had been 100 years ear-

lier. The Black Death certainly caused the depopulation or total disappearance of about 1,000 villages. Moreover there had already been some commutation of villein services and introduction of leasehold before the Black Death. Many of these changes brought a new fluidity to the hitherto rigid structures of society.

The population of western Europe did not again reach its pre-1348 level until the beginning of the 16th century and some historians consider the development of several countries to have been seriously retarded by endemic plague. F. A. Gasquet, who first drew attention to the violent incidence and the grave consequences of the Black Death in his book *The Great Pestilence* (1893), regarded it as the dividing point between medieval and modern history. However exaggerated his thesis, it has at least the merit of stressing the exceptional importance of the greatest disaster in western European history.

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BLACK DROP, in astronomy, an apparent distortion of the planets Mercury or Venus at the time of internal contact with the edge of the sun at the beginning or end of a transit. (A "transit" of Mercury or Venus refers to a passage by either planet between the earth and the sun; *see* MERCURY; VENUS.) The black drop has been in the past a source of much perplexity to observers of transits, but is now understood to be a result of an optical phenomenon produced by the atmosphere or by the aberration of the observing telescope.

BLACKETT, PATRICK MAYNARD STUART (1897–), British physicist, received the Nobel prize for physics in 1948 for his discoveries in cosmic radiation. He was born in London on Nov. 18, 1897. After graduating from Cambridge in 1921 he spent ten years as a research worker in the Cavendish laboratory. Early in this period Blackett began to develop the cloud chamber (*q.v.*) of C. T. R. Wilson into an automatic instrument for the study of nuclear disintegrations. Adapting this instrument to the investigation of cosmic radiation, Blackett devised the counter-controlled cloud chamber. The development of this powerful instrument and Blackett's subsequent successful application of it to the gathering of data on cosmic radiation were recognized by the award of the Nobel prize. He was elected fellow of the Royal society in 1933.

From 1933 to 1937, Blackett was London university professor of physics at Birkbeck college, leaving to become Langworthy professor of physics in the University of Manchester. While establishing a school of cosmic ray research that was internationally renowned, Blackett stimulated the development of other research interests, the most notable of which led to the creation of the first chair of radio astronomy and the building of the Jodrell Bank experimental station for radio astronomy.

In 1953 Blackett was appointed professor and head of the physics department of the Imperial College of Science and Technology, London. (N. CE.; X.)

BLACKETT, WILLIAM CUTHBERT (1859–1935), pioneer in the dilution of coal dust with inert rock, or stone, dust to render it harmless, was born at Durham, Eng., on Nov. 18, 1859. Following study at the Durham College of Physical Science and mining apprenticeship, he undertook mine management and, from 1887, was in charge of all the mines of the Charlaw and Sacriston collieries. He had wide experience of colliery explosions, was one of the first to recognize the danger of coal dust and was the first person in the north of England to use inert dust to render harmless the coal dust in mine passageways. He patented a number of mechanical appliances and safety devices for use in mines and served on many committees dealing with mine accidents. Among the honours and awards bestowed upon him were the Royal Humane society's silver medal for gallant rescue work (1903), the Greenwell medal of the North of England Institute of Mining and Mechanical Engineers (1906), presidency of that institute (1912–14), the medal of the Institution of Mining Engineers (1917) and presidency of that institution (1919–20). Blackett died at Durham on June 13, 1935. (C. W. D.)

BLACK-EYED SUSAN. A species of coneflower (*Rudbeckia hirta*), called also yellow daisy, native to dry open grounds from Ontario to Manitoba southward to Florida and Texas and widely distributed east of this area as a troublesome weed. It is a rough, hairy herb, about 2 ft. high, with thick, lance-shaped leaves and long leafless flower stalks with a single large head, 3 in. to 4 in. across, composed of brilliant golden-yellow ray flowers surrounding a dark brown cone-shaped centre (disk). It is a handsome but weedy American wild flower, rarely grown for ornament, and is the state flower of Maryland.

BLACKFISH, the name applied to various dark-coloured fishes. In the United States, it most commonly refers to the tautog (*Tautoga onitis*), but is also used of the black sea bass (*Centropristes striatus*) of Atlantic waters, and a minnow (*Orthodon microlepidotus*) of central California. In Alaska, the blackfish is the small, fresh-water *Dallia pectoralis*. In England, it is *Centrolophus niger*, a fish about 2 ft. long and shaped like a perch. By whalers "blackfish" denotes whales of the genus *Globicephalus*, which includes the ca'ing or pilot whale (*G. melas*).

BLACK FLY, any member of the family Simuliidae of the order Diptera (*see* FLY), regardless of colour, which is generally black or gray, only a few being yellowish. About 300 kinds are known, widely distributed throughout the world. They are also called turkey gnats and buffalo gnats. They are small, humpbacked flies with gauzy wings, stout antennae and legs and rather short mouth parts adapted for blood sucking. Only the females bite; they are sometimes so abundant as to kill chickens, birds and other domestic animals.

Simuliid adults, *Simulium caecutiens* in Africa and *Eusimulium avidum* and *E. ochraceum* in America, are vectors of nematode worms. *Onchocerca volvulus*, causing the disease onchocerciasis in man, is known from Mexico, Central America and Africa, and results in blindness if the worms settle in the eye; otherwise it causes subcutaneous nodules.

The larvae and pupae are aquatic, living only in flowing or moving water, in streams and on wave-washed shores. The larvae occur on stones, dams, weeds, etc., in fast flowing streams. The adults emerge directly from the water; the pupa frees itself from its cocoon, rises to the surface on a bubble of air, the back splits open, and the adult emerges and flies away. Repellents used for mosquitoes keep them away.

See also ENTOMOLOGY: *Medical and Veterinary Entomology.* (C. H. CN.)

BLACKFOOT, a group of three closely related and allied Algonkian-speaking tribes in Alberta and Montana, also known as Siksika and comprising the Blackfoot proper, Piegan and Blood. In the early years of the 18th century these tribes were pedestrian buffalo hunters living in the Saskatchewan valley about 400 mi. E. of the Rockies. Before 1750 they acquired horses and firearms. Driving weaker tribes before them they pushed westward to the Rockies and southward into present Montana. At the height of their power, in the first half of the 19th century, the Blackfoot held a vast territory extending from the North Saskatchewan to the southernmost headwaters of the Missouri.

The Blackfoot were known to fur traders as the strongest and most aggressive military power on the northwestern plains. For a quarter century after 1806 they prevented Americans from trapping in the rich beaver country of the upper tributaries of the Missouri. At the same time they warred upon neighbouring tribes, capturing horses and taking scalps. Horses were their wealth. Some rich men owned hundreds of these animals. Poor men had few or none at all. Each Blackfoot tribe was divided into several hunting bands led by one or more chiefs. These bands wintered separately in sheltered river valleys. In summer the scattered bands gathered in a great encampment to observe the sun dance, the principal tribal religious ceremony. Many individuals owned elaborate medicine bundles which they believed would bring success in war and protection against sickness and misfortune.

For three decades after their first treaty with the United States

in 1855, white men's efforts to encourage the Blackfoot to forsake the chase in favour of farming were of little avail. When the buffalo were almost exterminated in the early 1880s, nearly one quarter of the Piegan died of starvation. Thereafter the Blackfoot made progress as farmers and cattlemen. In 1950 approximately 5,900 Indians (mostly of Piegan descent) lived on the Blackfoot reservation in Montana. Less than 20% of them were fullbloods. In addition there were 2,600 Indians on the Blackfoot, Blood and Piegan reserves in Alberta. *See* also ALGONKIAN TRIBES; PLAINS INDIANS.

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BLACK FOREST (SCHWARZWALD), a highland in southwest Germany, in the *Land* of Baden-Württemberg, Federal Republic of Germany. Area 2,320 sq.mi.; total length, about 100 mi.; breadth varying from 10 to 25 mi. Structurally and topographically the Black Forest forms the counterpart of the Vosges, which lies west of the sunken valley of the Rhine.

The Black Forest is mainly a granite highland with rounded summit levels, though its northern part consists of forested red sandstones. It drops abruptly to the Rhine plain. It is bordered to the south by a narrow band of lower and more fertile limestone country. It is divided into two parts by the deep Kinzig valley, with the highest summits; *e.g.*, Feldberg (4,905 ft.), Herzogenhorn (4,642 ft.) and Blössling (4,295 ft.), to the south. The northern half has an average height of 2,000 ft. The climate in the higher districts is raw and only hardy cereals are grown; but the valleys are warm, with good pasture land. Oak and beech woods clothe the lower spurs, while stretching up to 4,000 ft. are the extensive forests of fir which have made the terms "forest" and "mountain" synonyms there. The excellent timber is partly sawn in the valleys and partly exported down the Rhine in logs. The manufacture of watches, clocks, toys and musical instruments is typical of this and other forested areas of central Europe.

There are numerous mineral springs and watering places, *e.g.*, Baden-Baden and Wildbad. The towns of Freiburg im Breisgau, Rastatt, Offenburg and Lahr lie under the western slopes. The Black Forest is a favourite tourist and winter sports resort.

(R. E. Di.)

BLACK FRIDAY, a term sometimes applied to Good Friday or to some specific Friday on which a serious crisis occurred. In England the term was used as early as the 18th century to denote the date Dec. 6, 1745, when news of the landing on English shores of the Young Pretender reached London and caused a panic. More than a century later the term was applied to May 11, 1866, when the banking house of Overend and Gurney of London failed and caused widespread financial distress.

In U.S. history, Sept. 24, 1869, came to be known as Black Friday because of the panic in the securities market that occurred then. For some time before that date the balance of trade had been running steadily against the United States and gold was being drained out of the country in tremendous amounts. This situation suggested to Jay Gould, the financier and speculator, and James Fisk, the Erie railroad magnate, that they might be able to corner the available gold supply, drive the price up and thus make a huge profit. Through the influence of his friend, Abel R. Corbin, who was Grant's brother-in-law, Gould was able to persuade the president not to release any government gold for sale, for that would have prevented his maintaining his corner on gold. In a short time, buying by Fisk and Gould forced the price of $100 in gold up to $140 in paper money, a price that was reached on Sept. 20, 1869. But by this time Grant realized what Gould and Fisk were doing. Gould learned that the president intended to sell government gold and secretly began selling his own. But he did not inform Fisk, who continued buying until Friday, Sept. 24, when the price of gold touched 163½. Finally, the secretary of the treasury ordered the sale of $4,000,000 in government gold, which quickly reduced the price to 133 and caused a panic in the securities market.

Another financial crisis occurred in U.S. history on Sept. 19, 1873, another Friday. The day before, the firm of Jay Cooke and Co. had failed, and Sept. 19 saw the failure of many other investment firms, marking the beginning of the panic of 1873.

(B. Mi.)

BLACK HAW (*Viburnum prunifolium*), a showy North American shrub or small tree of the honeysuckle family (Caprifoliaceae), called also stagbush, and often cultivated for ornament. It grows in dry soil from Connecticut and southern New York westward to Michigan and southward to northern Georgia, Texas and eastern Kansas. Although somewhat bushy in habit, with a short, usually crooked trunk, six to eight inches in diameter, and rigid, spreading branches, it sometimes reaches 30 ft. in height. It bears smooth, ovate, very finely toothed leaves and numerous small white flowers in compact clusters, two to four inches broad, and sweet, edible, bluish-black fruits (drupes), about one-third inch long, each containing a much flattened stone. The similar but larger southern black haw (*V. rufidulum*), sometimes 40 ft. high, with fruit one-half inch or more long and containing a nearly orbicular stone, is found in dry upland woods from Virginia westward to Missouri and southward to Florida and Texas.

ROCHE PHOTOGRAPH

BLACK HAW (VIBURNUM PRUNIFOLIUM)

The nannyberry or sheepberry (*V. lentago*) in some districts is called also black haw. In the Carolinas the root bark of *V. prunifolium* was once widely collected as a source of the "fluid-extract of black haw." This contains a crystalline glycoside thought to provide an effective depressant of uterine contractions.

See VIBURNUM. (E. S. Hr.; N. Tr.)

BLACK HAWK (Indian MA-KA-TAI-ME-SHE-KIA-KIAK) (1767–1838), a chief of the Sauk and Fox Indians, was born at Sauk village, Illinois, near the Mississippi river in 1767. Naturally antagonistic to Americans who were settling in territory which he insisted his people had not surrendered, Black Hawk joined the British in a number of engagements in the War of 1812. Thereafter U.S. officials cultivated Keokuk, a rival chief, and thus incensed Black Hawk and confirmed him in his hatred of Americans. With other discontented Sauk and Fox Indians he conferred with the British, who encouraged the Indians in their intransigence and gave them medals and supplies. For a time Keokuk's moderation prevailed, but as white men continued to penetrate the disputed territory, taking over the Indians' cornfields and cabins, Black Hawk regained power.

In 1832 Black Hawk and his British band were led to believe that other tribes would aid them, and were at the same time made desperate by hunger for food and for their old homeland. They crossed the Mississippi to the disputed area to plant crops and to resist further white encroachments. That the band of 1,000 included old men, women and children shows the move was not aggressive. Gov. John Reynolds of Illinois, alarmed at the "invasion," called out the militia and the United States despatched troops to repel the redmen. Black Hawk's band first caught the militia unaware and inflicted on them a stinging defeat. But their strength soon waned. The expected aid from other tribes did not materialize; food supplies were quickly exhausted; desertions, malnutrition and illness took their toll. During the Indians' retreat northward through the Rock valley bloody atrocities were committed on both sides. The superior forces prevailed and in the final battle or massacre at the Bad Axe river most of the surviving band were brutally slaughtered. Black Hawk himself escaped but was shortly captured and taken east where he was put in jail. In 1834 he was returned as a hostage to Keokuk's charge, a final blow to his pride from which he never recovered. He died Oct. 3,

1838. A later generation saw Black Hawk as a romantic figure and erected a huge statue of him by Lorado Taft near Oregon, Ill.

Black Hawk's own story was told in *Life of Ma-ka-tai-me-she-kia-kiak* (1833).

See William T. Hagan, *The Sac and Fox Indians* (1958). (P. W. G.)

BLACKHEATH, an open common and residential district, mainly in the boroughs of Lewisham and Greenwich (*qq.v.*), 6 mi. S.E. of Charing Cross, London, Eng. This high-lying tract was crossed by the Roman Watling street from Kent, on a line approximating to that of the modern Shooter's Hill; and was a rallying ground of Wat Tyler (1381), of Jack Cade (1450), and of Lord Audley, a leader of the Cornish rebels, defeated and captured there in 1497. It was once the haunt of highwaymen.

At Blackheath the citizens of London greeted Henry V on his return from Agincourt, and the army of the Restoration met Charles II there. The introduction into England of the game of golf is traditionally placed there in 1608, and attributed to King James I and his Scottish followers. Ancient barrows were opened on the heath. The common, with an area of 267 ac. (179 ac. in Lewisham), is used as a recreation ground.

BLACK HILLS, an isolated mountain range in western South Dakota and eastern Wyoming, U.S. The mountain mass has an elliptical shape; the north-south axis extends for 88 mi. and the shorter east-west axis for 60 mi. The hills rise about 3,000 ft. above the surrounding Great Plains. The highest peak, Harney, has an altitude of 7,242 ft. The Black hills are a result of upwarping of the earth's crust; removal of the higher portions of the dome by stream erosion has produced the present unique topographic features.

Scientific explorations began in the area as early as 1849 and some placer gold was worked. Members of a military expedition under George A. Custer discovered rich veins of gold in 1874. This discovery led to the gold rush days of 1875–76 and the great boom period of the area. One rich vein of gold (Homestake) located at Lead has yielded $500,000,000. In addition to gold, 29 other minerals have been found in the area, including beryllium and lithium, both of which are necessary in the production of atomic energy. Immediately west of Rapid City is Mount Rushmore National memorial (*q.v.*), a noted tourist attraction.

The climate of the Black hills is humid in contrast with the semiarid conditions of the surrounding plains. In response to these climatic differences the short grasses of the plains give way to the cedars and junipers of the foothills and the forests of spruce, ponderosa pine, lodgepole pine and limber pine further up the slopes. From a distance the forested slopes have a dark appearance—thus the name. Lumbering and grazing under government regulation are important activities. (H. B. Ha.)

BLACK JACK, one of the world's most popular gambling games played with cards, is a version of the French game *vingt-et-un* or twenty-one (as it is known in U.S. gambling houses) and is basically similar to baccarat (*q.v.*). Its aim, to acquire a total card value as near as possible to a given figure without exceeding it, is a principle of gambling games known long before playing cards were invented.

In black jack, the desired total is 21. A player tries to acquire cards which count exactly 21 or to stop closer below it than does the dealer (banker) against whom all betting is done.

Any number may play, using the standard 52-card deck. If there are a large number of players, two decks may be shuffled together and used as one. An ace counts 1 or 11 at the option of the holder, picture face cards count 10 each and all others take their pip or number value.

Play.—First dealer is chosen by cutting for high card or dealing until someone receives the first ace. After the deck is shuffled and cut, dealer exposes the top card and "burns" it by placing it face up at the bottom of the pack. If the top card is an ace, the deck must be reshuffled and another card burned. Dealer then gives each player, including himself, one card face down. Each player looks at his card and places a bet. The maximum bet may be established by agreement before the game begins or by each dealer for his deal.

Dealer then looks at his own card and may, if he wishes, double all bets. He then deals to each other player and to himself a second card face up. Cards are always dealt clockwise, beginning at the dealer's left.

If a player's first two cards total exactly 21 he has a "natural" or "black jack," and wins double his bet. If dealer has a natural he shows it at once and collects double from all players except one with another natural, who pays only what he bet.

After all bets on naturals have been settled, dealer offers additional cards to each player in turn. A player may "stand" on his two cards or ask for more by saying "hit me." Additional cards are then dealt to him face up one at a time, until he stands or goes over 21 (busts). If he busts, he pays the dealer immediately.

At dealer's turn, which is last, he may also stand or draw. If he busts, he pays any player with whom he has not already settled; if he hits 21 or stays under, he collects for a tie and from any player having a lower count, but pays to any hand nearer 21.

After each hand, dealer puts all the dealt cards face up at the bottom of the pack. When the "burned" card is reached, the deck is reshuffled and play continues. The deal, which carries a decided betting advantage, passes in rotation to the left after each deal or it may go to the first player to receive a natural.

Players' Options.—If a player's first two cards are a pair, he may turn them face up, duplicate the amount of his bet and play both as separate hands, the next card to each hand being dealt face down.

If a player's first two cards count to 11, he may turn them both face up, double his bet and receive one card face down. But he may draw no more; his bet is settled on his three cards.

Bonus Payments.—A player having a count of 21 or less in five cards can at once collect double his bet, regardless of dealer's total, or he can call for a sixth card and, if he still has less than 21 collects four times the amount of his bet. However, if the sixth card causes him to bust, he loses. A player making 21 with three sevens receives three times the amount of his bet.

Twenty-one.—As played in gambling houses the game has somewhat different rules. A permanent dealer represents the house or bank. Usually, each player must bet before any card is dealt. The dealer pays a natural one and one half times the bet, but if his own natural is tied, such ties are standoff. The dealer has no option on whether to stand or draw another card; he must stand on a count of 17 or more, but must continue to draw on 16 or less. Bonus payments are not made.

U.S. mathematics professor Edward O. Thorp in 1961 used a computer to analyze changes in probabilities for every combination as cards are played out of the deck. He identified those situations in which the odds favour the player and developed a betting system with which he beat the game at Nevada casinos.

See E. O. Thorp, *Beat the Dealer* (1962). (R. L. Fy.)

BLACKMAIL, or extortion (*q.v.*) as it is sometimes labeled, is one of the more serious crimes in Anglo-American law. In ordinary language it may be described as the demanding of money or other advantage (1) on the threat of exposure of information, true or false, about the victim; or (2) on the threat of violence to the person or property of the victim or of a third person in whom the victim has an interest. (In some jurisdictions, the term extortion is used to describe only intimidation by one acting under colour of official right.)

Blackmail was a crime at common law, though its exact scope was uncertain. At least as early as 1601, however, it became the subject of legislation and both in the British empire and the United States became generally proscribed by statute. In England, the governing provisions are to be found in sec. 29, 30 and 31 of the Larceny act of 1916. (Under these provisions, threats to obtain advantages other than money or personal property are not condemned.) In the United States, if the activities of the blackmailer come into contact with that area of regulation assigned to the national government, for example, by using the U.S. mails to make the threat, they could constitute a federal crime as defined in sec. 871 through 877 of the U.S. criminal code. Generally, however, the crime of blackmail is controlled by the laws of the several states, with the consequent variations in the law which

occur from one jurisdiction to the next.

Insofar as it is possible to generalize from the myriad of governing statutes and decisions, it is the threat which constitutes the essence of the crime of blackmail; it is not necessary that the victim succumb. Some threats are illegal as blackmail although the advantage sought was believed by the threatening party to be due him and indeed was due him. Thus, a threat to use physical violence, or to accuse of wrongful acts other than the failure to satisfy the demand rightfully made, could constitute the crime, although in fact the victim was required by law to perform the very acts which the threatening party demanded of him. Some threats, on the other hand, are improper only because the advantage sought could not reasonably be believed to be due from the victim. Thus a threat to sue or to accuse of not satisfying a liability could constitute blackmail if the threatening party made the threats with knowledge that his demands could not be made in good faith. Most prosecutions for blackmail involve those cases in which the threat is made without any pretension to a right to the money, property or other advantage demanded. It is not blackmail, however, to demand in good faith indemnity for a wrong actually suffered even though legal proceedings to enforce the demand might in fact bring shame and disgrace upon the person addressed.

Some jurisdictions follow the English example of permitting the victim of a blackmailing to prosecute in anonymity. Most jurisdictions, however, do not grant this protection to extortion victims. In these, the victim is put to the very difficult question of whether he should initiate prosecution which may bring about the very publicity with which he may be threatened by the blackmailer.

Punishment for conviction for blackmail is usually severe. The law in England draws a distinction between demanding with menaces, demanding with intent to steal, and threatening to publish with intent to extort. In England, where the crime has been appropriately called moral murder, punishment may be as heavy as life imprisonment. In spite of the weight of punishment usually accorded, the incidence of this crime is high. (P. B. K.)

BLACKMORE, SIR RICHARD (1654–1729), English physician and writer, who became physician in ordinary to William III (who knighted him in 1697 for professional services) and Anne. He was born at Corsham, Wiltshire, and died, on Oct. 9, 1729, at Boxted, Essex. Though he regarded poetry as merely the entertainment of his idle hours, he found time to write four epics in ten or more books, *Prince Arthur* (1695), *King Arthur* (1697), *Eliza* (1705) and *Alfred* (1723). He also wrote *Creation, A Philosophical Poem* (1712), designed to counter the spirit of skepticism by demonstrating "the Self-Existence of an Eternal Mind from the created and dependent Existence of the Universe"; this received high commendation in the *Spectator*. To each poem he wrote a preface censuring the lewdness and impiety of modern wits, a subject also treated in his verse *Satyr Against Wit* (1700). These and other writings in prose provoked retorts from Alexander Pope and his friends, and earned Blackmore his reputation as "father of the Bathos, and indeed the Homer of it."

See Richard C. Boys, *Sir Richard Blackmore and the Wits* (1949); E. Hudson Long, "Notes on Sir Richard Blackmore," *Modern Language Notes*, lviii, 585–9 (1943). (J. E. Br.)

BLACKMORE, RICHARD DODDRIDGE (1825–1900), English Victorian novelist whose west country romance *Lorna Doone* holds a secure place among English historical novels, was born on June 7, 1825, at the parsonage of Longworth, Berkshire. Educated at Blundell's school, Tiverton, and Exeter college, Oxford, he was called to the bar but withdrew because of ill-health. He married in 1852 and taught classics for five years. Then, upon receiving a legacy, he bought a property at Teddington and settled down to fruitgrowing and novel writing.

After publishing some poems, Blackmore produced *Clara Vaughan*, a first and fairly successful novel, in 1864 and *Cradock Nowell* in 1866. *Lorna Doone* (1869) was his third. Its popularity grew slowly, until the qualities of this imaginative and exciting tale of Exmoor eventually brought it fame. Blackmore himself, a shy, reserved, but kindly man who was prouder of his peach orchard than of his 14 novels, preferred *The Maid of Sker* (1872) but is remembered for *Lorna Doone*. He died at Teddington on Jan. 20, 1900.

See M. Elwin, *Victorian Wallflowers* (1934); Q. G. Burris, "R. D. B.: His Life and Novels," *University of Illinois Studies in Language and Literature* (1930), which includes bibliography.

BLACK MUSLIMS (Nation of Islam) is an independent socioreligious movement indigenous to certain Negro communities in the United States. The movement was founded by Wali Farad, believed to have been an orthodox Muslim born in Mecca around 1877, who migrated to the United States in 1930 and established his first temple (or mosque) in Detroit a year later. Shortly thereafter he founded a second temple in Chicago.

Most of Farad's initial followers were Negro migrants from the southern United States, who, because of prevailing racial policies and economic conditions were clustered together in the Negro ghettos of the great northern industrial cities. They believed Farad to be an incarnation of Allah who had come to liberate the "Lost-Found Nation of Islam in the West." Farad promised that if they would give heed to his teachings and learn the truth about themselves, they would overcome their white "slavemasters" and be restored to a position of dignity and primacy among the peoples of the world.

Chief developer of the movement was Elijah Muhammad, who succeeded Farad as leader or "messenger" in 1934. Muhammad, whose legal name was Elijah Poole, was born on a farm in Sandersville, Ga., on Oct. 10, 1897, the son of a Baptist preacher who derived his chief income from sharecropping. After a boyhood spent mostly on the farm, Muhammad and his wife (Clara Evans) moved their family to Detroit, Mich., in 1923, and there he came under the teachings of Wali Farad.

Under Muhammad the movement spread slowly at first. By the end of World War II, however, American Negroes had caught the spirit of protest and black nationalism that was sweeping Africa. The Muslim movement benefited directly from the pent-up frustrations of the Negro masses and offered them a militant expression. Soon there were mosques in all larger cities with sizable Negro populations.

The Black Muslims believe in the moral and cultural superiority of the "black man" and that all extant white civilizations must inevitably give way to an advancing, world-wide, black hegemony. The movement observes many of the ritual forms of orthodox Islam but limits its membership to Negroes and other nonwhites. All Caucasians are held to be "devils" and inherently incapable of the rigid moral practices demanded of the Nation of Islam. Christianity is regarded as the white man's chief stratagem for the enslavement of nonwhite people.

For a detailed study of the movement *see* C. Eric Lincoln, *The Black Muslims in America* (1961); *see* also E. U. Essien-Udom in *Britannica Book of the Year 1964*, pp. 253–255. (C. E. L.)

BLACK PLATE: *see* Tin Plate and Terneplate.

BLACKPOOL, a municipal, county (1904) and parliamentary (1918) borough of Lancashire, Eng., 17 mi. W.N.W. of Preston by road. Pop. (1961) 152,133. Area 13.2 sq.mi. This town on the Irish sea was in the 16th century a small hamlet known as Pool Houses, but by the 1780s it was already in vogue as a bathing place consisting of houses and inns scattered along the coastline. When William Hutton, a Birmingham man, visited Blackpool with his family in 1788, he wrote about the resort and his booklet was immediately bought up by enterprising innkeepers. This "infant commonwealth" had a coffee room, several hotels and a reputation for the health-giving effects of the sea water. The town's rapid growth was related to that of the Lancashire industrial area. With the development of a fast railway service and places of amusement, Blackpool attracted visitors from all over the country and by the 1960s more than 8,000,000 were being catered for every year in more than 5,000 hotels and boardinghouses. The sea front with its long sandy beach is well laid out; seven miles of promenade have been constructed, often with several tiers. There are spectacular illuminations at night. The front is dominated by a 520-ft. steel tower (built in 1895 and modeled on the Eiffel tower in Paris) containing a large ballroom, winter gardens, an aquarium, etc.

There are three piers, five swimming pools, four golf courses and a large amusement park. Stanley park, opened in 1926, provides about 300 ac. of pleasure gardens. Blackpool is a popular centre for conferences.

Besides the tourist trade, industries include the making of biscuits, sweets (candies), prefabricated joinery, aircraft, market gardening and coachbuilding. There is an airfield at Squire's Gate, 3 mi. S.S.E. The town was incorporated in 1876 and returns two members to parliament.

BLACK RIVER, the name of several rivers in the United States. The major ones include: (1) a 280-mi.-long stream which rises in the Ozarks of southeastern Missouri, flows southeasterly to Poplar Bluff, and then continues southwesterly to a junction with the White river near Newport, Ark. Limited navigation is possible for shallow draft vessels in the lower 15 mi. of its course. Its main tributary is the Current river. Clearwater dam near Piedmont, Mo., was constructed on the Black river as a major flood control project. (2) A 160-mi.-long stream which rises in north-central Wisconsin and flows southwestward to a junction with the Mississippi river near La Crosse. The lower one and one-half mile stretch has a depth maintained at nine feet for seasonal barge traffic delivering coal and petroleum products. There is also a Black river in northwestern Wisconsin. It features the 165-ft.-high Manitou falls of Pattison state park near Superior. (3) A 101-mi.-long tributary of the Red river in central Louisiana, formed by the confluence of the Ouachita and Tensas rivers. It is navigable all year with a depth maintained at 6.5 ft. Traffic consists mainly of chemicals and logs. (4) A 50-mi.-long tributary of the Cape Fear river in southeastern North Carolina. (5) A 235-mi.-long tributary of the Pee Dee river in northeastern South Carolina. (6) A 40-mi.-long river in south-central Vermont which joins the Connecticut river near Springfield. Another Black river in northern Vermont flows into Lake Memphremagog on the Canadian border. (7) A 120-mi.-long stream in northern New York which rises in the Adirondacks and flows northwesterly into Lake Ontario and which furnishes power to local pulp and paper mills. (E. Hg.)

BLACK ROCK DESERT, an arid region of lava beds and alkali flats is situated in Humboldt and Pershing counties of northwestern Nevada, U.S. About 70 mi. long and in some places 20 mi. wide, the desert embraces an area of about 1,000 sq.mi. The belt of greatest aridity (less than four inches of rainfall annually) extends from the northeast to the southwest just east of the Pine Forest and Black Rock mountain ranges.

The desert serves as the "sink" of the Quinn river, and, at times, is largely covered with water only a few inches deep. When the water evaporates in the summer it leaves a clay-bed of remarkable hardness, which is frequently encrusted with saline matter of a snowy whiteness. The section in the northwest corner of Pershing county is sometimes known as Granite Creek desert while the southwest extension of the Black Rock is called Smoke Creek desert.

BLACK ROD (more fully, "gentleman usher of the Black Rod"), an official of the house of lords, instituted in 1350. His appointment is by royal letters patent, and his title is due to his staff of office, an ebony stick surmounted with a gold lion. He is a personal attendant of the sovereign in the upper house, and is also usher of the order of the Garter, being doorkeeper at the meetings of the knights' chapter. He is responsible for the maintenance of order in the house of lords, and on him falls the duty of arresting any peer guilty of breach of privilege or other offense of which the house takes cognizance. In this respect his duties correspond to those of sergeant at arms in the house of commons.

The duty which brings him most into prominence, however, is that of summoning the commons and their speaker to the upper house to hear a speech from the throne or the royal assent given to bills. If the sovereign is present in parliament, Black Rod "commands" the attendance of the gentlemen of the commons, but when lords commissioners represent the sovereign he only "desires" such attendance.

Black Rod is on such occasions the central figure of a curious ceremony of much historic significance. As soon as the attendants of the house of commons are aware of his approach, they close the doors in his face. Black Rod then strikes three times with his staff, and on being asked "Who is there?" replies "Black Rod." Being then admitted he advances to the bar of the house, makes three obeisances and says, "Mr. Speaker, the King (Queen) commands this honourable House to attend His (Her) Majesty immediately in the House of Lords." This formality originated in the famous attempt of Charles I to arrest the five members, John Hampden, John Pym, Denzil Holles, Hasilrige and William Strode, in 1642. Indignant at this breach of privilege, the house of commons has ever since maintained its right of freedom of speech and uninterrupted debate by the closing of the doors on the sovereign's representative.

BLACK SEA, a large inland body of water, bounded by the U.S.S.R. on the north and east, by Rumania and Bulgaria on the west, and by Turkey on the south and southwest. Egress is through the Bosporus into the Sea of Marmara and the Dardanelles into the Aegean, and then into the Mediterranean. Kerch strait leads into the enclosed Sea of Azov, a gulflike projection to the northeast.

BLACK SEA, SHOWING INTERNATIONAL BOUNDARIES AFTER WORLD WAR II

Extending 330 mi. in its greatest width and 630 mi. in length, the sea covers an area of about 180,000 sq.mi. Depth increases progressively from north to south. West of Crimea it is nowhere deeper than 500 ft. and much of it is less than 150 ft. South of Crimea it sinks rapidly to 5,000 ft., reaching a maximum of more than 7,000 ft. northwest of Sinop on the Anatolian coast.

The shape of the Black sea was formed in an early geological period when the connection with the Mediterranean was opened. Previously it had been a deep brackish lake. The consequent rise in level flooded the lowland along its northern coast, drowning the estuaries of the rivers and creating a liman coast. Because of the great volume of water carried to the sea by the Danube, Dnieper, Don (via the Sea of Azov) and other rivers, the surface is relatively fresh. Below 650 ft., however, it is stagnant, as is evident from the large quantities of hydrogen sulfide and the absence of deep-sea life. The current is counterclockwise and, owing to differences in density, the surface water flows out through the Bosporus and Mediterranean water enters below 65 ft. There is little tide, but storms are frequent and sudden, causing considerable fluctuation in level along the coasts. The Sea of Azov is shallow, the maximum depth not exceeding 48 ft.

The shores of the Black sea are varied. On the west, from Cape Rumeli to Cape Kaliakra, the land rises to a moderate height around the sea, backed by picturesque mountains. Along the northwest and north the shore is again low, although near Odessa a series of bluffs provide an attractive setting for this major Russian port. At the mouths of the rivers heavy deposition occurs,

impeding navigation. The Danube has built a large delta, and long sandspits (*kosv*), such as the Tendra northwest of Crimea, separate quiet lagoons from the sea. Because of shallowness and low salinity, ice is frequent along the coast in winter. The Azov may be frozen up to three months. Mountains parallel much of the south coast of Crimea. Small, deep bays occur, such as at Yalta, but none have the advantages which have made Sevastopol on the west side of the peninsula the best harbour on the entire Black sea. Eastward from Feodosiya, the coast is again low, the lack of elevation also characterizing the shores of the Sea of Azov.

The east side of the Black sea, from Anapa to Sukhumi (Sukhem-Kaleh), is dominated by the lofty Caucasus mountains which, in places, closely approach the sea. A regular coast, the only major embayment is at Novorossisk (Novorossiisk) in the north. South of Sukhumi is the broad, poorly drained Colchis lowland, caused by the deposition of rivers descending from the interior uplands of Georgia. The Anatolian coast, backed by the high Pontic mountains, also lacks good natural ports. Exposure to northerly winds has always made navigation difficult.

History.—The sea is said to have received its name from the Turks, who feared the open stormy expanse of water; their epithet for it was the word for black, thus Karadeniz. To the ancients, however, it became, with knowledge, the Pontus Euxinus, or "hospitable sea." Across it, according to the story of the Argonauts, Jason sailed to Colchis in search of the Golden Fleece. Seven centuries B.C. the Greeks planted trading colonies on the south coast at Trabzon and Sinop, from which copper and iron, brought from the interior, were shipped to the Aegean islands. Additional colonies were founded about Kerch strait where they could control the trade and fisheries of the Azov region, on Crimea, and at the mouths of the northern rivers. By the 4th century B.C. half the grain imported by Athens originated on the shores of the Sea of Azov. Economic decline set in, due, in part, to the dislocation caused by the migration westward across the open grassland, or steppe, of successive waves of people from central Asia.

With the founding of Constantinople in A.D. 330, the importance of the Black sea increased considerably. From the 8th to the 10th centuries, trade flourished, especially between Byzantium and the Khazars, a people of Turkish origin converted to Judaism and securely in control of the territory east of the Don. In the 9th century, a new element appeared with the establishment of the Eastern Slavs on the Dnieper about Kiev, astride the great trade route which led from the Baltic to the Bosporus. In A.D. 907, Oleg, prince of Kiev, led an expedition against Constantinople and in 911 Byzantium and Kievan Rus signed a treaty of commerce. Slavic traders were everywhere. The attempt of Kiev to dominate the trade of the Black sea was far from successful, however. In the 11th century, Seljuk Turks devastated the southeast coast of the Black sea while Petchenegs and Kumans harassed the steppe dwellers. In the 13th century, Mongol horsemen overran Kiev and severed the Varangian route. Finally, the fall of Constantinople to the Ottoman Turks in 1453 ushered in a new era. For almost three centuries thereafter the sea was a Turkish lake, with commerce in the hands of Italian, French and, later, English traders.

The rise and expansion of Muscovy brought changes to the political complexion of the lands draining into the Black sea. Peter the Great, sea-minded and determined to westernize his country, recognized the need for a strong Black sea fleet to protect his growing commerce from Turkish attack. Campaigns against the remnants of the Mongol horde in the Crimea and the Kuban led to the construction of arsenals in the Sea of Azov and the laying of the foundations of future naval power. Under Peter's successors, Russia's growing ambition to gain control of the straits leading to the Mediterranean brought the new empire of the north into repeated collision with the Ottoman empire. Success led Russia to annex the territory between the Bug and the Dniester (1789) and Bessarabia (1812). Expansion also occurred into the Trans-Caucasus.

Economic development ensued, necessitating the construction of ports. Nikolayev on the Bug was founded in 1788, and Odessa was established in 1794. The Sevastopol naval base was begun in 1784. During the 18th and 19th centuries, weakened Ottoman control of the territory southwest of Bessarabia led to the emergence of independent Rumania and Bulgaria. A major setback to the growth of Russian power in the Black sea came in the treaty of Paris, which ended the Crimean War in 1856. However, Russia repudiated the restrictions in 1870 and until 1914 remained free to develop its resources in the Black sea. For the U.S.S.R. the Black sea, navigable throughout the year, is a waterway of major importance. In the coasting trade, oil is shipped from Batumi (Batum) and Novorossisk, manganese from Poti, coal from Zhdanov on the Azov sea, iron ore from Kerch, cement from Novorossisk, and grain from Odessa, Nikolayev, Kherson and Novorossisk. Oil and cement are also transported from the Black sea to Leningrad and the Soviet far east.

Sinop and Trabzon never recaptured for modern Turkey their ancient importance, but Zonguldak, to the west, ships local coal to domestic markets elsewhere. Constanţa in Rumania and Varna and Burgas in Bulgaria have local significance.

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BLACK SNAKE, in America, a name usually applied to *Coluber constrictor constrictor,* also called the northern black racer, a common harmless colubrine snake, black above and lighter beneath with a white chin. It ranges from southeastern Canada through the eastern United States. Subspecies occur across North America south to Guatemala; the most familiar are the blue racer of the central states, olive to bluish gray above with a bluish to yellow belly, and the southern black racer of the southeastern states.

The black snake is slender, usually 4 to 5 ft. long, rarely larger. It is alert, active and diurnal, and climbs and swims well. When alarmed it vibrates the tip of the tail, producing a buzzing sound. Mating occurs in spring; 10 to 35 eggs, laid from May through July, hatch in seven to nine weeks. The eggs are coated with granules resembling salt grains. The young are gray with reddish brown blotches. Food of the black snake includes insects, frogs, reptiles, birds, eggs and small mammals.

WALTER DAWN FROM NATIONAL AUDUBON SOCIETY

BLACK SNAKES (COLUBER CONSTRICTOR SUBSPECIES) MATING

The Australian black snake (*Pseudechis porphyriacus*), bluish black with a red belly and four and one-half to five and one-half ft. long, is venomous, but not highly dangerous. In Egypt, the middle east and northern India various cobras are sometimes called black snake. (S. A. M.)

BLACKSTONE, SIR WILLIAM (1723–1780), the most famous of English jurists, was born in Cheapside on July 10, 1723, the posthumous son of Charles Blackstone, silkman, citizen and bowyer, of London. From Charterhouse school he went at the age of 15 to Pembroke college, Oxford, and was entered at the Middle Temple in 1741. He was elected a fellow of All Souls in 1744, devoted himself ardently to the interests of the college, became bursar and prepared his *Essay on Collateral Consanguinity* to defeat the claims to fellowships of people who were of any degree

of kin to the founder, claims which threatened to lower the prestige and efficiency of the foundation of Archbishop Chichele. Called to the bar in 1746, he was chosen by the ancient borough of Wallingford as its recorder in 1749. He tried to practise at the bar during this period, but with so little success that in 1753 he was minded to quit London altogether and devote himself to an academic life. In Michaelmas term 1753 he began to read law lectures at Oxford. His hearers were captivated by the lucidity and charm of his style and by the simplicity with which he presented the subject, slurring over the difficulties and contrarieties of the law, giving the whole subject an air of completeness and mutual interdependence as if it were a uniform logical system, suppressing or ignoring the archaic learning and putting forward the English law as the embodiment of 18th-century wisdom.

But from the first he antagonized his rival for the position of the greatest English jurist, Jeremy Bentham, who seemed to dislike him as much as a man as he mistrusted him as a teacher. Bentham wrote of him that he was "a formal, precise and affected lecturer, just what you would expect from the character of his writings, cold, reserved and wary, exhibiting a frigid pride"; he, however, qualified to some extent this mordant censure when he also wrote: "correct, elegant, unembarrassed, the *style* is such as could scarce fail to recommend a work still more vicious in point of *matter* to the multitude of readers. He it is, in short, who, first of all institutional writers, has taught jurisprudence to speak the language of the scholar and the gentleman." In 1758 the lectures were first delivered in their present form. Blackstone having been elected to the newly founded Vinerian professorship, delivered the introductory lecture "On the Study of the Law," which is prefixed to the first volume of the *Commentaries*. It was some years before the author decided to present the *Commentaries* as a finished work; but notes of the lectures were in circulation, so in Nov. 1765 the first volume appeared, and the three remaining parts were published in the four succeeding years.

On May 5, 1761, he had married Sarah, daughter of James Clitherow of Boston House, Middlesex; on July 28 in the same year the earl of Westmorland, the chancellor of the university, made him principal of New Inn hall.

Professional advancement came side by side with academic. On May 6, 1761, the very day after his marriage, he received a patent of precedence giving him the rank of king's counsel. In 1763 he was made solicitor general to the queen, the first to hold that office under Queen Charlotte, to whom he dedicated the *Commentaries;* and about the same time he became a bencher of the Middle Temple where his well-known portrait by Gainsborough hangs. In that year his success at the bar led him to resign the professorship and the headship of New Inn hall, two positions which he is said by his anonymous biographer to have intended to use for the foundation of a law school. His career in parliament, to which he was elected first (1761) for Hindon, afterward for Westbury, was somewhat inglorious. He took the ministerial side in the controversy about the Middlesex election and drew a severe criticism from Junius, who boasted that he had answered "Dr. Blackstone" out of his own *Commentaries* and seemed to have completely silenced him.

Blackstone disliked attendance in parliament; this aversion, no doubt, determined him to refuse the solicitor generalship in 1770 and in February of the same year to accept a judgeship in the court of common pleas. In the ten years of his judgeship he administered the law satisfactorily but attained no special distinction, and his career is not associated with any famous trial. He seems to have given signs of rather premature decay toward 1780, attributed to his sedentary habits and avoidance of physical exercise, and on Feb. 14 of that year he died in London. Two volumes of his *Reports of Decided Cases*, with a brief memoir by his brother-in-law James Clitherow, appeared in 1781, but added little to his fame either as reporter or judge; the reports of his nephew Henry Blackstone are thought better of by the profession.

The Commentaries.—The famous *Commentaries* deserve some detailed account and criticism. Their design is exhibited in his first Vinerian lecture printed in the introduction to them. The author there dwells on the importance of noblemen, gentlemen and educated persons generally being well acquainted with the laws of their country; and his treatise, accordingly, is as far as possible a popular exposition of the laws of England. Falling into the common error of identifying the various meanings of the word law, he advances from the law of nature (being either the revealed or the inferred will of God) to municipal law, which he defines to be a rule of civil conduct prescribed by the supreme power in a state commanding what is right and prohibiting what is wrong. On this definition he founds the division observed in the *Commentaries*. The objects of law are rights and wrongs. Rights are either rights of persons or rights of things. Wrongs are either public or private. These four headings form respectively the subjects of the four books of the *Commentaries*.

Blackstone was by no means a scientific jurist. He had only the vaguest possible grasp of the elementary conceptions of law. He evidently regarded the law of gravitation, the law of nature and the law of England as different examples of the same principle—as rules of action or conduct imposed by a superior power on its subjects. He propounds in terms the doctrine that municipal or positive laws derive their validity from their conformity to the so-called law of nature or law of God. "No human laws," he says, "are of any validity if contrary to this." His distinction between rights of persons and rights of things, implying, as it would appear, that things as well as persons have rights, is attributable to a misunderstanding of the technical terms of the Roman law. In distinguishing between private and public wrongs (civil injuries and crimes) he fails to seize the true principle of the division. John Austin, who accused him of following slavishly the method of Sir Matthew Hale's *Analysis of the Law*, declares that he "blindly adopts the mistakes of his rude and compendious model; missing invariably, with a nice and surprising infelicity, the pregnant but obscure suggestions which it proffered to his attention, and which would have guided a discerning and inventive writer to an arrangement comparatively just." By the want of precise and closely defined terms, and his tendency to substitute loose literary phrases, he falls occasionally into irreconcilable contradictions. Even in discussing a subject of such immense importance as equity, he hardly takes pains to discriminate between the legal and popular senses of the word, and, from the small place which equity jurisprudence occupies in his arrangement, he would scarcely seem to have realized its true position in the law of England. Subject, however, to these strictures, the completeness of the treatise, its serviceable if not scientific order, and the power of lucid exposition possessed by the author demand emphatic recognition. Blackstone's defects as a jurist are more conspicuous in his treatment of the underlying principles and fundamental divisions of the law than in his account of its substantive principles.

Blackstone did not confine himself to the work of a legal commentator. It was his business, especially when he touched on the framework of society, to find a basis in history and reason for all the most characteristic English institutions. There is not much either of philosophy or fairness in this part of his work. Whether through the natural conservatism of a lawyer, or through his own timidity and subserviency as a man and a politician, he is always found to be a specious defender of the existing order of things. More undeniable than the political fairness of the treatise is its merit as a work of literature. It is written in a most graceful and attractive style, and although no opportunity of embellishment has been lost, the language is simple and clear. Whether because of its literary graces, or its success in flattering the prejudices of the public to which it was addressed, the influence of the book in England was extraordinary. Not only lawyers, and lawyers perhaps even less than others, accepted it as an authoritative revelation of the law. It performed for educated society in England much the same service as was rendered to the people of Rome by the publication of their previously unknown laws. It is more correct to regard it as a handbook of the law for laymen than as a legal treatise; and as the first and only book of the kind in England it was received with somewhat indiscriminating reverence. To this day Blackstone's criticism of the English constitution probably expresses the most profound political convictions of the majority of the English people.

Although Blackstone was much criticized for his superficiality and lack of the historical sense, he showed signs of the recognition of the duty of research. His two volumes of *Law Tracts* (1762) give a better impression of him as a student than the more eloquent *Commentaries* and seem to be the outcome of deeper learning and thought. But his inability to place himself in the position of legislators of remote times and his habit of justifying everything as reasonable come out very markedly in his treatment of the famous rule of the *bastard eigné* and *mulier puisné*. In the *Commentaries* themselves his account of the Revolution of 1688 exhibits these defects in the most pronounced form, as in his optimistic description of Edward VI as an amiable prince, in "the short sunshine" of whose reign England enjoyed a peculiar felicity. And his shallowness appears in his justification of the penal laws or apology for them. Instead of condemning them he says: "these laws are seldom exerted in their utmost rigour and indeed if they were it would be very difficult to excuse them." He did, however, go so far as to say in his first edition that he was not sure that some of the sectaries did not hold principles which made them as dangerous as the papists themselves, but in deference to an outbreak of indignation from the sectaries he softened or got rid of this expression in subsequent editions.

In the English law institutional writers are not recognized. The most famous and approved treatises have no such rank as is accorded for instance in Scotland to the works of James D. Stair, Henry Bell and the like. Consequently Blackstone is seldom or never referred to as an authority. His *Commentaries* are recommended for their literary value, and they have experienced the singular fate of being used as the framework upon which all the additions made to the law by statutes or decisions since his day have been attached for the use of students preparing for examinations, his original text being printed with the new matter interpolated in successive layers, producing in the result textbooks swollen out of all proportion into portents of ugliness. These monstrosities now, happily, are failing to attract as of old. And there is a reaction in favour of regarding Blackstone's great work from the standpoint of true historical and literary criticism as a complete work of art of the greatest literary merit, inadequate in deep learning, unscientific in arrangement, often mistaken in very elementary matters, but a genuine outcome of 18th-century culture and a true exposition of the 18th-century standpoint. This reaction is really the just tribute to Blackstone's greatness. (F. Sh.)

Blackstone in the U.S.—The fame of Blackstone in the 19th century was greater in the United States than in Blackstone's native land. After the Declaration of Independence the *Commentaries* were the chief source of the knowledge of English law for the commonwealth of the west. A book which in the old country was and is a textbook became in the new an oracle of law. The results were not always good. What was a true exposition of the spirit of the law in 18th-century England was unreal in the Illinois of Abraham Lincoln. Fortunately, living law in America was being shaped through local institutions. Legislators and judges were practical men in spite of the *Commentaries*. Nor did U.S. lawyers after 1850 try to copy Blackstone. With the advent of the law school reviews legal scholars escaped from Blackstone. They began to write extensively and critically, and they produced monographs in specialized areas. By the middle of the 20th century few Americans had read Blackstone even as a classic. Nevertheless, Blackstone is a symbol American lawyers remember. When the American Bar association met on its first official visit to London in July 1924, U.S. and Canadian lawyers presented to the law courts of London a plaster cast of a statue of Blackstone to be executed in marble. The sculptor was Paul Bartlett, who died before the finished statue was placed in position in June 1928. The sculptor's wife presented a bronze cast of the original statue to the United States in 1943. Ten years later this statue was placed before the United States courthouse for the District of Columbia in Washington.

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BLACK STONE OF MECCA (al-Hadjar al-Aswad), built into the eastern wall of the Ka'ba at Mecca, consists of three large pieces and some fragments of stone, surrounded by a stone ring and held together with a silver band; total diameter is about 12 in. The stone, an object of veneration by Muslim pilgrims to Mecca, probably dates back to the pre-Islamic religion of the Arabs.

BLACK VARNISH (or Japan), a class of oil varnishes in which bitumen replaces the natural gums or resins used as hardeners in clear varnish. Bitumens used include blown or unblown petroleum bitumen, natural asphalts such as gilsonite, and pitches, as from coal tar.

Because bitumen forms a protective coating against atmospheric corrosion, black varnish is widely used for ironwork, both exterior and interior, such as pipework, tanks, marine applications, stoves and roofing, and for tarpaulin.

The process of manufacture is similar to that used for clear varnish except that, as bitumen is soluble in oil, "running," or preheating the bitumen, is not necessary. Bitumen, in small pieces, is simply added to hot linseed or other drying oil together with driers such as red lead and litharge, or manganese dioxide, and the mass heated to about 450° F. until stringy. After cooling a solvent, usually turpentine substitute (white spirit), is added until the varnish is of the desired consistency. The cheapest black varnish (Brunswick black) is merely a solution of bitumen in white spirit. In coachbuilders' black japan only the purest grades of asphalt or pitch are used, together with a hard gum such as copal. A variety of black varnish known as Berlin black has a matte or eggshell finish; this is achieved by the incorporation of a proportion of vegetable or other carbon black. (E. G. Es.)

BLACK WATCH (Royal Highland Regiment), the title of a famous British Highland regiment. The origin of the regiment dates from 1725 when a number of loyal Highlanders were formed into six independent companies to help keep down lawlessness among their fellow countrymen after the abortive 1715 uprising of the clans under the earl of Mar. In enforcing the disarming act in Scotland they were required to keep a constant watch on rival clans to prevent plunder and reprisals. Their tartan, of sombre appearance (*see* Tartan), gained for the force the gaelic appellation of *Freicudan Du* ("Black Watch") in contrast to regular troops who wore scarlet coats, waistcoats and breeches, and were called *Seidaran Dearag* ("Red Soldiers"). In 1739 four additional companies were authorized and in 1740 the force was made a line regiment of the British army. The newly organized regiment was known as the 43rd foot until 1749 when it became the 42nd.

It was designated a Royal regiment in 1758 and in 1861 "Black Watch" became an official part of the name. The distinctive red plume, worn in contrast to the white plume of other Highland regiments, was authorized for the Black Watch by King George III in recognition of a daring exploit during the French Revolutionary Wars.

Other famous campaigns in which the regiment distinguished itself include the French and Indian War, the Crimean War, the Peninsular and Waterloo campaigns of the Napoleonic Wars, the South African War and World Wars I and II.

BLACKWATER, a river in the Republic of Ireland, 104 mi. long, noted for its trout and salmon, rises in the carboniferous uplands, sometimes called the Munster coalfield, which are dreary, almost coalless plateaus, 1,000 to 1,400 ft. high. The main headstream of the river forms the boundary between the counties of Cork and Kerry. In its upper course the Blackwater flows between the uplands and a spectacular east-west Devonian sandstone ridge with summits over 2,200 ft.

East-west lines of mountains mark the whole course of the Blackwater to Cappoquin, County Waterford, where the river suddenly bends southward for the last 15 mi. of its journey. Much of its course is through a valley of rich pastures and plentiful woodlands, and in the 18th and 19th centuries a large number of demesnes (*q.v.*) were established there, notably the Devonshire estates at Lismore (*q.v.*). Beyond the river the farm lands generally extend

to a height of 800 ft. or more.

There are a number of tributaries including the Finnow, which has Millstreet as its market centre and the Dalva, which drains the southeast part of the Leinster coalfields and has two towns, Kanturk with hosiery making, and Newmarket. Twelve miles downstream, the main railway from Dublin to Cork crosses the valley at Mallow (*q.v.*), an active and attractive commercial and grain milling town, and the river flows east, gathering from the north the Awbeg, to Fermoy 20 mi. farther on. Twenty miles more of fine valley scenery carries the river to Lismore and Cappoquin, and then the river's whole character changes as it cuts across the grain of the land in a series of gorges and depressions to meet the sea at Youghal (*q.v.*), a town associated with Sir Walter Raleigh.

(T. W. Fr.)

BLACKWATER FEVER, the most serious and least understood complication of malaria, in which hemoglobin appears in the urine. *See* Malaria: *Blackwater Fever.*

BLACKWELL, ELIZABETH (1821–1910), the first woman doctor of medicine, was born at Counterslip, Bristol, Eng., Feb. 3, 1821, the daughter of a sugar refiner who migrated to New York in Aug. 1832. Elizabeth sought admission in vain to the medical schools of Philadelphia, Pa., and New York city, but eventually secured admission to the medical class at Geneva, in western New York state, graduating M.D. in 1849. She then studied at St. Bartholomew's hospital, London, and on the continent. After her return to the United States she established in New York city in 1857, in spite of much opposition, a hospital entirely staffed by women. In due course she succeeded in founding there a full course of medical education for women, Sophia Jex-Blake being among the first students. Dr. Blackwell returned to England in 1857 and in 1869 settled there permanently. She died at Hastings on May 31, 1910.

See her *Pioneer Work: Autobiographical Sketches* (1895).

BLACKWELL, THOMAS (1701–1757), Scottish professor of wide learning, was born at Aberdeen on Aug. 4, 1701. He was educated at Aberdeen grammar school and Marischal college, where in 1723 he was given the chair of Greek, which he retained on his appointment (1748) as principal (a post also held by his father, the Rev. Thomas Blackwell). He was a stimulating teacher, and when principal carried out reforms in the curriculum. His *Enquiry Into the Life and Writings of Homer* (1735) was designed to explain "why no poem either formerly heard of, or now extant, was or is comparable to the Iliad and the Odyssey." He also wrote *Letters Concerning Mythology* (1748) on "the opinions of the ancients concerning the rise and government of the world," and the overrated *Memoirs of the Court of Augustus* (1755–64), of which most of the 3rd volume was compiled from his notes after his death in Edinburgh on March 8 1757.

BLACKWELL, a city of Kay County, Okla., U.S., midway between Oklahoma City and Wichita, Kan., 13 mi. (21 km.) from the Kansas state boundary. It is surrounded by productive gas and oil fields. Stock raising, poultry raising, and agriculture are important. Blackwell has grain elevators, an iron foundry, a zinc smelter, and glass factories. It was settled and incorporated in 1893. For population figures *see* table in Oklahoma: *Population.*

BLACK WIDOW, a common name applied in the United States to spiders of the genus *Latrodectus* (family Theridiidae). The mature female black widow is about one-half inch long, is shiny black and has a scarlet hourglass-shaped mark on the underside of the globular abdomen. The immature females may have a row of red spots along the back and some are without any red markings. The male is smaller (one-seventh to one-sixth inch long) and usually has a red hourglass figure on the underside of the abdomen. Dorsally there often is a variable pattern of red spots flanked by white lines.

BY COURTESY OF GEORGE ELWOOD JENKS

FIG. 1.—FEMALE BLACK WIDOW (LATRODECTUS MACTANS) HANGING FROM WEB WITH MALE CLINGING TO HER BACK

In temperate areas of the United States the black widow survives the winter in an immature stage and the young forms appear in the spring. The mature females appear in April; the males, though not as commonly seen, mature at about the same time.

Before mating, the male spins a delicate web upon which the seminal fluid is placed; he then collects the semen in a sac on the second pair of appendages (palpi). During mating one of the palpi is introduced into the genital opening of the female. As the male is smaller than the female, he runs the danger of being eaten by the female if he does not escape immediately after mating. While the male may mate more than once, the female apparently mates only once. The female places the eggs in silken globular cocoons about one-half inch in diameter. These may be found from late July until September. Each cocoon contains from 250 to 750 or more eggs. The numerous young remain in the cocoon until after the first molt, a period which varies from 14 to 30 days after the eggs are laid.

JOHN H. GERARD

FIG. 2.—BLACK WIDOW (LATRODECTUS MACTANS) SHOWING HOURGLASS ON UNDERSIDE OF ABDOMEN

Males molt from four to seven times before maturing, and live from 28 to 40 days after maturing; females molt from seven to nine times, and live from a few months to a year and a half after maturing.

Their webs are formed of a dense crisscross of threads. One side has a silk sheet which serves as a retreat. The web is found under loose bark, in crevices, in holes, in hollow stumps and other similar places. The silk is quite strong though the diameter of the threads is small. The black widow catches a variety of different insects in its net. Like all spiders, it makes small punctures into the body of the captured insect and sucks the liquid contents. The spider in turn is attacked by mud-dauber wasps, insect parasites and predators which attack the young forms.

Like all spiders, black widows have fangs and poison glands by which they kill their prey. They do at times bite humans, and their poison often produces such symptoms as severe pain and nausea and mild paralysis of the diaphragm. Although most of the bite victims recover without complications and deaths are rare, bites of these spiders should be regarded seriously. Possibly different species vary in the toxicity of their poisons, and individuals bitten vary greatly in their reactions to the poison.

H. Levi recognizes six species of *Latrodectus: L. geometricus,* possibly native to Africa; *L. curacaviensis,* of the Americas; *L. hystrix,* of Yemen; *L. dahli,* from Iran and Sokotra; *L. pallidus,* from Turkmen to North Africa; and *L. mactans,* from warm areas all over the world. Several geographical subspecies are recognized in *L. mactans;* they differ in colour pattern, carapace shape, leg length and spination as well as in other characters.

Latrodectus mactans, L. curacaviensis and *L. geometricus* are found in the United States. *L. geometricus* is encountered infrequently in Florida, and the females are usually gray. Of the other two species, *L. curacaviensis* is more abundant in temperate areas of both North and South America and is absent from Mexico, Central America and the greater Antilles. *L. mactans,* while present in most of the United States, is more abundant in warmer sections of the Americas.

In areas where these two species occur together, they often occupy different habitats. In the northern part of its range, *L. mactans* is found most often in trash and near dwellings, while *L. curacaviensis* lives under logs and stones and in woods and fields. In Florida *L. curacaviensis* lives in trees and shrubs above the ground, while *L. mactans* lives on the ground.

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BLACKWOOD, WILLIAM (1776–1834), founder of the publishing firm of William Blackwood and Sons, Ltd., was born at Edinburgh, Scot., on Nov. 20, 1776, and died there on Sept. 16, 1834. After learning antiquarian bookselling, in 1804 he set up a business in Edinburgh.

By 1810 Blackwood was acting in Scotland for John Murray and other London publishers, and publishing on his own account. In 1816 he brought out Walter Scott's *Tales of My Landlord*. In 1817 he founded the *Edinburgh Monthly Magazine*, later called *Blackwood's Edinburgh Magazine*, as a Tory counterblast to the Whig *Edinburgh Review*. It achieved notoriety with its "Chaldee Manuscript," a satire in Old Testament language on the Edinburgh Whigs, and attacks on the Cockney school of poets, as it chose to designate Leigh Hunt and his circle. Then it became more respectable, and secured a wide and steady influence. Scott, J. G. Lockhart, John Wilson, James Hogg, De Quincey and William Maginn were among its contributors. As "Christopher North," Wilson (*q.v.*) wrote most of the *Noctes Ambrosianae* for it.

William Blackwood was succeeded by his sons Alexander (1806–45), Robert (1808–52) and John (1818–79). They added a London office to the business in 1840, and an Edinburgh printing office in 1847. After them the conduct of the firm passed, in turn, to William Blackwood (1836–1912), George Blackwood (1876–1942), James Blackwood (1878–1951) and George Douglas Blackwood (1909–) great-great-grandson of the founder. Blackwood's published serially and then in book form works by George Eliot, Bulwer-Lytton, Charles Lever, Anthony Trollope and Joseph Conrad. They have also printed much material about British history and achievements in the empire and commonwealth.

See F. D. Tredrey, *The House of Blackwood, 1804–1954* (1954). (F. D. T.)

BLADDER, the membranous and muscular sac in animals that receives the urine from the kidneys. The word is also used for any similar sac, such as the gall bladder, the swim bladder in fishes, or the small vesicle in various seaweeds. *See* URINARY SYSTEM; *see* also references under "Bladder" in the Index.

BLADDER AND PROSTATE, DISEASES AND SURGERY OF: *see* URINARY SYSTEM; REPRODUCTIVE SYSTEM.

BLADDER WORM, a stage (technically called *cysticercus*) in the life cycle of tapeworms (class Cestoda), intestinal parasites of vertebrates, including man. *See* TAPEWORMS.

BLADDERWORT, the common name for an aquatic plant that traps in its numerous and small spherical bladders such various animals as larvae, crustaceans, small worms and protozoa that inhabit shallow water. These animals die, decompose and serve as nitrogenous food for the plant. *See* also CARNIVOROUS PLANTS; UTRICULARIA.

BLADEN, THOMAS (1698–1780), governor of Maryland, was born in Annapolis, Md., in 1698. He was educated in England and remained there until 1742, when he was appointed proprietary governor of Maryland. In this position he was responsible for negotiating a treaty with the Six Nations Indians, under which Maryland peacefully acquired substantial sections of land, and for settling Maryland's western boundary with the Indians and the Pennsylvania government. In 1747 he returned to England, where he became a member of Parliament. Bladen died in England in 1780. Bladensburg, Md., was named for him.

BLADENSBURG, a suburb of Washington, D.C., northeast of the capital in Prince Georges county, Md., about 32 mi. S.W. of Baltimore on the Anacostia river. The site of Bladensburg was originally a trading post known as Garrison's Landing, at the northern end of the navigable portion of the Anacostia. In 1742 Bladensburg was founded and named after Thomas Bladen, then governor of Maryland. The town achieved early prosperity because of its position on the river and on the main north-south highway through the colonies, but by the middle of the 19th century the Anacostia had become too shallow for large ships and the road was supplanted in importance by railroads; in addition, Washington, the national capital, had been established close by. After mid-20th century its population was less than 5,000.

During the War of 1812 it was the site of the battle of Bladensburg, in which an outnumbered army of British soldiers on Aug. 24, 1814, defeated an American force, which retreated, leaving Washington undefended. The British marched on the capital and sacked it, burning many important buildings. Just outside Bladensburg is the Bladensburg dueling field, where Washingtonians of the early 19th century, in order to avoid the stringent antidueling laws of the District of Columbia, fought their duels. Commodore Stephen Decatur was killed there in 1820.

BLAESILLA (d. 384) was the eldest daughter of Paula, who was a friend and patron of Jerome and his critic during the preparation of the Latin Vulgate Bible. Blaesilla lost her husband, Camillus, a friend of Jerome, after a marriage of seven months, whereupon Jerome wrote urging her to remain a widow. A dangerous fever led to her persuasion, and she became known for her austerities. A relapse of illness caused her death at the age of 20. Many Romans blamed her premature death on her fanaticism, and Jerome came in for severe censure. In a letter to Paula he offered sympathy in her grief, prophesying that in his writings Blaesilla's name would never die.

She was brilliant in conversation, and spoke Greek and Hebrew without accent. At her solicitation Jerome wrote the commentaries on Ecclesiastes. In letters of later years he referred to her study of the Greek commentaries, particularly Origen's, and to her entreaties that he make a Latin version of Origen's work on the Gospels of Matthew, Luke, and John.

BLAGOEVGRAD, a town in southwest Bulgaria, 102 km. (63 mi.) S. of Sofia, is situated in the valley of the Bistritsa river, a tributary of the Struma. Pop. (1963 est.) 30,797. A settlement known as Scaptopara existed there around the warm mineral springs in Thracian times. The town was known during the Turkish occupation as Djumaya or Dzhumaya, later as Gorna Djumaya, but since 1950 it has been known as Blagoevgrad, after Dimiter Blagoev, founder of the Bulgarian Communist party. It was formerly a farming centre, producing and trading in oriental tobacco. It is now an important tobacco processing centre with the largest tobacco-fermentation factory in the Balkans; the wood processing industry (plywood, parquet flooring) and the canning, textile and craft industries have also been developed. The mineral springs are still significant. (L. Dr.; S. H. Br.)

BLAGOVESHCHENSK, a town and administrative centre of the Amur *oblast* (province) of the Russian Soviet Federated Socialist Republic, U.S.S.R., stands at the confluence of the Amur and Zeya opposite Aigun, Heilungkiang province (China). Pop. (1959) 94,746. Founded in 1858 after the Russian occupation of the Amur basin, Blagoveshchensk has always been one of the major centres of the Russian far east. Communications are good—the Amur is navigable, a branch line links the town to the Trans-Siberian railway and roads run to Svobodny on the Trans-Siberian and to Khabarovsk. Its industries are food processing (flour milling, oilseed milling, meat packing, etc.), timber working (sawmilling, furniture and matchmaking), the making of woolens and leather goods and the building and repair of river craft. (R. A. F.)

BLAINE, JAMES GILLESPIE (1830–1893), U.S. congressman, senator, secretary of state and presidential candidate, was an outstanding leader of the Republican party in the decades following the Civil War. He was born on Jan. 31, 1830, in West Brownsville, Pa. After graduating from Washington college (now Washington and Jefferson college) in Washington, Pa., in 1847, Blaine taught school for six years, first as an instructor in mathematics at a military academy in Kentucky and later as an instructor in the Pennsylvania Institute for the Blind in Philadelphia. In 1850 he married Harriet Stanwood, a native of Augusta, Me. Four years later he moved to Augusta to assume the editorship and part ownership of the *Kennebec Journal*, a crusading Republican newspaper, and began to assume political identity. In 1856 he attended the first national convention of the newly organized Republican party. Two years later, at the age of 28, he was elected

to the Maine state legislature. There his mastery over the intricacies of parliamentary maneuvering and his political acumen enabled him to succeed, in 1860, to the speakership of the house, a post he held until his election to the U.S. house of representatives in 1862.

As a member of congress, Blaine supported a hard money policy, high protective tariffs, railroad subsidies and the radical reconstruction program. Though at odds with actions of the radicals in his party on some issues, Blaine joined with them to advocate a strict reconstruction policy toward the South. Throughout his career he generally held to the proposition that the southerners were traitors and rebels. Yet, convinced that a stable, prosperous South was vital to the financial well-being of the entire nation, he was willing to compromise on matters which did not weaken reconstruction and Republican control of the South.

In 1868 Blaine was elected to the powerful position of speaker of the house, a post well suited to his abilities and temperament. A superb speaker and a shrewd debater, Blaine had remarkable insight into political situations and could sway an audience with great skill. To his role of speaker he brought great energy and tact. His conception of the role differed considerably from that held by many of his predecessors in that he rarely descended from his chair to participate in the debates on the floor. Blaine developed a strong, loyal and devoted body of followers who gave him support throughout his long and varied career. To his followers he was known as the "Plumed Knight," an appellation given him by Col. Robert G. Ingersoll of Illinois who offered his name in nomination at the national Republican convention of 1876.

It was during the period of Blaine's speakership that disclosures were made of graft, corruption and improprieties of high officials in President Grant's administration. In 1876, immediately prior to the nominating convention, came the sudden and disquieting accusation that Blaine had used his office to profit from a financial transaction involving the Little Rock and Fort Smith railroad. Though Blaine made a brilliant speech on the floor of congress in an attempt to exonerate himself, the publicity which the incident received plus a heatstroke suffered on the eve of the convention adversely affected Blaine's chances in the close nominating race. On the seventh roll call, Rutherford B. Hayes defeated Blaine by a margin of 25 votes.

Immediately after the election Blaine was appointed to the senate to fill a vacancy and was soon elected for a full 6-year term. In 1880 he was again a candidate for the presidential nomination but was defeated by his friend, James A. Garfield. He then gave his support to Garfield and was active in his behalf throughout the campaign. Upon Garfield's victory Blaine resigned his senate seat to accept appointment as secretary of state. In this capacity he demonstrated both creativity and initiative and achieved some degree of success. His policies represented a modification of the long-standing Monroe Doctrine; rather than waiting until called upon to mediate disputes, Blaine broke tradition by extending the nation's good offices to Mexico in its boundary controversy with Guatemala and to the governments involved in the War of the Pacific (*q.v.*). The results, however, were disheartening. Most of the Latin American countries were already suspicious of the motives of the United States. Blaine's actions served merely to alienate them further.

Blaine envisaged a system of inter-American arbitration which might relieve international tensions, prevent future conflict and strengthen the Monroe Doctrine. He also hoped to increase commercial relations between the United States and its southern neighbours and to create a more favourable balance of trade. In 1881, therefore, he attempted to realize the idea—conceived earlier in the century—of inviting the independent nations of South America to an inter-American conference to discuss and consider a comprehensive system of arbitration designed to prevent future wars in the western hemisphere. This marked the beginnings of the Pan-American movement. Unfortunately, however, Blaine was forced to resign following the assassination of Garfield (1881) and his Pan-American conference was quickly shelved by his successor. (*See* PAN-AMERICAN CONFERENCES.)

During this term of office as secretary of state, Blaine also sought to modify or abrogate the Clayton-Bulwer Treaty of 1850. The treaty provided that the United States and Great Britain should have equal control of any canal across the isthmus of Panama. Blaine's diplomacy sought to reach an agreement by which a canal entirely under U.S. control might be constructed. His plans were realized, though not in his lifetime, with the Hay-Pauncefote treaty of 1901. (*See* PANAMA CANAL.)

Blaine was finally nominated for the presidency in 1884 only to lose by a narrow margin to Grover Cleveland in an issueless and sordid campaign. His defeat in an election that had appeared to promise certain victory has since stirred speculation regarding the causes. One interpretation attributes the outcome to the loss of the Irish Catholic vote in New York city, for Blaine lost the state of New York by only 1,149 votes. The phrase "Rum, Romanism and Rebellion" was used by Rev. Samuel D. Burchard to characterize the Democratic party in a campaign speech made in Blaine's presence at the Fifth Avenue hotel, New York city, on Oct. 29. Blaine did not disclaim the phrase; whether he heard the statement at all is open to question. There is considerable doubt, moreover, as to the effect of the remark on the Catholic vote. A second interpretation of the election results holds that Blaine's impugned character made him unacceptable to the public. It would appear, however, that the Republican vote in 1884 actually represented an increase in the proportion of total votes cast as compared to 1876 and that Blaine's candidacy helped to check the political resurgence of the Democratic party.

Blaine was given a second opportunity in 1889 to bring his foreign policy to fruition. Appointed secretary of state by Pres. Benjamin Harrison, he assumed the chairmanship of the first Pan-American conference, which had been authorized by congress the previous year. The conference, though in accord on many important political and economic problems, could not reach agreement on several far-reaching proposals to which Blaine was dedicated. The project for an American customs union failed to win the support of the majority of the committee studying the problem. Recommended in its stead was the negotiation of separate reciprocity treaties. Blaine's proposal that arbitration be compulsory for all controversies except those in which, in the opinion of the nations involved, sovereignty would be compromised, suffered a similar defeat.

Several other thorny problems which confronted Blaine while secretary of state were not solved: the controversy with Great Britain regarding the right of Canadian vessels to hunt seals in the waters of the Bering sea; the conflict with Great Britain and Germany concerning the disposition of Samoa; and the strained relations with Chile following the killing of several U.S. sailors in Valparaíso.

The question of reciprocity raised in the Pan-American conference was of particular concern to Blaine. Though an ardent protectionist, he nevertheless foresaw that reciprocity was essential to the improvement of trade relations with Latin America. He fought hard to include a reciprocity clause in the high-tariff McKinley bill of 1890. His plea for greater reciprocity was heartily endorsed by midwestern farmers who desired an enlarged market for their produce. Blaine's stand prevented the wholesale defection of the midwestern vote in succeeding elections.

Blaine resigned as secretary of state in June 1892, partly as a result of failing health, but also to block a movement by his friends to place his name before the 1892 nominating convention. He died in Washington, D.C., on Jan. 27, 1893.

BIBLIOGRAPHY.—The essence of Blaine's political philosophy and his views of the political occurrences of his era can be found in his two works: *Twenty Years in Congress: From Lincoln to Garfield*, Vol. I (1884) and II (1886), and *Political Discussions: Legislative, Diplomatic and Popular* (1887). The best biography of his life and career is David Saville Muzzey, *James G. Blaine, a Political Idol of Other Days* (1934).

(Jo. B.)

BLAIR, FRANCIS PRESTON (1791–1876), U.S. journalist and politician, was born at Abingdon, Va., on April 12, 1791. He graduated in 1811 from Transylvania university, then entered journalism and politics at Frankfort, Ky. A loyal supporter of Andrew Jackson, he established in 1830 and owned until 1845 the Washington *Globe*, a party organ, and also published the *Congres-*

sional Globe. He was a political journalist of the first rank, a member of Jackson's "kitchen cabinet" and a skilful party organizer. He was an expansionist, but opposed the territorial extension of slavery and in 1848 supported the Free-Soil presidential candidate, Martin Van Buren. One of the founders of the Republican party, he assisted materially in Lincoln's nomination in 1860 and became an influential adviser in the Lincoln administration. The president approved Blair's unofficial and unsuccessful mission to arrange peace at the Hampton Roads conference in Feb. 1865. After the war, Blair supported Pres. Andrew Johnson's plan of Reconstruction, opposed the radical Republicans and rejoined the Democratic party. He died at Silver Spring, Md., on Oct. 18, 1876.

His son, MONTGOMERY BLAIR (1813–83), lawyer and politician, was born in Franklin co., Ky., on May 10, 1813. He left Transylvania university to enter West Point, graduating in 1835 and serving briefly in the army. He then studied law and began practice in 1837 in St. Louis. A leading supporter of Sen. Thomas Hart Benton, he became, successively, U.S. attorney for Missouri, mayor of St. Louis, a judge of the court of common pleas and a leading lawyer. In 1853 he moved to Maryland where he practised extensively in the federal courts and served as one of the attorneys for Dred Scott in 1856–57. He was a Free-Soil Democrat and an advocate of western extension without slavery. Blair left his party to become a Republican and advocated the candidacy of Abraham Lincoln in 1860. Appointed postmaster general in 1861, he supported the policies of the Lincoln administration, but his moderation incurred the hostility of the radical Republicans who forced his resignation from the cabinet in 1864. His administration of the post office department was distinguished by the establishment of free city delivery, a money order system and other improvements. After the war he supported Pres. Andrew Johnson's policies, returned to the Democratic party and resumed the practice of law. He died at Silver Spring, Md., on July 27, 1883.

Another son, FRANCIS PRESTON BLAIR, JR. (1821–75), soldier and political leader, was born in Lexington, Ky., on Feb. 19, 1821. After graduating from Princeton in 1841, he studied law at Transylvania university and began to practise in St. Louis in 1842. Convinced that the institution of slavery was morally wrong and an economic hindrance to western development, he became a Free-Soil Democrat, a supporter of Thomas Hart Benton and an advocate of gradual compensated emancipation. He served from 1852 to 1856 in the Missouri legislature, assisted in organizing the new Republican party and was a member of congress for two terms, 1857–59 and 1861–63. His services in 1861 were probably significant in preventing the secession of Missouri, although his domineering and aggressive methods aroused opposition. As chairman of the military affairs committee of the house of representatives he rendered loyal and effective service. A general and corps commander in the Union army, he won recognition for competent military leadership. He opposed the congressional reconstruction policy, rejoined the Democratic party and in 1868 was the Democratic candidate for vice-president. In 1870 he was elected to the U.S. senate from Missouri to fill an unexpired term but was not re-elected in 1872. He died in St. Louis on July 8, 1875.

(T. S. BY.)

BLAIR, JAMES (1656–1743), American ecclesiastic and founder of the College of William and Mary, Williamsburg, Va., was born, probably in Edinburgh, Scot., in the year 1656. He was educated at the University of Edinburgh, receiving the degree of M.A. in 1673. Blair received ordination in 1679 but was deprived in 1681 for refusing to take a test oath imposed by the Scottish parliament for the purpose of securing the succession of the duke of York as James II. Unable to obtain any ecclesiastical appointment, he served for three years as clerk in the office of the master of the rolls in London. In 1685, through the recommendation of the bishop of London, Henry Compton, he was elected rector of Varina parish, Henrico county, Va. He was appointed commissary or ecclesiastical representative of the bishop of London in Virginia on Dec. 15, 1689, and it was in this capacity that in April 1691 he proposed the founding of a college. With the endorsement of the assembly, he went to England and secured from William and Mary a charter and grant of funds for the college, which was named in honour of its royal patrons. He became its president, in addition to being commissary, and saw it through all the vicissitudes of its early history. Though Blair, whose influence with the home government enabled him to secure the recall of three governors, became one of the most powerful men in the colony, his career outside the college was marked by frustration. This was partly the result of his personal limitations, but more the consequence of the ambiguity of his official position. The bishop of London's jurisdiction in the American colonies was never officially defined, and that of his commissaries was still more vague. Blair began by attempting to maintain some discipline over the laity, but gave it up after being rebuffed by the governor and council. His continuing efforts to exercise some authority over the clergy, to raise their salaries and to stabilize their tenure involved him in endless disputes with the governors, the assembly, the parish vestries and the clergy themselves. Most of the issues were still unresolved when he died on April 18, 1743.

See G. M. Brydon, *Virginia's Mother Church*, vol. i (1947).

(W. W. Ms.)

BLAIR, ROBERT (1699–1746), Scottish poet, whose poem *The Grave* achieved great popularity and influence by appealing to the morbidity underlying 18th-century rationalism, was born at Edinburgh in 1699. Educated there and in Holland, he was ordained in 1731 and appointed to Athelstaneford, East Lothian, where he died on Feb. 4, 1746. He was happily married, had six children and devoted his leisure to poetry, botany and optical experiments.

The Grave (1743) is his only important work. It is an uneven poem in blank verse which, while often macabre and melodramatic, sometimes rises to the level of true poetry. It inspired William Blake to make 12 illustrations which appeared in the 1808 edition.

The standard edition of Blair's *Poetical Works* was edited by R. Anderson in *Poets of Great Britain*, vol. viii (1794), with a biographical introduction.

BLAIR ATHOLL (Gaelic BLAIR, "a plain"), a village and civil parish in Perthshire, Scot., 34 mi. N.N.W. of Perth by road, lies at the confluence of the rivers Tilt and Garry. Pop. of civil parish (1961) 1,458. Blair castle, a seat of the duke of Atholl (chief of clan Murray), which dates in part from 1269, was considerably enlarged in the 1740s. The marquess of Montrose raised his standard there in the cause of Charles I in 1644. The castle was held for James II in 1689 at the time of the Battle of Killiecrankie. Viscount Dundee, killed in that engagement, was buried in the church of St. Bride, Old Blair, in which a tablet was erected to his memory 200 years later. Prince Charles Edward stayed at the castle in Aug. 1745 and Feb. 1746. Soon afterward occupied by government forces, it was besieged by Lord George Murray (the duke's brother) lieutenant general of the Jacobite forces. The Atholl gathering, in abeyance since 1913, was a famous event held annually in September to commemorate Queen Victoria's presentation of colours in Sept. 1845 to the duke's ceremonial bodyguard, still in existence and now called the Atholl Highlanders. The fine falls of Bruar are 4 mi. W. of Blair Atholl.

BLAKE, EDWARD (1833–1912), Irish-Canadian lawyer and statesman, was born in Metcalfe township, Ont., on Oct. 13, 1833. Blake was called to the bar in 1856, created a queen's counsel in 1864, and, following Confederation, became a leading authority on the Canadian constitution. In 1867 he was elected as a Liberal to both the Ontario legislature and the Canadian house of commons. He was prime minister of Ontario, 1871–72, and minister of justice, 1875–77, in Alexander Mackenzie's Dominion cabinet. In the latter position he was instrumental in settling controversial questions regarding the powers of the governor general. Following the defeat of Mackenzie's government in 1878 and his resignation as Liberal leader in 1880, Blake was elected his successor and led the party until 1887. Ill-health and discouragement at Liberal defeats in two general elections then caused him to resign the leadership, and in 1891 a temporary disagreement with his party over trade policy ended his Canadian political career.

From 1892 to 1907 Blake was an Irish nationalist member of the British house of commons, giving valuable advice on constitutional and financial matters, such as the drafting of the Home Rule bill of 1893 and the study of the financial relationship between Britain and Ireland. His greatest contribution, however, was in raising funds in Canada and the United States for the Irish parliamentary party which, through his efforts, was saved from collapse. He retired in 1907 and died at Toronto on March 1, 1912.

See Margaret A. Banks, *Edward Blake—Irish Nationalist* (1957). (M. A. Ba.)

BLAKE, ROBERT (1599–1657), English admiral, fought on the parliamentary side in the English Civil War and subsequently rendered valuable services to the Commonwealth through his reorganization of the navy and by his victories at sea. Born at Bridgwater in Somerset, the eldest son of a well-to-do merchant, he entered St. Alban hall, Oxford, in 1615, but soon moved to Wadham college, from which he graduated in 1625. From that date until his election for Bridgwater to the Short parliament in 1640 nothing certain is known about him. He is said to have visited the Netherlands and probably had some experience of the sea.

At the outbreak of the Civil War in England he declared for parliament and soon distinguished himself as a general. He defended Bristol against Prince Rupert in 1643 and became famous as a result of his defense of Lyme the next year. In July 1644 he took Taunton by surprise and held the town against the Royalists for the next two years. In 1645 he re-entered parliament as member for Bridgwater. In 1648, during the second phase of the Civil War, he organized the forces in Somerset.

In Feb. 1649 he was appointed with two other "generals at sea" —Richard Deane and Edward Popham—as "commissioner to command the fleet." In April he was sent against Rupert's squadron at Kinsale, where he blockaded the prince for six months. When Rupert escaped to Lisbon, Blake followed him into the Tagus but was refused permission by the king of Portugal to attack him. He made reprisal by capturing six ships and burning three of the returning Brazil fleet and brought his prizes home. Blake then sailed again to pursue Rupert into the Mediterranean, where he destroyed the Royalist squadron at Cartagena in Nov. 1650. For this service he was thanked by parliament and awarded a grant of £1,000. In May 1651, in conjunction with Sir George Ayscue, he captured the Scilly Islands which were held by Royalist privateers. Shortly afterward he was made a member of the council of state.

On the outbreak of the first Dutch War in 1652 he was appointed to the command of the fleet in the channel. In May, Martin Tromp's fleet of 42 ships appeared off Dover. Though Blake had only about 20 ships, he insisted on demanding the salute to the English flag and, when this was refused, attacked Tromp and forced him to withdraw with the loss of two ships. War was formally declared in July, and Blake was sent to capture most of the Dutch fishing fleet in the North sea; a gale prevented another battle with Tromp. On Sept. 28, 1652, Blake and William Penn encountered a Dutch fleet commanded by Michael de Ruyter and Cornelius de Witt off the Kentish Knock. The Dutch were defeated in a two days' battle and withdrew to Goree. In November Tromp was reinstated in command and met Blake off Dungeness with a superior force, compelling the English fleet to retreat into the Thames and originating the legend of Tromp lashing a broom to his masthead in triumph as a sign that he would sweep the English from the sea. On Feb. 18, 1653, an indecisive action was fought off Portland in which Tromp, with 80 warships and about 200 merchantmen, was engaged for three days but managed to escape; in this battle Blake was severely wounded. On June 3 another battle was fought off the Gabbard in which Richard Deane and George Monck had the worst of it until Blake appeared with 13 sail, whereupon Tromp retreated to the Texel. This was the first battle to be fought in line-ahead formation.

The effects of his wound compelled Blake, now aged 53, to retire from the sea for the next few months, though he took his seat as a member of the Barebone's parliament. The conclusion of peace with the Dutch in 1654 enabled Cromwell to turn his attention to the French and the Spanish. In Nov. 1654 Blake was given the command of a fleet of 24 ships to make English influence felt in the Mediterranean. Having exacted compensation from the grand duke of Tuscany, he sailed against the corsairs of Tunis, who constantly threatened English shipping in this area. When the bey refused to release his English slaves, Blake attacked his fleet at Porto Farina and destroyed the fortresses there.

War having been declared on Spain in 1656, Blake was sent with 48 ships to cruise off Cadiz and capture Gibraltar if opportunity offered. His force was not strong enough to attempt the latter task, but one of his captains, Richard Stayner, intercepted the plate fleet in September and captured treasure estimated at 5,000,000 pieces of eight. In April 1657 Blake, then in ill-health, heard that another plate fleet and its escort lay in the bay of Santa Cruz, Tenerife. The Spanish fleet consisted of 16 ships protected by six forts. In spite of their strong position, Blake ordered Stayner to lead into the attack on April 20 and in one of the most vigorously fought actions in naval history he totally destroyed the Spanish fleet and its defenses. There is a story that the wind shifted to enable him to withdraw at the conclusion of the action, but he himself states that "the wind was all the while blowing into the bay." The English only lost one ship and 50 men killed. "The whole action," says the earl of Clarendon, "was so incredible that all men who knew the place wondered that any sober man, with what courage soever endowed, would ever have undertaken it; and they could hardly persuade themselves to believe what they had done; while the Spaniards comforted themselves with the belief that they were devils and not men who had destroyed them in such a manner."

Since his health was seriously deteriorating, Blake was compelled to make for home before the end of the summer. He died on Aug. 7, 1657, one hour before his victorious fleet entered Plymouth sound. His body was embalmed and lay in state, like Nelson's, at Greenwich before a state funeral at Westminster abbey. In 1661 Charles II ordered the exhumation of his body, together with those of other leading members of Cromwell's regime, and it was flung into a pit north of the abbey.

Apart from his services at sea, Blake played an important part in the organization of the Commonwealth navy. He was the author of the Fighting Instructions which founded the tactics of the next century and he was responsible for the introduction of the Articles of War, the basis of naval discipline. He was a humble man, simple and sincere in his religion, brave in action and devoted to "the services of this Commonwealth." Clarendon, the royalist, bears this testimony to his example: "He betook himself wholly to the sea; and quickly made himself signal there. He was the first man that declined the old track, and made it manifest that the science might be attained in less time than was imagined; and despised those rules which had long been in practice, to keep his ship and his men out of danger. . . . He was the first man who brought the ships to contemn castles on shore, which had been thought ever very formidable. He was the first that infused that proportion of courage into the seamen, by making them see by experience, what mighty things they could do, if they were resolved; and though he hath been very well imitated and followed, he was the first that drew the copy of naval courage."

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BLAKE, WILLIAM (1757–1827), English mystic, poet and artist, was born in London, Nov. 28, 1757. His father, James Blake, of whose family and origin nothing is known, was a hosier, living at 28 Broad street, Golden square. His mother's maiden name was Catherine Harmitage. The family consisted of four sons and a daughter. William was the second son, and the only one to achieve distinction. The eldest, James, succeeded his father in the hosiery business. The third, John, died young, after a life of dissipation. The youngest, Robert, who showed considerable

capabilities as an artist, was greatly loved by his brother William, and was nursed by him through the illness of which he died at the age of 21. Another son, Richard, died in infancy.

William began to show his artistic leanings at an early age. His father wisely decided to encourage this side of his nature, and sent him at the age of ten to Henry Pars's drawing school in the Strand. He also gave him casts from which to draw and allowed him to buy prints after the old masters at the sale rooms. In Aug. 1772 he was apprenticed to Basire the engraver and served his time faithfully in learning the conventional styles of engraving. He also made drawings of the monuments in Westminster abbey and these were engraved for Gough's *Sepulchral Monuments*. His mind was profoundly influenced by the surroundings in which he worked, and the Gothic style was to him the ideal, the "living form," for ever after. At the same time he was cultivating his mind in other ways and is known to have read Burke, Locke, Bacon and Fuseli's translation of Winckelmann. His creative faculty found its outlet in the early years in poetry, some of which has survived in the thin volume of *Poetical Sketches,* printed for Blake by his friends in 1783. These pieces were composed between his 12th and 20th years. Although they show the influence of contemporary poetry, notably Ossian, they owe something too, to the Elizabethans and the poets of the later 17th century; yet they have a pure strain of lyrical inspiration which sets them apart as a landmark in English literature. They remained unknown and so had no influence on the poetry of their time, but nevertheless were the forerunners of the freer age in poetry which began some 20 years later.

In 1779 Blake had completed his apprenticeship, and at the age of 21 set out to earn his living as a professional engraver. He executed many commissions for the booksellers and publishers, and during the next 20 years supported himself largely by this means. His circle of friends about the year 1780 included T. Stothard, J. Flaxman and H. Fuseli, all of whom played a large part in the course of his later life. In this year he first exhibited at the Royal Academy pictures admired by Romney.

In 1781 he met his future wife, Catherine Boucher, the illiterate daughter of a Battersea market-gardener. They were married in Aug. 1782, and lodged at first at 23 Green street, Leicester Fields. The name of Catherine Blake will go down to posterity as that of an almost perfect wife. She learned to draw and paint well enough to be able to help Blake in his work. She remained childless, and survived her husband only four years, dying in 1831.

During the years 1783–87 Blake met a number of distinguished people at the house of the Rev. A. S. Matthews, who had helped in printing the *Poetical Sketches;* but this society soon disgusted him, and he ridiculed it in a satire, or burlesque novel, now known as *An Island in the Moon* written about 1785. One interest of the piece now lies in the fact that it contains early drafts of three of the *Songs of Innocence*. In 1784 Blake had started a print shop in partnership with a former fellow apprentice, Parker, at 27 Broad street, but this did not succeed and was soon abandoned. Meanwhile he was earning a livelihood by engraving ordinary copperplates for the publishers, and in 1788 he began to experiment with a new method of printing from etched copperplates. It is related that the secret of this process was revealed to him in a vision by the spirit of his brother Robert. More probably he had received a hint of it some time before from his friend, George Cumberland of Bristol, who had been working on it as early as 1784. Both words and decorations were drawn on the copperplate with a resistant medium, and the copper was then etched with acid. Text and design remained in relief and could be printed in any tint that pleased the artist. The print could then be left plain or be coloured by hand with water colours or printed as a monotype in opaque pigments. The first results of this process were the small dogmatic works, *There Is No Natural Religion,* and *All Religions Are One*. It developed further with the production of *Songs of Innocence,* which consisted of simple lyrical poems etched on copper with decorations coloured by hand. The volume was finished in 1789 and was sold for a few shillings. This was the prelude to the remarkable series of books in "illuminated printing" which occupied Blake in some degree for the remainder of his life.

Blake was now living in Hercules road, Lambeth, and here he completed the works entitled *The Book of Thel*, 1789; *The Marriage of Heaven and Hell*, 1793; *Songs of Experience*, 1794 (a companion volume to *Songs of Innocence*); *America*, 1793; *Visions of the Daughters of Albion*, 1793; *Europe*, 1794; *Urizen*, 1794; *The Book of Los*, 1795; *The Book of Ahania*, 1795; and *The Song of Los*, 1795. In *Songs of Experience* the lyrical and mystical elements were intimately mingled. This book had been preceded by *Thel*, and by a prose work, *The Marriage of Heaven and Hell*, in which mysticism and philosophy began to gain the upper hand. In the succeeding works Blake's visionary powers overwhelmed him, and they were wholly devoted to an elaboration of his mystical and metaphysical systems, which have proved a stumbling block to many of his readers, but have now been largely elucidated by a better understanding of his complicated symbolism and its sources. They are written in an irregular verse form which entitles Blake to be regarded as the forerunner of the *vers libre* of recent times.

Meanwhile Blake's output as an artist was very large. About the year 1795 he produced his stupendous series of large colour prints, which can scarcely be matched in the whole history of art for imaginative content and magnificence of colouring. These include "Nebuchadnezzar," "The Elohim Creating Adam" and "Newton." By 1797 he had completed his series of 537 water-colour designs for Young's *Night Thoughts*. He had also made numerous separate paintings in water colour and tempera, but never painted in oils.

BY COURTESY OF VICTORIA AND ALBERT MUSEUM

"THE INFANT JESUS RIDING ON A LAMB" BY WILLIAM BLAKE: TEMPERA ON CANVAS

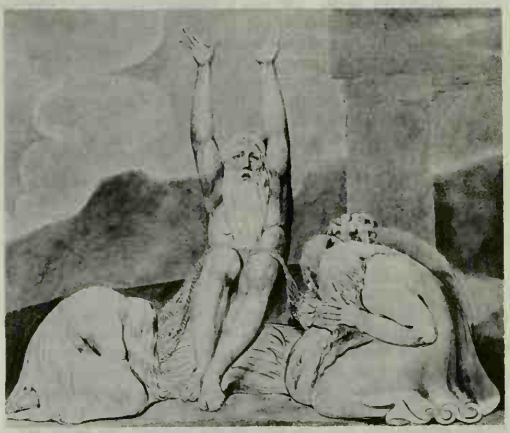
Blake's circle of friends had widened somewhat, and now included Thomas Butts, chief clerk in the office of the muster-master general. It was chiefly Butts's patronage which enabled Blake to earn a livelihood while expending much time and energy on his symbolical works, which never produced any adequate return by their sales. He even laboured at a long poem which never was, and was never intended to be, produced in its original form. This was *Vala* or *The Four Zoas*, a poem of the greatest significance for the understanding of Blake, though the manuscript (now in the British museum) was not properly transcribed and edited until 1925, nearly a century after the author's death. The poem was begun about 1795 and was elaborately revised five years later, some passages from it being used in later works.

During the seven years from 1793 to 1800 his creative output was almost greater than can be believed. Periods of mental and physical exhaustion were the inevitable result, and it was probably a fortunate event that in 1800 introduced Blake to the notice of William Hayley in order that he might execute copperplates for various works on which Hayley was engaged. As a result of this introduction, brought about by Flaxman, Blake paid a visit in the early part of 1800 to Hayley at Felpham in Sussex, and later in the year he rented a cottage in the village, so that he might work

under Hayley's eye at the engravings for the projected *Life of Cowper*. Blake removed to Felpham with his wife and sister, intending to stay there for an indefinite period. Three years later he returned with a great sense of relief to London. At first he had been able to work happily enough at Felpham, but as time passed he became increasingly irritated by Hayley's patronizing ways and lack of understanding, and his feelings found relief in the scurrilous doggerel and epigrams scribbled in his notebook. At length he realized that the best way of keeping Hayley's friendship was to leave his company, so he returned to London. Part of the three years at Felpham were charged with spiritual discomfort. Blake obtained no respite from the visions which crowded ceaselessly upon him. He was forced to lead a double life, pandering on the surface to Hayley's vanities and forced to develop in secret his own imaginative faculties. The Felpham period was, therefore, a strangely mixed output of second-rate engravings for Hayley, of fine paintings, and of mystical poetry of great power, which was mostly embodied in the poem *Milton* first printed from copperplates in 1808. Thomas Butts bought most of Blake's paintings, and to this faithful friend he confided his difficulties in his letters. An additional trouble was the well-known incident following a misunderstanding with a soldier, John Scofield, whom Blake forcibly turned out of the garden of his cottage. Scofield afterward fabricated evidence against Blake, accusing him of using treasonable words against the king. He was tried at Chichester sessions in Jan. 1804 and was triumphantly acquitted of the charge.

After his return to London he lived at 17 South Molton street, determined to devote his life to art without further hindrance from the outside. He believed that he had learned from Hayley the way to obtain worldly success and riches as a publisher of his own works, but in this he was disappointed, and he found the means of livelihood more precarious than ever. Butts continued to buy his pictures and he was given some work as an engraver, but for his own books he was unable to find a market. He refused, however, to be discouraged for long, and in 1805 he entered with zest into a scheme with the engraver Cromek for the production of a series of engravings for Robert Blair's *The Grave*. Here he was again deceived. Cromek paid him a small sum for the designs, and then contrary to his agreement employed another to engrave them. The book containing them was published in 1808. Blake, already embittered by neglect, became still more embittered by incidents such as this and suffered from fits of depression. He reacted, however, about 1808 when he decided to hold an exhibition of his works at the house of his brother James in Broad street, Golden square. Sixteen pictures only were exhibited, including his large painting of Chaucer's Canterbury Pilgrims, and each visitor to the house received for his entrance fee of *2s. 6d.* a copy of the now celebrated *Descriptive Catalogue*. The exhibition was opened in May 1809, and attracted very little notice, the only criticism of it, which appeared in Leigh Hunt's *Examiner*, being spiteful and unfair. The few visitors included Charles Lamb and Henry Crabb Robinson, the barrister and diarist, who has left a valuable account of his acquaintanceship with Blake during his later years. Blake was again disappointed of the recognition which he knew he merited, and was further ruffled by what he believed to be dishonesty on Stothard's part concerning his picture of the Canterbury Pilgrims. Probably the knavery was Cromek's, who, having seen Blake's design, suggested the idea to Stothard and so made him an innocent plagiarist. Stothard's commonplace picture was a popular success—a cruel blow to Blake's pride.

During the years following his exhibition Blake sank into an obscurity from which it has been difficult to disinter the bare facts of his existence. For the years 1810–17 only a few scattered references remain, and it is uncertain how he found the means of earning his living. It has even been suggested that for part of this time he was confined in an asylum, but it is now certain that there is no foundation for this rumour. Some of Blake's acquaintances, such as Robert Southey, who had visited him in 1811, did regard him as insane. But the testimony of his more intimate friends is of greater value, and they have repeatedly stated their conviction that he was anything but mad. Samuel Palmer, a close friend of his later years, wrote of him as "the most practically sane, steady, frugal and industrious" man he ever knew. Moreover there are facts enough to show that Blake was living from 1810 to 1817 merely in retirement, having accepted his fate like



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"JOB'S DESPAIR," A DRAWING FROM ILLUSTRATIONS OF THE BOOK OF JOB BY WILLIAM BLAKE

the wise man that he was. Throughout this period he was occasionally selling copies of his illuminated books. In 1812 he showed several pictures at the last exhibition of the Associated Artists in Water Colour. In 1815 he called on the Rev. Thomas Dibdin, probably in connection with some illustrations to *Milton* which he had made. During most of these years he was still executing engravings for various employers, including a number of plates for Josiah Wedgwood the younger. Finally in the years 1808–18 he was engaged upon the 100 etched plates of his greatest symbolical poem, *Jerusalem*. This magnificent work can have brought him very little financial return, as only six copies issued by him are known to exist, and the only one of these that he coloured was still in his possession in 1827.

In the year 1818 Blake entered upon the last phase of his life, and until his death in 1827 was probably happier in his friends and in his work than he had been at any other period. This was due primarily to his friendship with John Linnell, portrait and landscape painter, to whom he was introduced by his old friend, George Cumberland. Blake was still living in South Molton street, and under Linnell's guidance began to move more freely in society. He was enabled to obtain more work, and became the centre of a circle of young artists who regarded him with affection and veneration. The chief of these were Palmer, Calvert, Richmond, Finch and Tatham, some of whose names are still well known. Frederick Tatham is of little note as an artist, but is remembered as the author of a short life of Blake, and as the owner of most, perhaps also the destroyer of some, of Blake's effects after the death of Mrs. Blake in 1831. Another friend introduced by Linnell was John Varley, the water colourist. He was greatly interested in astrology, and at his instigation Blake drew his visionary heads of historical personages, an occupation which was clearly much less serious to him than to Varley.

In 1821 Blake moved from South Molton street to 3 Fountain court, Strand, and here he executed his most widely known work in creative art, the *Illustrations of the Book of Job*. He had previously made 20 water-colour paintings which had been bought by Butts. Linnell commissioned a duplicate set, and later suggested that he should make engravings of these subjects. The initial expense was borne by Linnell, and the copperplates were engraved in the years 1823–25, the book of 21 uncoloured prints being published in March 1826. Though superficially illustrations of the Bible story, the engravings actually form one of the most important of Blake's symbolical books. Their mystical content has not

prevented the designs from being the most widely known and generally appreciated of Blake's works. From about 1824 Blake had been suffering from symptoms of the gallstones which eventually caused his death. He was a frequent visitor at Linnell's country home at Hampstead, but as time passed he found it increasingly difficult to make the journey there. He was still, however, to make one more great effort in his art. In Oct. 1825, Linnell commissioned him to make illustrations to Dante's *Divine Comedy,* and to engrave them. He completed 100 water-colour designs, of which seven were engraved, and was still at work upon these when he died on Aug. 12, 1827. He was buried in an unmarked grave in Bunhill Fields cemetery, the approximate place being now indicated by a tablet placed there on Aug. 12, 1927.

Blake had lived for nearly 70 years and for more than 50 had worked unremittingly as creative artist and as journeyman engraver. His position in the history of the art of England is peculiar owing to his double achievement as poet and as painter. It is moreover impossible to determine his place in either poetry or painting separately, the two being interdependent both in his own mind and in the forms he used for their expression. His impulse as a lyrical poet had shown itself before the age of 14 and was not quite exhausted until more than 30 years later. It is seen at its best in the volume of *Poetical Sketches,* printed in 1783, in the *Songs of Innocence* and *Songs of Experience,* produced in the years 1789 to 1794, and in some of the later poems from manuscripts and letters, and this part of his writings has justly been the chief source of his present popularity. Gradually this faculty gave way, as his mind developed, before a rising tide of mysticism which strove to find expression through an increasingly complex system of symbolism. In the *Songs* some symbolism and simple pictorial designs were added to lyrical poetry. In his latest poems, *Milton* and *Jerusalem,* the symbolism became predominant and its pictorial representation more elaborate. As a painter he was entirely uninterested in realism, his favourite subjects being taken from the Bible or from writers such as Shakespeare and Milton. He sought to express in a picture the things of the mind as much as in a poem, and it is to the mind of the observer that they appeal. It is useless therefore to look in Blake's pictures for accuracy of detail. He laid great store by firmness of outline, but abhorred copying nature. His pictures live by their qualities of design, colouring and imaginative content, and his mystical poetry by the vigour of the intellect which produced it.

It cannot be disputed that Blake suffered from the defects of his qualities. His mind was never systematically cultivated, just as his hand was never intensively trained to draw from the living model. He was therefore apt to be intolerant through ignorance, and inaccurate through lack of observation. It is doubtful, however, whether he would have achieved more or have had a greater influence at the present time if he had possessed the academic virtues. His qualities isolated him from his contemporaries and drove his mind in upon itself, so that the interpretation of his message to mankind cannot be made with precision. But through all his mental turmoil and difficulties in dealings with his fellow men he kept his intellectual integrity, and he never prostituted his art. Throughout his life he sought to exalt the things of the mind, and for him the imagination was man's highest faculty. Ceaselessly he fought against materialism and attempted to gain his own spiritual regeneration through struggles against self. He was deeply religious, though in no conventional sense. In his later years Christ became identified in his mind with Art, and this fact provides many clues for the understanding of his doctrines. In his symbolic writings his own mental experiences were described without regard to the difficulties of his readers. Late in his life he made some attempt to embody his view of Christianity in more direct language, but his poem *The Everlasting Gospel,* written about 1818, was never finished, and exists now only in disconnected fragments. Perhaps the most illuminating revelation of his mind for most readers are the aphorisms and didactic statements which he engraved about the year 1820 around a representation of the Laocoön group.

It is not surprising, therefore, that Blake was incomprehensible to his contemporaries. He influenced them as little as he was influenced by them, and for many years after his death his name was unknown. His first full biography, written by Alexander Gilchrist, was published in 1863, and was reprinted under the supervision of D. G. Rossetti in 1880. Since that time his power and originality have gained fuller recognition, and he now holds a position as one of the greatest figures in English poetry and art. A bronze bust of him by Sir Jacob Epstein was placed in the Poet's Corner in Westminster abbey in Nov. 1957 to mark the bicentenary of his birth. Many of his pictures are to be seen in the Tate gallery, London, and collections of his illuminated books in the British museum and the Fitzwilliam museum, Cambridge.

See also references under "Blake, William" in the Index.

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(G. L. K.)

BLAKELOCK, RALPH ALBERT (1847–1919), U.S. painter, whose powerful impasto paintings of lunar scenes convey a mysterious romanticism, was born in New York city on Oct. 15, 1847. He graduated at the College of the City of New York in 1867. In art he was self-taught, original and a prolific worker. His subjects included pictures of North American Indian life and landscapes derived from a trip to the far west in 1869. His early works are related to the Hudson River school.

Under the strain of continual failure, with his large family in a condition of abject poverty, Blakelock broke down in 1899. His work ceased and almost all of the remainder of his life was spent in an asylum. During his confinement his fame burgeoned, and his paintings brought high prices. In 1916 the Toledo Art museum paid $20,000 for his "Brook by Moonlight," a work which he had been forced to dispose of for a humiliating amount 17 years before. He died near Elizabethtown, N.Y., on Aug. 9, 1919.

See L. Goodrich, *Ralph Albert Blakelock* (1947).

BLAKENEY, WILLIAM BLAKENEY, BARON (1672–1761), British soldier, best remembered for his defense of Minorca during the Seven Years' War, was born at Mount Blakeney, Limerick, Ire. He joined the army in 1702 and served throughout the War of the Spanish Succession under the duke of Marlborough. He commanded a brigade in the expedition to Cartagena in 1741 and was governor of Stirling castle when it was besieged by the Highlanders in 1745, but dispersed them by a vigorous sortie. He became lieutenant governor of Minorca in 1747. At the beginning of the Seven Years' War (1756), the island was attacked by a strong French force. Its defenses were dilapidated and the garrison too small to man them effectively, but Blakeney's resolution so inspired his men that they held out for 70 days, despite the failure of Adm. John Byng's attempt to drive off the French fleet. This gallant defense made Blakeney a popular idol and he was created Knight of the Bath and an Irish baron. His health was undermined by the hardships of the siege, however, and he died on Sept. 20, 1761. He was a true "soldiers' officer," always

in close touch and sympathy with his men. Of a frugal nature, he lived on his army pay, leaving his brothers to reside on the family estate in Limerick. His *Memoirs* were published in 1756.
(E. W. Sh.)

BLAKESLEE, ALBERT FRANCIS (1874–1954), U.S. botanist and geneticist, whose chief contribution to science resulted from his extensive investigations with the genera *Datura* (Jimson weed), *Mucor* (molds), *Rudbeckia* and *Portulaca*, was born at Geneseo, N.Y., on Nov. 9, 1874. He graduated from Wesleyan college in 1896 and obtained his Ph.D. degree from Harvard university in 1904. After teaching botany at several institutions, including Harvard and the Connecticut Agricultural college, he joined the department of genetics of the Carnegie institution of Washington, D.C., in 1915, working as its director from 1935 until his retirement in 1941. In that year he established the genetics experiment station at Smith college, Northampton, Mass., and directed it until his death on Nov. 16, 1954.

Blakeslee's Ph.D. thesis on sexual reproduction in the genus *Mucor* received wide recognition. His investigations on *Datura* genetics contributed new knowledge concerning cytogenetics, gene and chromosome mutations, effects of radiation, polyploidy and hybridization between species. He also studied the differences among individual persons in the senses of taste and smell.
(S. Sa.)

BLAMEY, SIR THOMAS ALBERT (1884–1951), Australian soldier who commanded the Australian military forces in World War II, was born on Jan. 24, 1884, at Wagga Wagga, New South Wales, where his father was a storekeeper. He was commissioned in 1906 and before World War I served in India, where he attended the Quetta staff college. During 1914–18 he served in Egypt, in the Gallipoli campaign and in France. He was awarded the Distinguished Service Order and was created companion of St. Michael and St. George in 1918 and companion of the Bath in 1919. After a period as Australian defense representative in London, he returned to Australia in 1923 as second chief of the general staff. In 1925 he retired from the army and became chief commissioner of police in Victoria, combining this office with territorial army activities. Soon after the outbreak of World War II he was recalled and flew to Palestine in 1940 as commander of the Australian I corps. In 1941 he was promoted to full general and appointed deputy commander in chief, middle east, under Lord Wavell. Early in 1942 he returned to Australia to become commander in chief of all Australian ground military forces, and was later appointed commander in chief, Allied land forces, southwest Pacific area, under Gen. Douglas MacArthur. In June 1950 Blamey was promoted to field marshal, the first Australian to attain the rank. He died in Melbourne on May 27, 1951.
(E. B. Bn.)

BLANC, (JEAN JOSEPH CHARLES) LOUIS (1811–1882), French political leader and historian whose ideas have had a great influence on the development of socialism, was born on Oct. 29, 1811, in Madrid, where his father was inspector general of the Spanish finances under Joseph Bonaparte. As C. A. Pozzo di Borgo, his mother's uncle, did nothing to help him, Louis Blanc lived in poverty in Paris after the Bourbon restoration, studying law and writing for various journals. In 1839 he founded the *Revue du progrès*, in which he published his famous essay "L'Organisation du travail." The principles laid down in this essay form the key to Blanc's whole political career. Attributing all social evils to the pressure of competition whereby the weaker are driven to the wall, he demanded the equalization of wages and the merging of personal interests in the common good, with an economy based on the principle "To each according to his needs, from each according to his abilities." This was to be effected by the establishment of "social workshops," a sort of combined co-operative society and trade union, in which the workmen in each trade were to unite their efforts for their common benefits.

In 1843 Blanc joined the committee of *La Réforme*, the journal of the extreme left-wing Republicans. In 1847 he was prominent in the banquets campaign for electoral reform (*see* France: *History*). After the revolution of 1848 he became a member of the provisional government of the second republic. On his motion, on Feb. 25, 1848, the government undertook "to guarantee the livelihood of the workers by work" and "to guarantee work for every citizen." Next, though his demand for a ministry of labour was refused, the government agreed to shorten working hours and authorized an assembly of Paris workers' delegates to make recommendations for the reorganization of labour and industry under the supervision of Louis Blanc and Albert (*q.v.*) "the Worker." This assembly, the celebrated Luxembourg commission (so-called because it met in the Luxembourg palace), became an arbiter in trade disputes and a centre of socialist propaganda. Blanc's increasing popularity, however, alarmed the more conservative members of the government, so that when the national assembly met at the beginning of May, he was not re-elected to his post, and the recommendations of the Luxembourg commission were ignored. Furthermore, the government had already set up a rival organization, the "national workshops" (*q.v.*), conducted on a parody of Blanc's principles and denounced by him, under the supervision of A. T. Marie, minister of public works and one of Blanc's political enemies. Forced to flee to England after the defeat of the workers in the revolt of June 1848, Blanc did not return to France until the fall of the second empire (1870). He was elected a deputy for Paris in Feb. 1871, but he would not join the Communards, whom he tried to reconcile with the government at Versailles in March. Under the constitution of 1875 he was elected deputy for Saint-Denis in 1876. He was opposed to the extreme left-wing republicans but introduced a proposal for the amnesty of the Communards in Jan. 1879. He died at Cannes on Dec. 6, 1882.

Louis Blanc had not only a vivid and picturesque style but also considerable power of research, exemplified for instance by his studies of English affairs during his exile from France. His books include *Histoire de dix ans, 1830–1840*, five volumes (1841–44), an attack on the July monarchy; *Histoire de la Révolution française*, two volumes (1847–62); *Lettres sur l'Angleterre*, two volumes (1866–67); *Histoire de la Révolution de 1848*, two volumes (1870); *Dix ans de l'histoire de l'Angleterre*, ten volumes (1879–81); and *Questions d'aujourd'hui et de demain*, five volumes (1873–84). There is also a collection of his speeches, *Discours politiques, 1847–1881* (1882).

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BLANCHARD, JEAN PIERRE (1753–1809), French aeronaut who, together with the American, John Jeffries, made the first aerial crossing of the English channel, and who was also the first man to make balloon ascensions in England and in America, was born in Les Andelys on July 4, 1753. Within a year following the first balloon ascensions of the Montgolfier brothers (*see* Balloon), Blanchard began his career, making his first balloon flight in Paris on March 2, 1784. Later that year, he made his pioneer ascension from English soil. Accompanied by Jeffries, he took off from Dover in a balloon and made a successful landing on the French coast near Calais on Jan. 7, 1785. The first international airmail was carried on this flight. In that same year in England, Blanchard made the first use of a parachute (*q.v.*), dropping a dog (or, according to another authority, a cat) in a basket to which a parachute was attached from a balloon. Blanchard was one of the first balloonists to attempt to achieve "dirigibility" in balloons by using sails or "oars," but had no success. (The practical dirigible airship came many years later when propellers and lightweight power plants became available; *see* Airship.) After making many exhibition flights in Europe, Blanchard went to the United States and made the first balloon ascension in the North American continent on Jan. 9, 1793. He took off from the Washington prison yard in Philadelphia and landed in Gloucester county, N.J. Pres. George Washington was an interested spectator. Blanchard returned to Europe and made many other successful flights. Following an accident in which he fell from his balloon at The Hague, Neth., he died in Paris on March 7, 1809.
(S. P. J.)

BLANCHE, JACQUES ÉMILE (1861–1942), French

painter and writer, was born in Paris on Feb. 1, 1861. He was an elegant and witty portraitist of innumerable contemporary English and French artists and writers, in both prose and paint. Blanche's painting developed under the successive inspirations of Manet, of his close friends Degas and Sickert, and of Fauvism and of Expressionism. His "Arthur Symons," "Thomas Hardy" and others are in the Tate gallery, London, and he is represented in the Rouen museum, the Art Institute of Chicago and elsewhere. He died on Oct. 3, 1942.

See Jacques Émile Blanche, *Portraits of a Lifetime* (1937), *More Portraits of a Lifetime* (1939).

BLANCHE OF CASTILE (1188–1252), queen consort of Louis VIII of France and twice regent for Louis IX, was born at Palencia in Old Castile, the third daughter of Alfonso VIII, king of Castile, and Eleanor, daughter of Henry II of England. In consequence of a treaty between Philip II Augustus of France and her uncle John of England, she was betrothed to Philip's son Louis and brought to France, in the spring of 1200, by John's mother, Eleanor of Aquitaine. On May 22, 1200, the treaty was finally signed, John ceding with his niece the fiefs of Issoudun and Graçay together with certain fiefs in Berry. The marriage was solemnized the next day, at Portmort, in John's Norman domains, as Philip's domains lay under an interdict. Blanche first displayed her great qualities in 1216, when Louis, who on John's death claimed the English crown in her right, invaded England, only to find a nation united against him. As Philip Augustus refused to help his son, Blanche established herself at Calais and organized reinforcements, but all her energy was in vain.

Although it would seem that her masterful temper exercised a sensible influence on Louis's gentler character, Blanche's role during his reign (1223–26) is little known. On his death he left Blanche regent and guardian of his children, including Louis IX (Saint Louis), the heir, who was only 12 years old. During this first regency (1226–34) Blanche had to bear the whole burden of affairs alone, to break up a league of the barons (1226) and to repel an English attack (1230). She gained the support of one of the confederate nobles, Thibaut IV of Champagne, protected him from the attacks of his former allies and, when he inherited the throne of Navarre, obtained from him the countships of Blois, Chartres and Sancerre. By judicious marriage treaties she secured Toulouse and Provence to the royal house. Louis IX, indeed, owed his realm to his mother, who brought him up strictly and according to devoutly Christian principles, and he always remained somewhat under her influence.

In 1248 Blanche again became regent, during Louis's absence on the crusade, a project she had strongly opposed. In the disasters that followed she maintained peace, while draining the land of men and money to aid her son in the east. She fell ill at Melun in Nov. 1252 and was taken to Paris, where she died a few days later.

Apart from general histories of the reigns of Louis VIII and Louis IX (*qq.v.*), *see* Élie Berger, "Histoire de Blanche de Castille, reine de France," *Bibliothèque des écoles françaises d'Athènes et de Rome*, vol. lxx (1895); M. Brion, *Blanche de Castille, femme de Louis VIII, mère de Saint Louis* (1939).

BLANDRATA (BIANDRATA), **GIORGIO** (*c.* 1515–1588), Italian physician and an important figure in the history of unitarianism, was born at Saluzzo in Piedmont about 1515. He studied at the university of Montpellier and in 1533 graduated as a doctor of medicine. His writings on the diseases of women gained him a wide reputation, and in 1540 he was called to the court of King Sigismund of Poland, to be the personal physician of his queen, the Milanese Bona Sforza. After 12 years he returned to Italy and practised at Mestre and at Pavia. He became involved in the antitrinitarian movement and had to flee to Geneva to escape from the Inquisition. His relations with Calvin were at first friendly, but later they quarrelled, and Blandrata had to flee to Poland. The remainder of his life was marked by frequent changes in his religious opinions and by equally frequent changes of domicile. His polemical activities brought him into grave danger, from which he was saved by his professional reputation and his courtly manners. His end is obscure, but he is said to have returned to Rome with a fortune and to have renounced his heresies. According to contemporary gossip he was murdered by a nephew in May 1588.

See also UNITARIANISM.

See E. M. Wilbur, *A History of Unitarianism* (1945). (W. J. BP.)

BLANE, SIR GILBERT (1749–1834), Scottish physician whose reforms in naval hygiene and medicine included the use of lime juice to prevent scurvy, was born at Blanefield, Ayrshire, on Aug. 29, 1749. He studied medicine at Edinburgh university but took his M.D. degree at Glasgow in 1778. He then became private physician to Admiral (later Lord) Rodney, whom he accompanied to the West Indies in 1779. He improved the health of the sailors by adding lime juice and other fresh foods to their diet and by enforcing a number of sanitary measures, and it was through him that the use of lime juice was, in 1795, made obligatory throughout the navy.

He returned to London and became physician to St. Thomas' hospital (1783–95), and physician-in-ordinary to George IV (both as regent and as king) and to William IV. He was made a baronet in 1812 in reward for his services in connection with the return of the ill-fated Walcheren expedition. He died in London on June 26, 1834.

His published works include *On the Most Effectual Means for Preserving the Health of Seamen* (1780); *Observations on the Diseases of Seamen* (1785); and *Elements of Medical Logick* (1819). (W. J. BP.; X.)

BLANK VERSE, so called because it lacks rhyme, is the unrhymed iambic metre which has 9, 10, 11 or 12 syllables in each line with five main stresses. Classical heroic verse, which was the model for later European epic and dramatic poetry, is generally unrhymed. When the revival of interest in classical metre led to the development of a modern unrhymed verse, it took the form of ten syllables (in general) in a line divided into five iambic feet, instead of following the pattern of the classical hexameter (*q.v.*). Introduced in 16th-century Italy, blank verse reached its fullest development in English literature. The skill in using it lies in the variation of the stress, and of the pause or pauses within the line, and in the musical sonorous upbuild of lines into paragraphs.

The Italian humanist Francesco Maria Molza was the first to attempt the writing of consecutive unrhymed verse in his translation of Virgil's *Aeneid* (1514). Other experiments in 16th-century Italy were the tragedy of *Sofonisba* (1515) by G. Trissino, who developed a strictly classical form, and G. Rucellai's didactic poem *Le Api* (published 1539). Rucellai's was the first use of the term *versi sciolti*, which became translated as blank verse. Renaissance Italy quickly adopted the form and the comedies of Ariosto, the *Aminta* of Tasso, and the *Pastor Fido* of Guarini are all in unrhymed verse. Italian poets used an 11th syllable or feminine ending to complete the line.

Henry Howard, earl of Surrey (*q.v.*), took the measure from Italy to England. Making the line stronger by omitting the final syllable, Surrey translated two books of the *Aeneid* (1557) in the "straunge meter." He soon found imitators. Thomas Sackville and Thomas Norton used blank verse for the first time in English tragic drama in *Gorboduc* (1562). John Lyly in *The Woman in the Moone* and George Peele in *The Arraygnement of Paris* sought to combine rhyme with blank verse. Christopher Marlowe's use of blank verse is important: in *Tamburlaine, Doctor Faustus* and *Edward II* his "mighty line" occasionally combines the music of Edmund Spenser's poetry with the emotional power of Shakespearean drama.

It was Shakespeare who transformed the line and the instrument of blank verse into the vehicle for the greatest English dramatic poetry. In his early plays, such as *Love's Labour's Lost, Romeo and Juliet* and *The Two Gentlemen of Verona*, Shakespeare used prose as well as a ten-syllabled rhymed couplet. After Marlowe's death he used a blank verse, dependent, as Robert Bridges has said, on stress rather than on syllabic length. Shakespeare's verse in *Hamlet, King Lear, Othello, Macbeth* and *The Winter's Tale*, is supple, approximating to the rhythms of speech, yet capable of conveying the subtlest human delight, grief or perplexity:

To be, or not to be, that is the question—

> Whether 'tis nobler in the mind to suffer
> The slings and arrows of outrageous fortune;
> Or to take arms against a sea of troubles,
> And by opposing end them?

After Shakespeare, blank verse fell from its high place. Beaumont and Fletcher, authors of *The Knight of the Burning Pestle* and *The Maid's Tragedy*, made excessive use of the feminine ending. Thomas Middleton was long-winded. John Webster was violent. Philip Massinger's verse approached the tenuous borderline where poetry meets prose. Cyril Tourneur, George Chapman, Thomas Kyd, Ben Jonson, John Ford, James Shirley and Thomas Heywood were in no sense masters of blank verse.

John Milton's blank verse stands next to Shakespeare's. He used it in the three great epic poems, *Paradise Lost, Paradise Regained* and *Samson Agonistes*, as Shakespeare had used it in drama. In the preface of 1668 to a reissue of the first edition of *Paradise Lost* (1667) Milton wrote:

> The measure is English Heroic Verse without Rime, as that of Homer in Greek, and of Virgil in Latin; Rime being no necessary Adjunct or true Ornament of Poem or good Verse, in longer Works especially, but the Invention of a barbarous Age . . . . . it rather is to be esteem'd an example set, the first in English, of ancient liberty recover'd to Heroic Poem from the troublesome and modern bondage of Rimeing.

Milton's verse is intellectually complex yet flexible, using inversions, latinized words and all manner of stress, line length, variation of pause and paragraphing to gain descriptive and dramatic effect. After Milton, dramatists returned to the use of blank verse and John Dryden, with Nathanial Lee and Thomas Otway, regained for it some of the Shakespearean magnificence.

In the 18th century James Thomson used the measure in his long descriptive poem *The Seasons*, and Edward Young's *Night Thoughts* gained power and passion from its use. Wordsworth wrote his great autobiography of the poetic spirit *The Prelude* (1805) in a blank verse which is capable both of high tension and of pedestrian flaccidity. Shelley's drama *The Cenci* (1819) was written in the form. Keats used it in *Hyperion* (1820). In *The Princess* (1847), Tennyson employed alliteration to offset the lack of rhyme. Both Robert Browning and Elizabeth Barrett Browning attempted blank verse.

Of 20th-century writers of blank verse, Lascelles Abercrombie, Robert Bridges, and Robert Frost in *A Masque of Reason* (1945) are notable. In his plays, *The Family Reunion*, *The Cocktail Party* and *The Confidential Clerk*, T. S. Eliot has offered what he himself has called a "trickle" of unrhymed lines that flows somewhere between blank verse and dramatically utilitarian prose.

See also the articles METRE; RHYME; VERSE. (J. W. T.)

BLANQUI, (LOUIS) AUGUSTE (1805–1881), French socialist and revolutionary, was born on Feb. 1, 1805, at Puget-Théniers, where his father (a former member of the Convention) was a subprefect. He studied both law and medicine but early became interested in politics. He fought in the revolution of 1830, receiving a decoration for his services. Rapidly disillusioned by the conduct of the new government of Louis Philippe, he began to organize secret republican societies and was twice imprisoned (1831 and 1836). In 1838 he organized a new "Society of the Seasons," with Armand Barbès and Martin Bernard as colleagues. Its attempt at insurrection on May 12, 1839, was a fiasco, and Blanqui, with his colleagues, was arrested and sentenced to death, commuted to imprisonment for life. Later he was granted a formal pardon in the belief that he was dying, but he could not leave the prison hospital until just before the revolution of Feb. 1848. He found himself the chief republican club leader, having set up the Société Républicaine Centrale, and continually pressed the government to follow a more socialist and Jacobin policy. As the most skilled tactician, he might have momentarily succeeded in this object had not Barbès ruined his influence by sponsoring a baseless charge of treachery. Unable to prevent the senseless attack on the assembly on May 15, Blanqui suffered its consequences, being sentenced to ten years' imprisonment.

During these years he thought out his political philosophy, advocating the dictatorship of the proletariat (exercised through Paris) as the only means of achieving communism. He maintained that the proletariat must fight the rule of the *bourgeoisie* by forming trade unions, by strikes and, above all, by revolution, and must overthrow the existing political structure before it could achieve its social aims. In Blanqui's philosophy, revolution meant progress. As time went on, Blanqui became more concerned with revolution and less with a social program. He refused to countenance an attack on property after a revolution had been achieved, but wanted gradual economic evolution from capitalism. Released from prison in 1859, Blanqui resumed his organization of secret societies. Again imprisoned in 1861, he escaped to Belgium in 1865 and directed operations from there. By 1870, when he returned to France for good, he was at the head of a secret, armed and drilled force of about 4,000 men in Paris; he also had many adherents who were not included in his army. On the news of the disaster of Sedan the Blanquist army formed the "hard centre" that directed the energies of the indignant crowd, so that the downfall of the empire was secured. It was not, however, able to influence the composition of the new government except by forcing the inclusion of Henri Rochefort.

Blanqui, who was ardently patriotic, was infuriated by the slackness of the government left behind in Paris by Léon Gambetta to conduct the war. He believed that it was more hostile to the left-wing battalions of the national guard than to the Prussians. On Oct. 31, 1870, the battalions that followed his lead came into conflict with the orthodox regiments, and for a few hours Blanqui was at the head of a provisional government; he came, however, to an arrangement with the expelled government and withdrew. On the signing by Louis Adolphe Thiers of the armistice of Jan. 27, 1871, Blanqui retired to Lot to recover his health, broken by exertion and disappointment. There, by order of Thiers, he was arrested on March 17, just before the outbreak of the Paris Commune (*q.v.*), for his part in the revolution of Oct. 31, 1870. Though elected to a seat on the commune, which was led chiefly by his followers, he was held a close prisoner until after its defeat, when he was again sentenced to imprisonment for life. As a result of agitation, culminating in his standing as deputy for Bordeaux, he was released after the amnesty of 1879 and ended his life in peaceful propaganda. His published works include: *La Patrie en danger* (1871); *L'Éternité par les astres* (1872), a philosophical work strongly tinged with mysticism; *L'Armée esclave et opprimée* (1880); and, most important, *Critique sociale*, 2 vol., published posthumously in 1885. He died in Paris on Jan. 1, 1881. The Blanquist party was absorbed in the unified French Socialist party by negotiation in 1904–05.

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BLANQUI, JEROME ADOLPHE (1798–1854), French economist, whose *History of Political Economy in Europe* (translated in 1880) was the first major study of the history of economic thought. Born Nov. 21, 1798, at Nice, he succeeded J. B. Say, under whom he had studied, to the chair of political economy at the Conservatoire des Arts et Métiers. Blanqui's writing blended both theoretical and empirical approaches in an analysis of industry and commerce. He devoted himself primarily to an examination of the conditions of the working class. Though he advocated government action in the protection of the worker, Blanqui remained a liberal in the tradition of Adam Smith. He died Jan. 28, 1854, in Paris. (L. N.)

BLANTYRE, a town in Lanarkshire, Scot., lies 9 mi. S.E. of Glasgow and is made up of the previously independent villages of Auchintibber, High Blantyre, Stonefield and Low Blantyre. Pop. (1951) 17,769. The main industries are coal mining and engineering; there is also an industrial estate. In 1813 David Livingstone (*q.v.*) was born in a small single-roomed house in Low Blantyre and he was later employed in the cotton mills there. The Livingstone National memorial, which includes this house and the surrounding grounds, contains a complete record of Livingstone's life and African journeys, together with a scale model of the original village and mills. Scanty remains of Blantyre priory

(13th century) stand on the left bank of the Clyde adjacent to the memorial. Opposite, the towers and walls of Bothwell castle crown a red sandstone cliff.

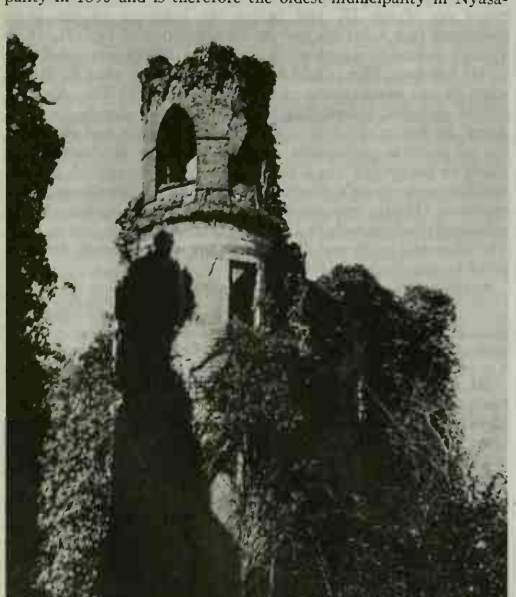
BLANTYRE-LIMBE, a town in the Southern province, Nyasaland, lies in the Shiré highlands at an altitude of about 3,600 ft. It is the largest town in Nyasaland, covering an area of approximately 16 sq.mi., and was formed in 1956 out of the adjoining townships of Blantyre and Limbe. Pop. (1962 est.) 59,700. The altitude gives it a temperate climate with a rainy season from December to March.

By the early 1960s the town showed all the signs of rapid growth including the construction of a new township for Africans. Kindergarten, primary and secondary education are provided, and there is a school for Europeans and one for Asians. There are Roman Catholic and Anglican cathedrals, a public library, hospitals for Africans and Europeans as well as for all races, four public parks and two markets. Blantyre-Limbe is connected by rail with Beira (Mozambique) 330 mi. distant, and a main road links it with Salishury (380 mi.). Chileka, 7 mi. N., is an airport for services from Southern Rhodesia, Northern Rhodesia and east Africa and the base for local air services in Nyasaland. Blantyre-Limbe is the chief commercial and distribution centre of Nyasaland. Its industries include saw mills and the manufacture of cement, tobacco and mineral waters (effervescent drinks). It is also the centre for visiting the Mlanje mountain area to the south and Lake Nyasa to the north.

Blantyre, originally a Church of Scotland mission station, was named after David Livingstone's birthplace in Scotland and dates its foundation from 1876. The town was constituted a municipality in 1895 and is therefore the oldest municipality in Nyasaland. The Livingstonia Central Africa company (which is now called the African Lakes corporation) has its headquarters at Blantyre. Its trade was at one time mainly in ivory for which it developed communications, thus laying the foundations of the town's commercial importance.

Limbe (founded 1909), five miles away, grew round the headquarters of the Nyasaland railways. The area between them was built over, and in 1956 the two towns were amalgamated.

(K. H. J. V.)



CAMERA PRESS—PIX FROM PUBLIX

THE RUINED CASTLE TOWER WHICH CONTAINS THE BLARNEY STONE

BLARNEY (Blárna), a village in County Cork, Republic of Ireland, well known for its castle, lies in wooded country 5 mi. N.W. of Cork. Pop. (1961) 995. Tweed is manufactured there. Blarney castle, built about 1446 by Cormac Laidhiv McCarthy, lord of Muskerry, has walls 18 ft. thick. Below the battlements on the southern wall is the "Blarney Stone," reputed to confer eloquence on those who kiss it, an operation performed only by hanging head downward. Unknown in the early 18th century, there is no legendary explanation of how the stone became invested with its remarkable properties. The word blarney has come to mean smoothly flattering or cajoling talk. The castle played an important part in the history of the area, being besieged both by Cromwellians and by the troops of William III.

BLASCO IBÁÑEZ, VICENTE (1867–1928), Spanish writer and politician whose early regional novels are vividly descriptive but who achieved spectacular success at the expense of literary quality. He was born at Valencia in Jan. 1867, and at 17 went to Madrid to study law, there beginning his career by incurring the first of many terms of imprisonment for a republican poem. After visiting Paris he returned to Valencia, founded (1891) a republican journal, *El Pueblo,* and in 1901 was elected to the *cortes,* to which he was returned seven times before his voluntary exile at the beginning of the Primo Rivera regime in 1923. Restless energy and political hazards often drove him abroad: into exile for supporting the Cuban nationalists in 1896, and to Argentina and Paraguay, where he tried to found colonies in 1909.

His early novels—*Flor de Mayo* (1895), *La barroca* (1899) and *Cañas y barro* (1902)—depict with intense realism the tragic lives of Catalan farmers and fishermen and excel in the creation of vigorous, elemental characters and the description of nature. In *La catedral* (1903) ideology began to swamp character and action, and although he wrote powerful novels on serious social themes—*La bodega* (1906), *Luna Benamor* (1909)—, his sensibilities gradually became blunted. In *La maja desnuda* (1906), *Sangre y arena* (1909) and the best-selling *Los cuatro jinetes del Apocalipsis* (1916; filmed as *The Four Horsemen of the Apocalypse* with Rudolph Valentino), energy degenerated into sensationalism. Detailed description lost significance when applied to places only superficially known, and such works as *Los Argonautas* (1914) and *Mare nostrum* (1918), although popular, did not enhance his literary reputation. He amassed a fortune, went on a world tour, built a mansion on the Riviera and exploited his exile to create publicity. He died at Menton, Jan. 28, 1928.

See his *Obras completas* (1947); J. A. Balseiro, *V. B. Ibáñez, hombre de acción y de letras* (1935).

BLASHFIELD, EDWIN HOWLAND (1848–1936), U.S. genre and mural painter, whose academic adaptations of symbolism and allegory were much admired, was born in New York city on Dec. 15, 1848. From 1867 he studied in Paris with Léon Bonnat, exhibited genre there (salon of 1874 and later) and in New York from 1881. His decorative work began at the Chicago exposition of 1893. Typical among his numerous commissions thereafter were those for the capitol, St. Paul, Minn.; the courthouse, Baltimore, Md.; and City college, New York. His extensive organizational activities included the presidency of the National Academy of Design (1920–26). With A. A. Hopkins he edited Vasari's *Lives* (1897); with his first wife, Evangeline Wilbour, he wrote *Italian Cities* (1900). His principal publication was *Mural Painting in America* (1913). His many honours included the gold medal of the National Institute of Arts and Letters (1923). He died on Cape Cod, Mass., Oct. 12, 1936. (Vl. B.)

BLASIS, CARLO (1795–1878), a distinguished Italian ballet dancer, teacher and writer on the technique, history and theory

of dancing. He was the first to codify and publish an analysis of the classic ballet technique, in his *Traité élémentaire, théorique, et pratique de l'art de la danse* ("Elementary Treatise Upon the Theory and Practice of the Art of Dancing"; 1820).

Born in Naples on Nov. 4, 1795, he studied under Jean Dauberval in Bordeaux, France, danced briefly at the Paris Opéra and appeared in Salvatore Viganò's ballets at La Scala, Milan. In 1837 Blasis was appointed director of the ballet school at La Scala, where he trained many brilliant dancers, including Amalia Ferraris and Giovanni Lepri.

See also BALLET: *The Italian School.* (LN. ME.)

BLASIUS (BLAISE, BLAIZE), **SAINT,** bishop of Sebaste (modern Sivas, Turkey), was martyred early in the 4th century. He is said to have been torn with wool combers' irons before he was beheaded, and, perhaps for this reason became the patron saint of wool combers. Because of a miracle which he is alleged to have worked on a child suffering from a throat affection, St. Blasius' aid was held sovereign against throat and lung diseases. The Roman Catholic Church keeps his festival on Feb. 3, the Orthodox on Feb. 11.

BLASPHEMY is a word that has been used with different and often not very precise meanings at different times. By moral theologians blasphemy is regarded as a sin; St. Thomas Aquinas described it as a sin against faith. It has points in common with heresy, but must, nevertheless, be differentiated: heresy consists in holding a belief contrary to the orthodox one; blasphemy imports the idea of irreverence and profanity. Thus it is not blasphemous to deny the existence of God or to question the established tenets of the Christian faith unless this is done in a mocking and derisive spirit. For a Muslim it is blasphemy to speak contemptuously not only of God but also of Mohammed.

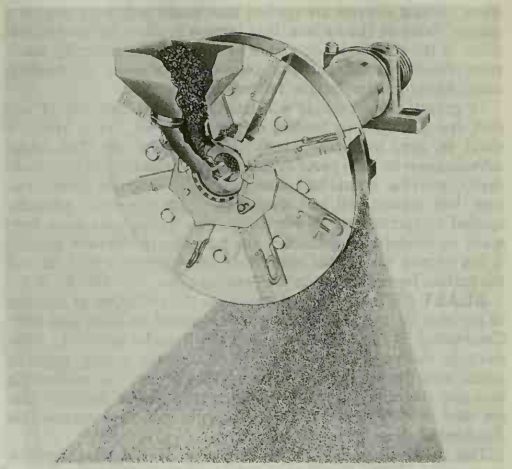
Among many peoples blasphemy in some form or another has been an offense. The Mosaic law decreed death by stoning as the penalty for a blasphemer, "the sojourner as well as the native" (Lev. xxiv, 16). The extent to which sins have been treated also as crimes by the secular power has varied from age to age and place to place. Under Justinian I the death penalty was decreed for blasphemy. The French code for Cambodia made mockery of an idol an offense. Many states of the United States have legislation aimed at blasphemy. In Scotland until the 18th century it was punishable by death. In England it is both a statutory and a common-law offense. Recognized as the latter in the 17th century, in theory it must be taken to have been such from time immemorial, the underlying idea appearing to be that an attack on religion is necessarily an attack on the state, for in the words of Chief Justice Hale, in *Taylor's Case* (1675, 1 Vent. 293), "the allegation that religion is a cheat tends to the dissolution of all government." This idea probably has been the reason why penalties have been laid down for blasphemy in some secular legal codes.

See J. Hastings (ed.), *Encyclopaedia of Religion and Ethics,* vol. ii, pp. 669–672 (1909). For blasphemy in English law *see* G. D. Nokes, *A History of the Crime of Blasphemy* (1928). (E. G. MO.)

BLAST CLEANING AND SHOT PEENING. Blast cleaning is a process in which a stream of solid particles is propelled with sufficient velocity against a surface to cause a cleaning action. There are two means of propelling the abrasive—compressed air and centrifugal force. Although some types of work require the use of compressed air—*e.g.,* complex internal holes in castings—centrifugal force has generally replaced air in most applications.

The centrifugal blasting wheel was developed in the early 1930s. Usually it is an eight-bladed wheel about 20 in. in diameter and from 2 to 5 in. wide. The abrasive is fed to the centre of the wheel and metered to the blades which turn at more than 2,000 r.p.m. The major advantage of centrifugal force as opposed to compressed air is reduced operating cost. A blasting wheel will throw 300 lb. of abrasive per minute while requiring only 15 h.p.; five $\frac{3}{8}$ in. air nozzles are required to throw the same quantity at 80 lb. per square inch pressure, consuming 190 h.p.

The first use of the process was by the metalworking industry. In particular, the foundry and forging industries are major users of the process. It is also widely used in steel mills, structural fabricating shops, pipe mills and die-casting shops.



BY COURTESY OF WHEELABRATOR CORP.

CUTAWAY VIEW OF CENTRIFUGAL BLAST CLEANING WHEEL, SHOWING ABRASIVE PATTERN

A wide variety of materials are used as the abrasive, including many types of metal, vegetable matter and sand. The first abrasive used was sand, but because it was very short lived, other abrasives were sought. Cast chilled iron was the first metallic abrasive to be generally used. Extremely hard, it is far superior to sand in any cleaning operation where the abrasive can be recovered. Malleable iron shot and grit, and steel shot and grit, are generally considered superior to chilled iron for most applications. Other metallic abrasives include cut wire, nail clippings and many of the nonferrous metals such as copper, aluminum, etc. Vegetable matter, such as crushed corncobs, walnut shells and peach and apricot pits, is used in many applications where a softer abrasive is needed. Sand is seldom used in the metalworking industry as a cleaning abrasive, but it is employed in cleaning stonework on buildings and other structures. The plastics industry is also a large user of blasting equipment for mechanical deflashing and finishing of molded plastic parts; vegetable abrasives are widely used in this work.

Industrial blast cleaning equipment is constructed in many different forms. The tumbling machine, which utilizes an endless belt conveyor in the blast chamber, is used for batch cleaning of parts that can be tumbled. This type of machine ranges in capacity from 1 cu.ft. to more than 100 cu.ft. For parts that are either too large or too fragile to be tumbled, the table-type machine is used. In this machine the table is loaded with work and then revolved in the blast. The table can be an integral part of the machine with only a quadrant exposed to the blast at any one time or it can be enclosed to permit blasting the entire table surface at once.

Shot Peening.—Shot peening is a cold-working method accomplished by pelting the surface of a metal part with round metallic shot thrown at a relatively high velocity. Each shot makes a small dent in the surface of the metal and stretches the surface radially as it hits. The rain of shot causes a plastic flow of the surface fibres beyond their yield point in tension. The fibres underneath the top layer, however, are not stretched to their yield point and therefore retain their elasticity. The under fibres are bonded to the stretched surface layer, and after the peening action the inner fibres force the outer fibres to return to a shorter length than that at which the stretched fibres would tend to remain. In the equilibrium which results, the surface fibres are in residual compression while the inner fibres are in tension. The surface compression stress is several times greater than the tension stresses in the interior of the section, so that

when working stresses are applied that would ordinarily impose a tension stress on the surface, that tension is offset by the residual stress in the surface layer. Since fatigue failures generally result from tension stresses, not from compressive stresses, the result is considerably greater fatigue failure strength.

In general, shot peening will lengthen the fatigue life of any part that is subject to bending or twisting stress, but it has little effect on axial push-pull stress. Shot peening has been found advantageous on such parts as axles, gears, propeller shafts, crankshafts, steering knuckles, connecting rods, universal joints, pistons, leaf springs and helical springs. The process is generally applied to ferrous metals but successful applications have been made on nonferrous products. Once an object has been peened, it can receive no further machining because this would remove the surface layer and negate the peening effect. (W. E. N.)

BLAST FURNACE, a furnace for the reduction of iron ore to pig iron by the action of carbon, supplied by coke and heat. Combustion is forced by a current of air under pressure; limestone is charged into the furnace to convert earthy minerals mixed with the ore and the coke ash into a slag; and molten pig iron and slag are drained from the hearth. Blast furnaces also are used in the production of lead, copper and other metals (see *Nonferrous Blast Furnaces,* below).

This article discusses the development of the blast furnace, the process of obtaining pig iron from ore, furnace construction and operation and blast furnaces for nonferrous metals. For the history of the manufacture and use of iron *see* IRON AND STEEL INDUSTRY: *Early History.*

Development.—In the middle ages iron was made in furnaces of relatively small size, in which pure ore was reduced to a pasty mass by means of charcoal, and this was subsequently hammered to get rid of the impurities. About the 15th century the type of furnace was altered by the addition of an upper portion, or stack, in which primary preparation of the materials took place. This revision made possible the melting of the metallic product, so freeing it from earthy impurities and giving a material, pig iron, altogether different from the forged metal formerly made. Thus the blast furnace first came into use.

Until the 18th century only charcoal was the furnace fuel. An acre of forest would furnish only from 7 to 12 tons of charcoal which was less than the amount needed for the production of a ton of iron per day for a one week period. This depletion of the forests caused grave alarm and stringent laws were enacted in 1558, during the reign of Queen Elizabeth I, which forbade the cutting of trees for conversion into charcoal and the making of iron, except at Kent. These laws caused such ironmakers as Simon Sturtevant (1612), John Rovenson (1613) and Dud Dudley (1622) to turn their efforts toward the use of "sea-coale, pit-cole, etc." for ironmaking. By the early 1700s iron smelting with coke had been accomplished by Abraham Darby I at Colebrookdale (*see* also SHROPSHIRE: *History*). The first cokes were made by methods similar to charcoal (*q.v.*) burning. After the Civil War when cokes were made from the Connelsville, Pa., coals they were very strong and did not crush under heavy burdens thus permitting blast furnace stacks to be raised to 95 ft. in height, an advance known as the "Duquesne revolution."

In 1892 James Gayley reported that in Germany carbon brick refractories had already been developed for lining furnace hearths and this along with his work on furnace design and construction presaged the modern practice of using carbon blocks in preference to the firebrick construction of earlier days. Both practices became common.

Julian Avery (1938) suggested that high pressure blast furnace operation could be accomplished by controlling the outflow gas—a method subsequently developed at Cleveland, O. The first actual pressure operation started on April 26, 1944, and the top pressure was raised one half pound each day until ten pounds was reached. This development was reported in May, 1947 by J. Slater who operated the furnace. Modern blast furnaces are over 100 ft. in over-all height with hearths over 30 ft. in diameter, and may produce as much as 3,000 tons of iron in one day.

The Process.—Minerals containing iron in amounts permitting their use as economic ores are widely distributed in nature. The common ores most suitable for direct use in the blast furnace are the reddish hematite, Fe_2O_3, the yellow to brown limonitic ores, $Fe_2O_3(H_2O)$, and the black magnetite, Fe_3O_4. The bulk of these natural impure ores is made up of ferric oxide, Fe_2O_3, with iron and oxygen atoms combined in the ratio of 2 to 3. Means, therefore, must be provided to abstract oxygen thus leaving the metallic iron, a process known technically as reduction. This reduction requires both high temperatures and the use of suitable reducing agents, such as carbon and carbon monoxide. These conditions are readily ensured by the combination of oxygen of the air with the hot carbon in the furnace hearth in the ordinary process of combustion wherein ample heat is generated and reducing gases are liberated.

TABLE I.—*Examples of Blast Furnace Operation in Various Parts of the World*

Technical Details	England Appleby-Frodingham, Scunthorpe	U.S. Republic Warren, O. (high top pressure)	Sweden Stora Kopparberg, Borlange	Japan Imperial Steel Works, Yawata
Height of furnace tuyères to stock line (in ft.)	76′	74′	40′	61′–3″
Diameter of bearth (in ft.)	31′	28′	15′	15′–3″
Output of furnace (in net tons of iron per day)	1,400	1,630	536	270
Quality of iron made	basic	basic	Bessemer blowing	acid Bessemer
Analysis of iron (in %)				
Silicon	.70	.84	.30	1.57
Phosphorus	1.38	.267	1.80	.10
Sulfur	.050	.038	.050	.04
Manganese	.92	1.79	.70	1.13
Weight of coke charged per ton of iron made (in lb.)	1,600	1,600	1,170	2,318
Weight of slag per net ton of iron made (in lb.)	2,600	944	850	1,482
Slag analysis (in %)				
Silica	34.4	36.9	33.6	33.5
Lime	40.4	41.9	42.4	47.9
Magnesia	4.1	10.0	6.7	1.8
Alumina	17.1	12.5	10.1	14.2
Sulfur	1.3	2.0	1.2	—
Iron and manganese oxide equivalents	1.9	—	3.0	2.6
Volume of air blast Per net ton of iron made (in cu.ft.)	80,000	85,000	47,000	113,300
Pressure of air blast (in lb. per sq.in.)	31	23.6*	8–9	9
Temperature of air blast (in °F.)	1,250	1,045	1,497	1,157
Number of air blast tuyères	18	18	11	12

*Operations at no. 5 top press.

Ores are never pure iron oxides but contain a portion of earthy materials made up of silica, alumina, lime, magnesia, soda and potash, etc., which must be removed in the process as molten slag. At sufficiently high temperatures, the basic oxides, lime and magnesia, derived from the flux stone charged into the furnace combine with the acidic oxides, silica and alumina, and other earthy materials to form a molten slag. The ratio of these basic to acidic oxides in the slag is carefully controlled as it affects both the operation of the furnace, the composition of the iron, the removal of impurities such as sulfur from the iron, the fluidity of the slag and its melting temperature range. The slag does not mix with the iron as it is of a lower density and floats on top.

Pig iron is by no means pure iron. It contains a total of from 5% to 9% of carbon, silicon, manganese, phosphorus and usually rather small amounts of sulfur. Each of these constituents has an important effect on the quality of the pig iron.

In order that the product should be the quality required the mass of material, or "burden" as it is called technically, from which the pig iron is made must contain, in addition to iron, the requisite proportions of the other constituents mentioned. There is charged into the furnace therefore: (1) the burden which includes the iron ore, fluxes for forming the slag, and any other additions, *e.g.,* manganese ore or phosphoric rock, needed to give the proper manganese and phosphorus contents; (2) the fuel, which is generally coke; (3) the air blast, which is injected above the hearth of the furnace to burn the fuel and maintain a sufficiently high temperature to render both metal and slag freely molten.

The section of a modern furnace is shown in fig. 1, the parts of the interior known as the stack, bosh and hearth respectively

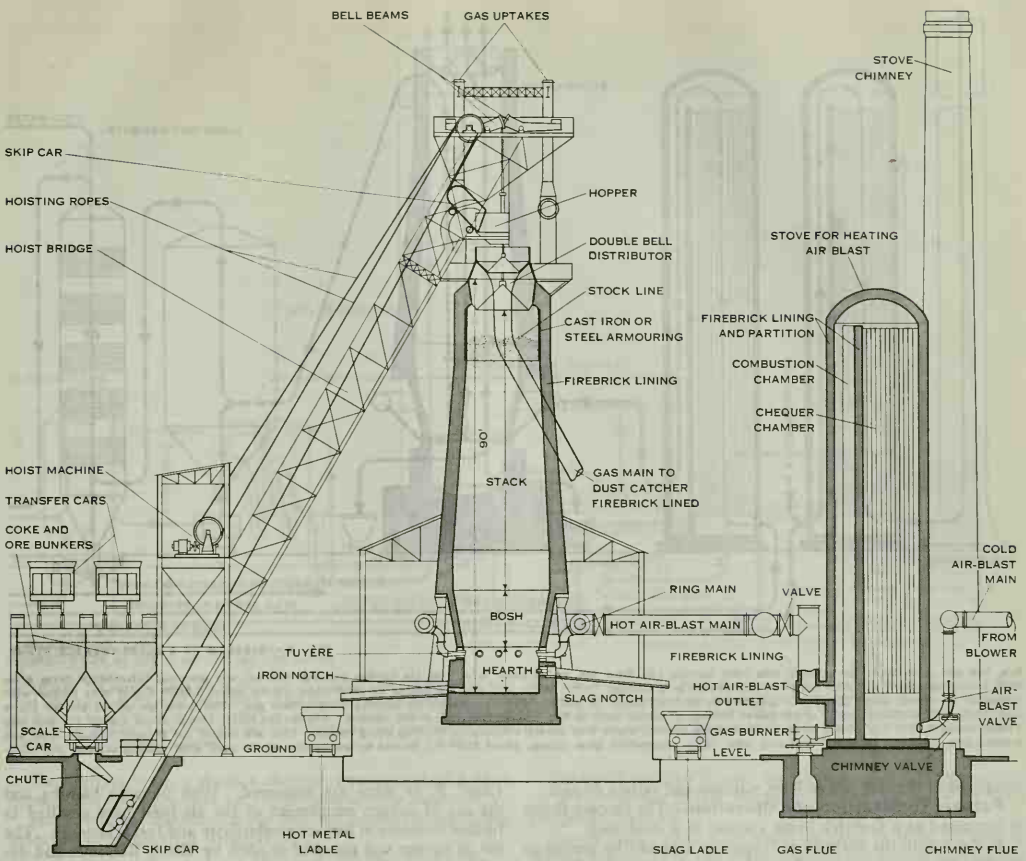


FIG. 1.—DIAGRAMMATIC SKETCH OF A SECTION OF A MODERN BLAST FURNACE

being indicated. The solid materials are charged into the top of the furnace while the air blast is blown through tuyères (nozzles) into the hearth where the highest temperature (about 3,400° F.) is generated. The oxygen of the air combines with the carbon of the coke, momentarily forming carbon dioxide, but as the hearth is full of incandescent coke, a reverse reaction rapidly takes place, the carbon dioxide being converted into carbon monoxide which is a powerful reducing agent. The hot gases composed of the carbon monoxide and the nitrogen of the air, along with some hydrogen derived from the dissociation of the moisture carried in the air, pass upward through the column of solid materials, their temperature being progressively reduced as a result of direct contact and chemical reaction, until they leave the top at about 460° F. The constituents of the burden pass through the furnace in 8 to 16 hours, while the gas passes upward through the burden in three to five seconds. When charged the constituents immediately come into contact with the hot gases and any moisture is quickly driven off. As they slowly descend the stack, the temperature increases and the carbon monoxide in the gases combines with the oxygen of the iron oxide to form carbon dioxide, leaving metallic iron in a finely divided form, or as iron sponge. The nonferrous materials are mixed intimately with the reduced iron, and separation does not take place until near the top of the bosh, where both the iron and the slag begin to melt. The coke passes through the furnace with only a light solution loss and a constant increase in temperature, until it reaches the tuyère zone, where intense combustion takes place with the oxygen of the air blast. The bosh and hearth however are filled with coke and, as the slag and iron melt, the liquids trickle down until they reach the well, in the bottom of the hearth, where they slowly accumulate and separate, the slag layer being on the top. The iron and slag are tapped from the furnace through separate tapholes at intervals timed in accordance with the capacity of the furnace.

TABLE II.—*Analysis of Top Gas*
(per cent of volume)

Carbon monoxide (CO)	24–27
Carbon dioxide (CO_2)	13–16
Hydrogen (H_2)	1–2
Methane (CH_4)	0.25
Nitrogen (N_2)	56–59

As the iron runs from the iron notch it passes into a trough, thence beneath a skimmer block or dam and on down the runner into the awaiting ladles. Toward the end of the iron tapping or runoff, slag comes from the furnace along with the iron. The molten iron acts as a seal beneath the skimmer dam and prevents the slag which floats on top of the iron from flowing down the iron runner thus separating the slag from the iron. The slag accumulates until it fills the trough and overflows into a slag runner and finally into the slag ladles.

A large volume of gases, sufficiently rich in combustibles to be of value, is produced during the process. The combustible gases are the carbon monoxide and hydrogen, but the major volume is

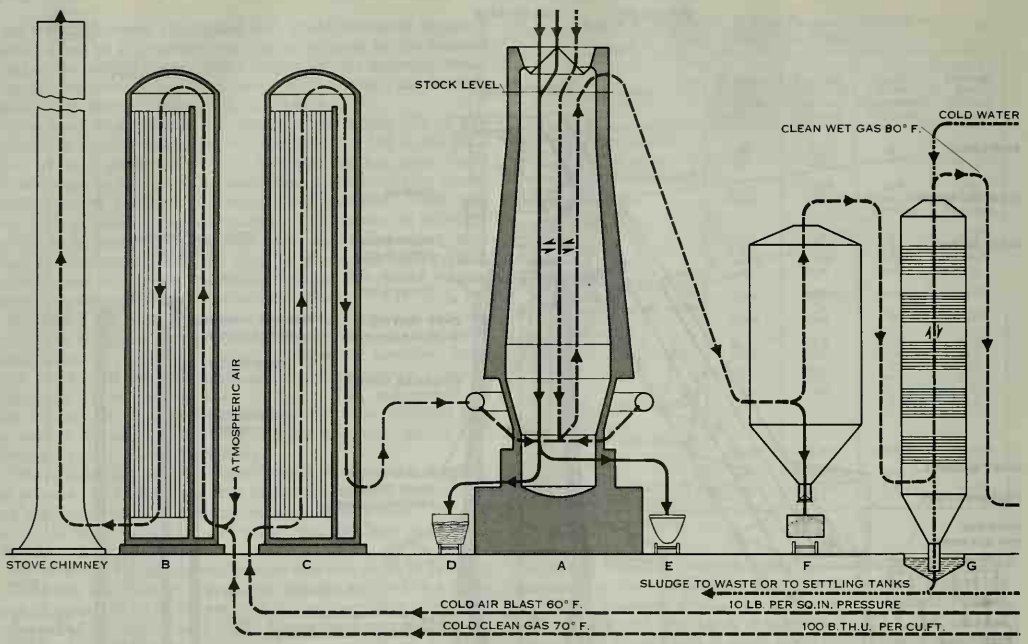


FIG. 2.—DIAGRAM OF A BLAST-FURNACE PLANT.

Ore, flux and coke (fuel) are charged into blast furnace (A) from top, up to stock level. As the burden descends thermal and chemical interchange takes place with escending gases until they arrive at the hearth in a reduced form. Metal and slag are melted by combustion (temp. about 3,200° F.) of coke burned with preheated air (temp. about 1,400° F.) supplied by air-blast stoves (B and C) which are heated by burning blast-furnace gas. The stoves are on gas and air blasts alternately; and a steady supply of air passes through a heated stove to the tuyères (nozzles) of the furnace. The molten metal (temp. about 2,650° F.) and slag (temp. about 2,770° F.) trickle down to the furnace hearth, where they separate naturally, the slag being on top. They are tapped out through suitable holes and troughs into hot-metal ladle (D) and slag ladle (E). Meanwhile gases (temp. about 450° F.) formed by combustion of the coke, after passing through and inter-

composed of the noncombustibles, nitrogen and carbon dioxide.

Furnace Construction and Operation.—The furnace shown is composed of a firebrick lining encased in a steel shell.

In the hearth the firebrick is frequently replaced by carbon or graphite block refractories. Everything is of a substantial nature since it has to withstand strenuous work. The weight of the materials in the furnace may approach 1,000 tons while that of the lining and structure is about 1,200 tons. Those parts of the furnace which are subjected to high temperatures are protected by water cooling. The life of a furnace lining is about five years, during which a quantity of iron up to 2,000,000 tons may be made. The raw materials are discharged from trucks into bins, from which they are drawn as required into a scale car. After weighing they are emptied into a skip which is hoisted electrically on an inclined track to the top of the furnace, where it is automatically tipped and stopped. The materials are received on a bell which is capable of being mechanically revolved to any point in the complete circle, and after moving to the proper position are lowered onto a second and larger bell. When the latter is fully loaded by a series of deliveries from the upper bell, it is lowered and the materials slide into the furnace. The level of the solids is about eight feet below the large bell, and the intention of the arrangement described is to distribute the incoming charge evenly over the stock line without allowing any gases to escape to atmosphere through the furnace top.

Air blast at the requisite pressure is provided by a blower, which may be a steam-driven reciprocating engine, a steam-driven turboblower, or a gas-driven reciprocating engine. In any case the blast furnace gases are used as the source of motive power. James Neilson of Scotland in 1828 discovered that increasing the temperature of the air blast before entry into the furnace resulted in a marked fuel economy, and air blast temperatures up to 1,800° F. or more are employed. High pressure blowing and the use of oxygen enrichment of the air blast have resulted in further increases in furnace productivity and fuel economies. The use of oxygen was patented in 1876 by Henry Bessemer and developed at Oberhausen, Ger., in 1933–40.

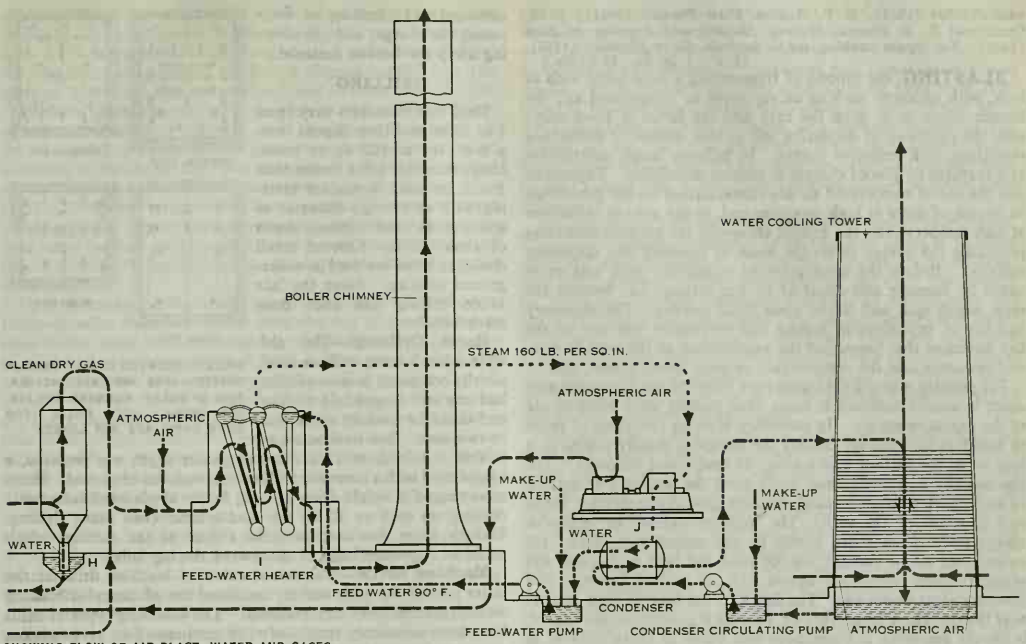
Hot blast stoves are used for heating the air blast and each unit is composed of a mass of brickwork, arranged as chequer work, contained in a steel casing. The temperature of the brickwork is raised to the required intensity by the combustion of blast furnace gases. The gases are then shut off and the air blast allowed to pass through the stove on its way to the furnace. Two or more stoves are required in order that the process may be continuous.

TABLE III.—*Qualities of Pig Iron*

Class of iron	Analysis (per cent)				
	Total carbon	Silicon	Sulfur	Phosphorus	Manganese
Basic	4.4	1.0	.03	.25	1.8
Thomas	3.8	.7	.10	2.10	2.0
Malleable	4.1	2.0	.04	.15	0.8

The gases leaving the furnace are passed through primary dust catchers and ultimately through towers where they are washed with water before use in the hot blast stoves. The remainder of the gases are utilized in raising steam, or as direct fuel in blast furnace gas-driven engines. The distribution of the available gases is approximately as follows:

Hot blast stoves	27%
Power for air blast	15
Wastage	3
Available for other purposes	55
	100%



SHOWING FLOW OF AIR BLAST, WATER AND GASES

acting with the burden, leave the furnace into a gravity dust catcher (F); then into a washer (G), where they are cleaned with water, and ultimately into a dryer (H). A portion of the clean gas (temp. about 80° F.) is used for firing water-tube boilers (I) in which steam is generated for the turboblower (J). The blower, which may be a steam-driven reciprocating engine, a steam-driven turboblower or a gas-driven reciprocating engine, forces air at a suitable pressure to heating stoves, while exhaust steam from the turbine is condensed and returned to boiler. A part of the remaining furnace gas is used in heating stoves while surplus is available for use in other processes

The diagram in fig. 2 shows a skeleton arrangement of a blast furnace plant and the data for typical practice are indicated.

Many different qualities of pig iron are made, representative examples being shown in Table III.

(F. C.; J. M. Sn.; D. E. Bk.)

Nonferrous Blast Furnaces.—Blast furnaces are used for the production of some of the nonferrous metals, particularly lead but to a lesser extent also for antimony, tin, copper and zinc. Such furnaces are much smaller than an iron blast furnace and are normally rectangular in plan. Furthermore, they do not use a hot blast and so do not have the large stoves that are such a prominent part of an iron blast furnace plant.

Modern lead blast furnaces will vary from 17 to 28 ft. in height from the tuyères where the air is introduced near the bottom of the furnace to the charge floor at the top of the furnace. The inside length at the tuyères will be about 16 ft. and the width 5 ft., although larger furnaces have been built both at Trail, British Columbia and Port Pirie, Australia.

The walls of the furnace are of water cooled steel jackets resting on a crucible of refractory brick and extending upward to a rectangular brick shaft that forms the upper part of the furnace. The steel jackets on the sides slope out so that the furnace has a greater area at the top.

Feed to the furnace consists chiefly of lead oxide formed by sintering lead sulfide concentrates, fluxes to form a proper slag, and coke to act as fuel and as a reducing agent. As the charge is heated in the furnace the lead and slag are formed and settle in the crucible with the slag on top of the metal. Normally the lead overflows continually into a pot from a channel to the bottom of the crucible, while the slag is tapped at intervals of a few minutes through a hole in the end of the furnace. Dust, fume and gases leave through a connection to the flue from the top or near the top of the furnace.

The use of the blast furnace for the production of antimony and tin is very similar to that described for lead, but there are other competing methods.

Copper blast furnaces are much the same as those for lead although usually all of the liquid contents are tapped through one hole and then allowed to separate in a container known as a forehearth. However, the reduction of copper oxides with coke in a blast furnace to form metallic copper is not common practice, because the simultaneous reduction of any iron oxides will form an alloy known as black copper. Blast furnaces are more likely to be used to melt a mixture of copper sulfide minerals and fluxes to form a slag and a liquid sulfide phase called a matte. The matte is subsequently converted to metallic copper in a Bessemer type converter.

The production of metallic zinc in a blast furnace is an unusual process first achieved in 1950 at Avonmouth, Eng. The process and furnace differ from those previously described in that the zinc is produced as a vapour and leaves the furnace with the gases. The zinc vapour is then condensed by a spray of molten lead and the zinc subsequently separated from the molten lead-zinc alloy. Molten slag and any liquid lead resulting from a mixed zinc-lead ore are tapped from the bottom of the furnace.

Furnaces even smaller than those described and usually cylindrical in shape are used for the melting down of both lead and copper scrap.

(A. W. S.)

See also Cowper Stove; Cupola Furnace; Furnace, Metallurgical; Iron and Steel Industry: *Blast Furnaces: Blast Furnace Plant.*

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nace Practice (1938); R. P. Hudson, *Blast Furnace* (1942); J. M. Camp and C. B. Francis, *Making, Shaping and Treating of Steel* (1951). For copper smelting, *see* G. Agricola, *De re Metallica* (1556). (F. C.; J. M. Sn.; D. E. Be.)

BLASTING, the process of fragmenting a solid body, such as rock, with an agent such as an explosive or compressed air, the former either in or upon the rock and the latter in holes only; also, the processes of displacing soil or tree stumps or destroying structures with explosive agents. In military usage, destruction of structures by placed charges is termed demolition. Explosions and the use of compressed air are characterized by the generation or release of gases at high pressures and, in the case of explosives at high temperatures, the kinetic energy of the gaseous molecules producing the energy to do the work of breaking and displacing material. Before the application of explosives, rock was excavated by hammer and chisel or by fire setting; *i.e.*, heating the rock, which split and flaked upon rapid cooling. The discovery and use of explosives in mining and excavation was one of the key advances that permitted the exploitation of the world's mineral resources and the construction of great dams, canals, etc.

For primary blasting (breaking rock from the solid) an explosive agent is usually confined in holes, thus making more efficient use of the explosive energy. In secondary blasting (breaking of rocks or boulders into smaller pieces) the charge is usually placed in a hole or on the surface with a cover of mud (mud capping). The size and shape of charge and depth from the nearest free surface to accomplish efficient breakage depend upon the properties, shape and structure of the rock. The pressure exerted by explosive agents varies from about 10,000 lb. per square inch (p.s.i.) for compressed air to about 1,500,000 p.s.i. for high explosives, and several million pounds per square inch for nuclear (atomic) and thermonuclear explosives. The shock of the blast is most intense near the charge. Compressed air, because it presents no fire hazard, is usually employed in bituminous coal mines to break the coal in large fragments. Black powder and high explosives may cause crushing immediately around the hole, but at the limit of the crushed zone the strain wave proceeds radially, diminishing rapidly in intensity. The shock from nuclear explosives produces melting and vaporization of rock in the immediate vicinity, then a crushed zone and finally a fractured zone if the charge is near enough to a free surface.

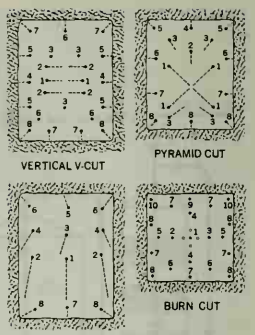
Fragmentation may be caused by compression, tension and perhaps occasionally shear stresses. If the rock near a high-energy explosive is compressible enough, it may break because of compression near the charge. When a charge of a given size is placed at an optimum distance from a free surface, compressive waves generated in the rock by the explosion will be reflected from the free surfaces as tensile waves, because the acoustic impedance (density times sound velocity) of the rock at the rock-air interface is much greater than that of air. Slabbing proceeds from the surface inward because of tensile failure of the rock, inasmuch as rock is much weaker (usually only one-tenth as strong) in tension than in compression. Energy in waves not impinging upon free surfaces proceeds outward in the ground in the form of waves and may cause damage to nearby structures. Poorly confined explosives may cause sufficient air blast, sometimes reflected from layers of the atmosphere of different temperatures, to break windows. The crater broken by a spherical charge at the proper depth theoretically should be conical in shape. However, the heterogeneity of rocks causes craters of irregular shapes to be formed.

The amount of explosive required to break a mass of rock effectively is proportional to that mass. Thus, the volume of rock broken is proportional to the weight of explosive, W; the surface areas of the crater are proportional to $\sqrt[3]{W^2}$; and the linear dimensions are proportional to $\sqrt[3]{W}$. This is the much-used cube-root scaling law, stating, inversely, that the amount of explosive required is proportional to the cube of the charge depth for similar size and shape.

Usual blasting operations (cycles) are composed of several phases: (1) drilling holes; (2) placing a charge and detonator in each hole; (3) tamping and stemming the charge (compacting the explosive and filling the remainder of the hole with clay or rock cuttings); (4) igniting or detonating the charge; and (5) clearing away the broken material.

DRILLING

Drill-hole diameters vary from 1 to 12 in. and their depths from a few feet to 100 ft. or more. Large diameter holes (more than 3 in.) are used in surface blasting, with an average diameter of about 6 in. and average depth of about 30 ft. Shorter, small diameter holes are used in underground blasting. Since the late 1800s drilling has been done mechanically.



DRILL ROUNDS FOR SMALL TUNNELS. DOTTED LINES INDICATE INCLINATION OF HOLES; NUMBERS, THE FIRING ORDER. OPEN HOLES (FOR BURN CUTS) ARE NOT LOADED

Hand Drilling.—The old-style miner's hand drill, or steel, usually octagonal in cross section, had one end forged into a chisel and could be used by either one or two men. One steel was used to drill a hole about 12 in., and if greater depth was required, a longer steel with a narrower width chisel end was employed. Hammers ranged in weight from 3½ to 4½ lb. for single-hand (one man) drilling, up to 8 or 10 lb. for double-hand (two man) drilling. Enough water was used to make a mud of the cuttings which could be "spooned" out of downward sloping holes.

Machine Drills.—The introduction of machine drills in the latter part of the 19th century increased the efficiency of blasting and excavation work tremendously. The following types of drills have been commonly employed: (1) compressed-air reciprocating or piston drills; (2) hammer drills; (3) electric auger drills; (4) electric reciprocating drills; (5) hydraulic drills; (6) rotary drills; (7) rotary air-blast drills; (8) cable (churn) drills and (9) jet-piercing drills. The compressed-air drills are obsolete and have been replaced by hammer drills. Electric auger drills are used in relatively soft materials, but these and the electric reciprocating and hydraulic drills are relatively unimportant although hydraulic drills are used to some extent in Europe. In these, hydraulic cylinders, driven by water pressure, operate a hollow bit with a serrated edge at about 6 r.p.m.; the bit, under a pressure of 800 to 1,000 p.s.i., crushes and grinds the rock, which is carried from the hole by a stream of water that also cools the bit. Rotary drills are used for hard abrasive material, employing diamond-set, tungsten carbide or roller-cone bits; they are also used extensively in oil well drilling. Rotary air-blast drills were first introduced in 1950; they use compressed air as a cooling medium for the drill bit. Cable drills will produce only vertical holes and have limited application. Jet-piercing drills were introduced commercially in 1949 and use thermal energy in the form of a very hot flame to heat and spall certain types of rock. The flame is generated by combustion of liquid petroleum fuels with oxygen. The impinging of the flame jet on a rock surface causes a thin flake to expand and break away. The gases of the jet plus the vapour formed by a cooling jet of water carry the spalled fragments out of the drill hole. Fusion of the rock is undesirable and rocks must have certain characteristics to make jet piercing more economical than other types of drilling. The efficient operation of the process also demands the proper combination of heat transfer rates for rapid spalling and high kinetic energy of the flame to keep the cutting face clean. *See* also Drilling Machinery.

LOCATION OF HOLES

Successful fragmentation for a minimum powder factor (pound of explosive per ton of rock broken) is dependent upon the proper placement of holes. Several configurations are used depending upon whether the blast is to be on the surface or underground and, if underground, the type of opening being blasted. Fragmentation is most easily obtained if there is a large number of free surfaces within an optimum distance of the charge. Thus, a sphere with a

charge at the centre would provide the maximum of free surface, while the face of a tunnel would provide only one free surface. Also, a cylindrical hole loaded along most of its length will break the rock more effectively if the hole is aligned parallel to a free surface. Most blast-hole patterns are based on these two principles.

Surface Blasting.—In most quarries, as well as for such construction projects as highways and canals, vertical holes are drilled parallel to a vertical face with several rows of holes spaced according to the charge size, hole diameter and "burden" (amount of rock the explosive in the successively outermost hole is to break). Holes are arranged in a rectangular or triangular pattern and charges are usually fired in rows with millisecond delay caps (*see* below) which are claimed to give better fragmentation and reduce possible vibrational damage to nearby buildings and other structures.

Open pit mines employ sloping benches instead of vertical faces. Large-diameter holes are drilled from the top of the benches in some mines, while in others small hole drills of hammer type may be used to drill either a series of holes into the toe of the bench or a combination of toe and top holes. The small holes are enlarged (sprung) at the bottom with small charges of explosive to form a chamber large enough to hold the main charge. Stripping of relatively loose overburden in surface coal mines is accomplished by exploding charges of suitable size, usually in widely spaced holes unless the rock overlying the coal is hard to blast.

Very large blasts, in which the explosive is loaded in tunnels usually about 4 × 5 ft. in cross section for the purpose of furnishing broken rock for dams or fills, have employed well over 1,000,000 lb. of high explosive in a single blast. Ripple Rock, a navigational hazard in the inland water route to Alaska, was removed by one of the largest nonnuclear blasts in history.

Underground Blasting.—Tunnels, drifts, shafts and similar openings have only one free surface into which the holes can be drilled and from which rock fragments can be broken. A "round" of holes in openings up to about 10 ft. high or wide consists of: (1) cut holes; (2) relief holes; (3) breast or enlarger holes; and (4) trim holes, including "lifters." The cut portion of the round is fired first to provide additional free surface to which the remainder of the round may break. Cut holes are either drilled at an angle to the face to make a V-cut, a pyramid cut or a draw cut, or several holes are drilled close together perpendicular to the face and only part of them are loaded, the unloaded holes providing free surface to form a "burn cut." The relief, breast and trim holes are spaced and aligned with respect to the cut portion of the round so that the rock will break to the desired shape of opening without placing too much burden on any one hole. A blast hole about which the rock fails to break is called a "bootleg." Some deep rounds employ large centre holes, up to 6 in. or more in diameter, with four or more blast holes slanted slightly inward toward the large hole. The blast holes must be carefully located and aligned for successful breakage. In large tunnels, small pilot tunnels may be driven first and the remainder of the large tunnel broken by bench blasting.

Mining of ore in rooms or stopes in a mine is usually performed with a modified type of bench blasting, or with holes drilled at an acute angle to a free surface to "slab off" the rock or ore.

In Sweden, where parallel openings are driven, holes are drilled from one tunnel into the face in the adjoining one so that the holes are parallel to the face of the unblasted tunnel. This method has very limited application.

EXPLOSIVES

Three types of explosives are used for blasting: (1) low explosives; (2) high explosives; and (3) nuclear explosives. Energy is released from low explosives (black powder) by chemical reaction by very rapid burning called deflagration. The release of energy from high explosives (dynamites and military explosives such as TNT) is by a process known as detonation, which is characterized by the propagation of a shock wave through the explosive supported by the chemical reaction accompanying the shock wave.

Black powder, which is used only where a slow explosive of low power is required to avoid shattering, as in building-stone quarries and some nongassy coal mines, was supplanted as an explosive when Alfred Nobel invented dynamite in 1867 by mixing sensitive nitroglycerin with kieselguhr (powdered SiO_2), making it safe to handle. Combustible absorbents such as wood pulp were later found to be more effective and still safe to handle. Part or all of the nitroglycerin may be replaced with blasting gelatin or ammonium nitrate. Salt or a similar inert substance is often added to dynamites to reduce their flame temperature and make them safer to use in gassy coal mines; they are then classed as permissible explosives.

For commercial blasting a wide range of dynamites is employed. These are mechanical mixtures of an oxidizing agent, a reducing agent and other substances. The most common grades of dynamite are ammonium nitrate dynamites for dry work and gelatins for wet work. Gelatin dynamites are made of nitroglycerin and nitrocellulose and are mixed with other substances to yield water-resistant dynamites of various strengths. These are made into cartridges, usually about $1\frac{1}{8}$ in. in diameter by 8 in. long. In general, higher strength explosives are required for harder rocks. Nonfreezing dynamites are made by the addition of ethylene glycol dinitrate or other antifreezing agent.

Although it was known in the late 1800s that ammonium nitrate (NH_4NO_3), an oxidizing agent, would explode when alone or when mixed with a fuel, it was not until the production of inexpensive fertilizer grade ammonium nitrate took place in the 1940s that mixtures of NH_4NO_3 and fuel oil became popular explosives for use in large (over 3-in.) diameter holes because of their low cost and safety in handling. The most common mixture is approximately 94% NH_4NO_3 and 6% No. 2 fuel oil, which gives a maximum strength explosive. Its performance, sensitivity to detonation and detonation velocity are all markedly dependent on particle size, density of mixture, particle density and the fuels or sensitizers employed with it. The above percentages are calculated from an oxygen balanced mixture; *i.e.*, one in which there is just enough oxygen to convert all of the hydrogen to water and all of the carbon to CO_2, assuming fuel oil to contain carbon and hydrogen in the ratio of 1 to 2:

$$NH_4NO_3 + \tfrac{1}{3}(CH_2) = N_2 + \tfrac{1}{3}H_2O + \tfrac{1}{3}CO_2$$

Ammonium nitrate-TNT-water slurries have also proven effective in wet holes in which ammonium nitrate-oil mixtures will not detonate because of the high solubility of NH_4NO_3.

Blasting With High Explosives.—Explosions are initiated in high explosives with detonators, more commonly called blasting caps, either of fuse or electric type, or with detonating fuse. Either type of cap is embedded in a cartridge, called a primer, which is usually placed at the bottom or top of the explosive column in a hole while detonating fuse is threaded through the primer. Timing of hole blasts with fuse is fixed by the fuse length, while timing with electric caps is done with timing elements in the caps themselves. Holes must be fired in proper order even if there are only few thousandths of a second delay between them. Electric caps may be connected in series or parallel, and regular (one second) delay or millisecond delay caps (usually $\frac{50}{1,000}$ of a second between caps or groups of caps) are used depending upon the particular application. The amount of explosive in each hole depends upon hole spacing and toughness of rock, and is usually determined by actual test. Electricity for detonators may be obtained from a regular power source or from a blasting machine, which is a small hand-operated electric generator.

Since World War II several nuclear charges have been detonated at varying depths under the surface of the ground. Many of these tests were designed to ascertain the possibility of employing nuclear explosions to perform excavation as well as breakage of rock. Others were designed to test the amount of burden necessary to completely confine a nuclear explosion. Research has been undertaken to test the possibility of employing nuclear explosives in mining large ore bodies, excavating canals and harbours, and fracturing oil-bearing strata for recovery of the oil contained in them.

Shaped jet charges of high explosives are used for perforating

oil well casings and tap hole facings (jet tapping) of blast furnaces; cylindrical charges are shaped so that the detonation front encloses a concavity, producing in it a convergent shock wave (the Munroe effect, discovered by Charles E. Munroe in 1887), are used to achieve deep penetration, a principle used in the bazooka and other armour-piercing projectiles (*see* AMMUNITION, ARTILLERY: *Artillery Ammunition After World War I: Armour-Piercing Projectiles*).

See also COAL AND COAL MINING: *Types and Methods of Mining;* EXCAVATION; EXPLOSIVES; MINING, METAL: *The Mining Cycle.*

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BLAVATSKY, HELENA PETROVNA (1831–1891), founder of the Theosophical society, was born at Ekaterinoslav, Russia. Her father was Col. Peter von Hahn, descended from the counts Rotenstern-Hahn of Mecklenburg who settled in Russia. Her mother was the novelist Helena (Eléna) Hahn, who advocated the emancipation of women. In her 17th year she married a man much her senior, Nikifor V. Blavatsky, but separated from him in a few months. She traveled for many years, visiting Turkey, Greece, Egypt and Canada, crossing the U.S. in a covered wagon, going on to Central and South America, and to India and Java. After spending some time in Tibet in 1856, she returned to Russia for several years before setting out on further extensive travels in the near east and Asia, visiting Tibet again in 1868 and Egypt in 1872. In 1873 she went to New York city, where, with the assistance of Col. H. S. Olcott, William Q. Judge and others, Mme Blavatsky founded the Theosophical society in 1875. Its aims were defined: (1) to form a nucleus of the universal brotherhood of humanity without distinction of race, creed, sex, caste or colour; (2) to promote the study of comparative religion, philosophy and science; and (3) to investigate the unexplained laws of nature and the powers latent in man. The publication of Mme Blavatsky's *Isis Unveiled* in 1877 attracted wide attention and criticism.

In 1879 she and Colonel Olcott went to India where they established the permanent headquarters of the Theosophical society at Adyar, near Madras, in 1883. In 1885 she left India and settled first in Germany and then in London, where the European headquarters of the society was established. She died on May 8, 1891.

Mme Blavatsky's *Collected Writings* were published at Adyar in seven volumes, completed by 1958. In addition to *Isis Unveiled,* her works include *The Secret Doctrine* (1888); *The Key to Theosophy* (1889); *The Voice of Silence* (1889). *See* also THEOSOPHY.

See Charles J. Ryan, *H. P. Blavatsky and the Theosophical Movement* (1937); Mary K. Neff (ed.), *Personal Memoirs of H. P. Blavatsky* (1937). (K. W. MO.)

BLAYDON, an urban district and manufacturing town in the Blaydon parliamentary division of Durham, Eng., on the Tyne near its junction with the Derwent, 5 mi. W. of Newcastle. Pop. (1961) 30,292. The town, still a hamlet in the 18th century with local lead mining and iron smelting, developed with the Northumberland and Durham coal field. Many of the inhabitants are engaged in mining, but a feature of the region is the development of coal by-products. Apart from coking, there is iron founding, general and sanitary engineering, brickmaking and some smaller industries. Axwell hall (1760) is an approved school. Nearly half a mile upstream is Stella, where there is a beautiful Elizabethan mansion, with later additions, and a chapel. The song "Blaydon Races," by Geordie Ridley (d. 1864), has become the "anthem of Tyneside."

BLEACHING, the process of whitening textiles or other materials by removing natural colouring and other unwanted substances. Although a considerable amount of bleaching was performed in the home in the early 1960s, including the whitening of clothing during laundering and the decolouring of human hair for cosmetic purposes, the main use of bleaching was in industry, especially in the bleaching of textile fibres and fabrics. Among the textiles usually bleached during processing were cotton, linen, wool, silk and synthetic fibres. Other materials often decolorized included paper pulp, waxes and oils, flour and sugar. This article deals with the bleaching of textile fabrics with emphasis on bleaching of cotton, which accounts for most industrial bleaching. Other articles on bleaching will be found under the titles PAPER MANUFACTURE: *Washing and Bleaching;* OILS, FATS AND WAXES: *Bleaching;* FLOUR: *Bleaching;* HYDROGEN PEROXIDE: *Uses of Hydrogen Peroxide and Its Derivatives.*

History.—The art of bleaching textile fabrics is very ancient, having been practised by all the early civilizations. Egyptians, Phoenicians, Greeks and Romans produced white linen goods, but little is known of the methods they employed. Pliny refers to the use of plants and the ashes of plants, mentioning especially the "Struthium," which was probably the plant *Saponaria officinalis.* The Dutch established a great reputation as linen bleachers after the last of the crusades and retained a near monopoly of the industry until the middle of the 18th century.

In England, bleaching grounds are said to have existed near Manchester as early as 1322, and there was a bleachworks at Southwark near London in the middle of the 17th century, but the bulk of the brown linen manufactured in Scotland was sent to the Haarlem region of Holland to be bleached. The brown linen was shipped in March and the bleached product was returned at the end of October. In 1728 the Scottish Board of Manufacturers accepted a proposal by James Adair to open a bleachfield in Galloway and voted £2,000 as premiums for establishing bleachfields throughout the country.

The British bleachers (who were sometimes called whitsters) appear to have been taught, or to have copied, the Dutch methods, which consisted of steeping the linen in lyes for several days and washing it clean (called bucking), then spreading it on the grass (crofting) for some weeks. Bucking and crofting were repeated alternately five or six times. The cloth was next steeped in sour milk or buttermilk for several days, washed clean and again crofted. The processes were repeated until the material acquired the requisite whiteness. In 1736 an act was passed in England permitting the use of cotton in cloth; this law resulted in the manufacture of larger quantities of cloth and a greater demand for bleaching.

A far-reaching change occurred in the bleaching industry in 1787 when the use of chlorine for bleaching was introduced at the Macgregor works in Glasgow at the suggestion of James Watt, inventor of the steam engine and son-in-law of the owner. Watt learned about oxygenated muriatic acid, as chlorine was then called, from Claude Berthollet, who was the first to record the bleaching effect of chlorine on linen. Berthollet reported his observations in a paper read before the Academy of Sciences at Paris in 1785 and published that year in the *Journal de physique* (vol. xxvi, p. 325). Further reports appeared in the *Journal* in 1786. Thomas Henry was the first to bleach with chlorine in the Manchester district. At that time, the bleacher made his own chlorine and exposed the fabrics to the gas in chambers or steeped them in an aqueous solution. The process was inconvenient, disagreeable and, worst of all, detrimental to the health of the workers, so it was not surprising that, in spite of the rapid bleaching action, the chlorine method did not gain great favour. The disadvantages were reduced with the introduction in 1792 of *eau de Javelle,* which was made near Paris by absorbing chlorine in a solution of potash until effervescence began. In 1799 Charles Tennant of Glasgow suc-

cessfully prepared chlorine in the even more workable form of a bleaching powder by passing chlorine over lime and was able to supply bleachers with a solid reagent one-third of whose weight was available chlorine.

In the 1920s hydrogen peroxide began to be used as a bleaching agent after it became available in large amounts and at favourable prices as a result of the development of new electrolytic methods of production. By the 1960s, after many refinements in production processes, hydrogen peroxide was used for bleaching most cotton goods.

THE BLEACHING OF COTTON

General.—Cotton is bleached in several physical forms—as loose fibre ("raw stock"), yarn or thread, and knitted or woven fabric. The main object of bleaching cotton is to remove as much colour and as many impurities as possible without damaging the fibre. A secondary aim is to produce uniformly absorbent, easily wettable fibre that can be satisfactorily dyed, printed or otherwise finished as desired. It is possible to produce cotton with a high degree of whiteness, or almost complete absence of colour. Whiteness is expressed according to the amount of light bleached cotton reflects, using the reflection from magnesium oxide as 100. Commercially bleached cloth is considered suitably white if it reflects in the range 85–90.

Other tests are made on bleached cotton for absorbency and for damage to the fibres. The test for fibre damage is commonly made by determining the viscosity of a solution of the bleached fibre in a cellulose solvent, usually cupriethylene diamine; viscosity (ordinarily expressed in units of fluidity as "rhes," or reciprocal poises) has been shown to be related to the extent of chemical damage to the fibre.

Choosing a Bleaching Method.—There are a variety of methods for bleaching cotton goods, including continuous flow and discontinuous or "batch" methods. In all of them, the bulk of the impurities other than colour must be removed before bleaching can be carried out satisfactorily. Impurities include those naturally present in the cotton and those added for one reason or another while the yarn and fabric were being manufactured. The preliminary purification is considered part of the over-all bleaching operation. Impurities associated with the mechanically cleaned but otherwise unprocessed dry cotton fibre are shown in the following table:

Impurity	Per cent of dry weight		
	Typical	Low	High
Protein	1.3	1.1	1.9
Pectic substances	0.9	0.7	1.2
Ash	1.2	0.7	1.6
Wax	0.6	0.4	1.0
Malic, citric, other organic acids	0.8	0.5	1.0
Total sugars	0.3	...	...
Pigments	trace	...	...
Other	0.9	...	...

In addition, a fabric just removed from the loom after weaving may also contain 5% to 10% of starch and other agents used in preparing the warp to withstand the operation of weaving. The fabric also may contain a small amount of mineral oil used in yarn manufacturing, plus dye used as tints for identification purposes. After the bleach is completed all that remains is about 0.3% wax, 0.25% ash, and traces of the other original constituents so small as to be negligible.

If normal care is taken, excellent results can be obtained by any of the standard bleaching processes. The choice of process usually depends on: (1) the physical form in which the goods are to be handled; and (2) the volume of similar goods to be bleached. The bleaching agents most often used are hypochlorite (usually sodium hypochlorite, NaOCl, often called the "chlorine" bleach), and hydrogen peroxide (H_2O_2). Considerable progress has also been made, particularly in Europe, in utilizing sodium chlorite ($NaClO_2$) as a bleaching agent.

The Batch and Continuous Flow Methods.—In the discontinuous or batch method, loose cotton fibre or stock and yarn wound on packages (a single strand weighing one to three pounds wound

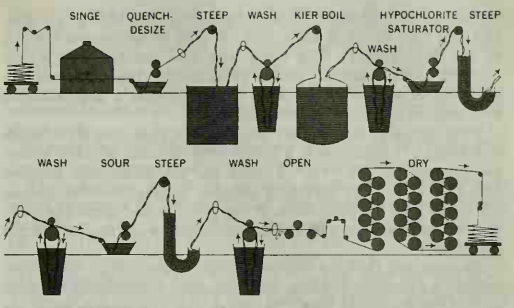

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FIG. 1.—FLOW DIAGRAM FOR SEMICONTINUOUS HYPOCHLORITE BLEACH

on a perforated tube) or on beams (several hundred strands wound side by side on a large perforated core), as well as cloth, may be processed. Most cotton fabric is bleached, except when hypochlorite is the bleaching agent, by the continuous flow method. To allow time for the required chemical action to take place in the continuous flow method, a large rectangular tank shaped in the form of the letter J is used for steeping the fabric saturated with the bleaching agent. The enclosure, called the J-box, usually holds 2,500 to 5,000 lb. of fabric, depending on the production speed and the time required for steeping. The fabric usually remains in the J-box about one hour, moving slowly all that time.

Both batch and continuous methods can be carried out with the fabric in a loosely folded strand or "rope" form, or with the material held at open width, free of folds. The weight of the cloth and tightness of the construction determine whether the rope form can be utilized; heavier, firmer goods cannot be uniformly processed while folded. Processors prefer the rope form because it is easier and less expensive to handle.

The continuous methods of processing are adapted to large-volume bleaching of a limited variety of fabric styles. Continuous production methods became possible when hydrogen peroxide became available for use as a bleaching agent. Hydrogen peroxide can be used at high temperatures under alkaline conditions. In contrast, hypochlorite is used at room temperatures, requires a more severe preliminary scour (cleansing with a detergent) than does peroxide and consequently does not permit the use of a continuous scour; prolonged boiling under pressure in a kier is needed when hypochlorite is the bleaching agent. The latter method, *i.e.*, kier boil followed by hypochlorite bleach, is still widely used with excellent results where space and production requirements permit. (*See* fig. 1.)

Methods utilizing both sodium hypochlorite and hydrogen peroxide in successive steps in the same continuous process have been advocated and adopted to a limited extent; likewise, sodium chlorite has won some acceptance for both batch and continuous work.

Bleaching in Kiers.—Cotton raw stock and yarn are ordinarily bleached in closed kiers that heat the processing liquor and circulate it uniformly through the mass of fibres. Usually the kiers can be sealed and the temperature of the circulating liquor raised to between 240° and 250° F., although atmospheric pressures and temperatures of 200°–210° F. are frequently used. The first stage is treatment in a 1%–2% solution of sodium hydroxide for one to six hours, depending on the quality of the fibre and the effect desired. After thorough rinsing in fresh water, the goods may be given either a hypochlorite or a peroxide bleach; the former is more common in England and Europe, the latter in the U.S. When hypochlorite is employed it is used in the form of a cold solution containing 0.1% to 0.3% available chlorine and at an alkalinity of pH 9.5 to 11. The bleaching time may be from 30 min. to several hours. After bleaching is completed, the goods are washed thoroughly and given an antichlor to neutralize and remove all residual hypochlorite, which would degrade the fibre if left in. Sodium bisulfite solution or sulfur dioxide gas introduced into water may

be used as the antichlor. Sometimes a treatment with dilute mineral acid (the so-called white sour) is used to decompose the last of the hypochlorite. The white sour also removes any water-insoluble calcium salts if calcium hypochlorite (bleaching powder) solutions have been used. After acid treatment a neutralization with sodium carbonate is recommended.

When peroxide is used, kier bleaching requires from 45 minutes to 6 hours of circulation in a 0.5%–1.0% solution of 35% hydrogen peroxide at 180°–190° F. with the pH maintained between 10.3 and 10.6. The bleaching solution usually includes sodium silicate to slow the breakdown of the peroxide and sometimes may include small amounts of sodium hydroxide when needed for pH adjustment.

Singeing and Desizing.—When fabric is bleached by batch procedures the scouring and bleaching treatment is essentially the same as that for stock and yarn. However, two preliminary steps are necessary for fabric. These are: (1) singeing, in which the short hairy or fuzzy surface fibres on the yarns are burned off to produce a clean, smooth appearance; and (2) desizing in which the starch size on the warp yarns is chemically removed to prevent its interference with subsequent processing.

In singeing, the cloth is passed at high speed between rows of gas burners (either or both sides of the fabric may be singed) and then fed directly into a quench box, which can be almost any kind of mangle or padder and which serves the double purpose of saturating the fabric with a desizing agent while extinguishing any sparks on the fabric.

Several distinct methods are used in desizing. All of them serve to hydrolyze the starch; *i.e.*, split it into simpler compounds, such as dextrins and sugars, that are soluble and easily washed out of the goods. Care must be taken in desizing to keep the hydrolysis from extending to and degrading the cellulose. For many years, starch has been removed by steeping the fabrics in weak acid. A typical procedure is to saturate the material with a 0.5%–2.0% solution of sulfuric acid for three to four hours at room temperature, with provision to prevent any part of the fabric from drying out, thereby weakening the fibre.

The most popular and effective means of removing size is by the use of enzymes. These chemicals are complex, nitrogen-containing substances secreted by certain plant cells and produced by several species of microorganisms and having the power to accelerate specific chemical changes to a pronounced degree. Enzymes specific for dextrinizing and solubilizing starch may be obtained from malt and other sources. To remove the starch, the goods are saturated with a solution of the selected enzyme, then held at a temperature best suited for enzyme action and the type of equipment used. After being impregnated with enzyme, the goods may be piled in pits or bins for several hours, steeped in kiers or other vessels at elevated temperatures for a shorter period, or processed continuously at high temperatures if certain heat-resistant enzymes are used. At the higher temperatures, desizing requires only a few minutes or seconds. After desizing, the goods are washed thoroughly.

At one time a lime (calcium hydroxide) boil in an open kier followed by a soda (sodium carbonate) boil was employed for scouring fabric after desizing and prior to bleaching. Later an acid sour was used between the lime and soda treatments. The purpose of these three steps was: (1) to saponify the waxes, forming lime soaps; (2) to decompose the insoluble lime soaps into free fatty acids; and (3) to convert the fatty acids into soluble soaps. Later, the use of a single boiling under pressure in a closed kier with caustic soda (sodium hydroxide) was introduced and has replaced the old, lengthy, three-step treatment.

Technique of Continuous Flow.—In spite of advances in the technology of bleaching, batch processing of fabric still often requires 10 to 20 hours for the scouring and bleaching alone. For this reason, persons responsible for new plant construction and old plant expansion or modernization consider continuous equipment carefully if the production per week is intended to be 200,000 yd. or more. It is now possible, making use of continuous methods, to bleach many fabric constructions quite satisfactorily in less than three hours, including all steps from singeing through final drying. In fact, under certain conditions it may be possible to complete the entire operation in less than one hour.

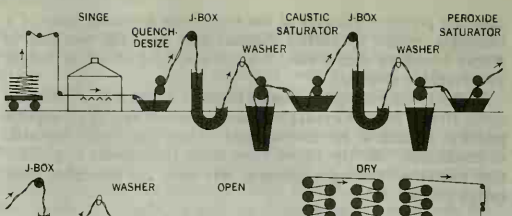

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FIG. 2.—FLOW DIAGRAM FOR CONTINUOUS HYDROGEN PEROXIDE BLEACH

Rapid processing requires a special layout of equipment similar to that pictured in fig. 2. The large J-boxes are constructed of stainless steel and insulated to maintain temperatures close to 212° F. The commonest arrangement for continuous peroxide bleaching allows for two stages: (1) an alkaline scour; and (2) an alkaline peroxide treatment. These steps may be carried out in two routings through a range consisting of a saturator, a J-box and a set of wash boxes, or, if greater production capacity is required, in one routing through two ranges in tandem. The saturator for the scour contains a 3%–4% solution of sodium hydroxide; the saturator for the peroxide stage contains 1.5%–2.2% of sodium silicate and 0.75%–1.5% of 35% hydrogen peroxide. The alkalinity of the bleach bath is approximately pH 10.5. The conventional storage period (or dwell time) in each J-box is about one hour; it has been found possible with special bleach formulas, however, to reduce the dwell time to seven or eight minutes. Another variation that has had some commercial acceptance is a one-step combination scour and bleach in a single J-box. Both the combined scour-bleach and the special bleach methods are more expensive than the slower methods, but the extra cost is offset by lower labour, utilities and initial equipment costs and smaller space requirements. The final operation in the continuous bleaching process is a thorough washing to remove residual chemicals.

When fabric containing coloured yarns (ordinarily dyed with vat and naphthol dyestuffs) is to be bleached, the preliminary scour with caustic is not used because of possible colour damage. Two successive bleaches, sometimes using less concentrated peroxide and a lower pH, are substituted. A hydrogen peroxide bleach liquor that contains free caustic soda tends to promote the bleeding of some dyes; so soda ash is preferred under these circumstances.

Optical Whiteners.—The use of so-called optical whiteners (brighteners or fluorescent white dyes) to enhance the appearance of bleached goods to be sold as whites is quite common. Optical whiteners improve the uniformity of reflectance over the visible portion of the spectrum, resulting in greater apparent whiteness. Fluorescent brighteners do not replace bleaching; they may, however, reduce the length or severity of the bleach required. Optical whiteners are absorbed by the fabric like dyes. Some resist oxidation and can be added to the bleach bath, while others are subject to oxidation and must be applied in a separate bath, or in the last rinse after bleaching. Generally a solution of about 0.05% brightener based on the fabric weight is sufficient.

BLEACHING FIBRES OTHER THAN COTTON

Bleaching is of considerable technical importance for a number of fibres other than cotton, including rayon, linen, jute, hemp, ramie, wool, silk and synthetic fibres, although the amount of these fibres that are bleached is very small compared with the volume of cotton bleached.

Rayon (a regenerated cellulose) seldom needs bleaching because

it is quite white when produced. But if the ultimate in whiteness is desired, a mild bleach with either sodium hypochlorite or hydrogen peroxide or simply a treatment with a substantive optical bleach may be given.

Bast fibres, among which linen is of the most interest as far as bleaching is concerned but which also include jute, hemp and ramie, contain a much larger percentage of noncellulose material than does cotton; the object of bleaching bast fibres is to whiten the fibre while removing only part of the noncellulose matter. Bast fibre bleaching usually involves scouring followed by extended bleaching with either alkaline hypochlorite or hydrogen peroxide; in general the treatment is much longer but milder than for cotton.

Wool and silk are both scoured in a comparatively mild alkaline solution to remove the rather large quantities of impurities associated with the raw fibres. Temperatures used for wool are generally below 140° F., while silk may be boiled. The bleaching of wool was originally carried out by an operation called "stoving" in which moist wool was exposed overnight to fumes from burning sulfur; the sulfurous acid formed bleached the wool. However, modern methods utilize hydrogen peroxide made alkaline and stabilized with sodium silicate and employed at a temperature of about 120° F. Hypochlorites degrade wool and tend to yellow rather than whiten it; for these reasons hypochlorites are not used for bleaching wool.

Nylon and the newer synthetic polymer fibres such as the polyesters (*e.g.*, Dacron and Terylene) and the acrylics (*e.g.*, Orlon and Acrilan) generally do not require bleaching. For an unusually high degree of whiteness, however, nylon may be bleached at 180° F. with peracetic acid adjusted (with sodium hydroxide) to a pH of about 6 or by the use of sodium chlorite at a pH of 3.5 (with formic acid) at 205°–210° F. Polyester fibre and acrylics may require boiling with sodium chlorite plus oxalic acid and nitric acid.

See Cotton Manufacture; Linen Manufacture; *see* also references under "Bleaching" in the Index.

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(K. S. Ca.)

BLEACHING POWDER, also known as chloride of lime, is a white solid having the odour of chlorine. It is formed by the combination of chlorine with slaked lime. Used as a bleaching and disinfecting agent, it has the same effect as chlorine with the advantage of easier handling. It was introduced by Charles Tennant of Glasgow in 1799 and was soon produced in large quantity for the textile and paper industries. Its disadvantages are its instability and the large proportion of inert material present. It decomposes at high temperatures and reacts with moisture and carbon dioxide from the atmosphere, gradually losing its strength.

In the older method of manufacture, still largely used, the slaked lime is spread, in layers of 2 in. or 3 in. deep, on the floor of large rectangular chambers made of lead or of concrete protected with an inside coating of tar; these chambers are from 6 ft. to 7 ft. high, 10 ft. to 20 ft. wide, and up to 100 ft. long. The lime is raked into ridges in order to increase the surface exposed to the gas. The chamber, or series of chambers, is then closed and chlorine admitted. The gas is readily absorbed and, if it is concentrated, so much heat may be generated by the reaction that in hot climates cooling coils are necessary in the floor of the chambers to prevent decomposition of the bleaching powder. A later method dispenses with chambers and employs mechanical means to propel the lime through a horizontal tube or series of tubes. The gas is fed into the plant in a direction opposite to that in which the lime travels.

While bleaching powder is commonly represented by the formula $CaCl(OCl)$, it is not a pure substance, its composition approximating $CaCl(OCl).Ca(OH)_2$. There is some doubt as to the existence of $CaCl(OCl)$. C. W. Bunn, L. M. Clark and I. L. Clifford in 1935 reported on the basis of X-ray analysis that bleaching powder consists of a mixture of the true hypochlorite, $Ca(OCl)_2$, with a basic chloride of the composition $CaCl_2.Ca(OH)_2.H_2O$. The strength of bleaching powder is commonly expressed in terms of "% available chlorine," the maximum being about 40%.

In oxidizing or bleaching capacity 100 lb. of such bleaching powder would be equivalent to 40 lb. of pure chlorine.

The bleaching action is ascribed to the hypochlorous acid which is formed by the reaction of bleaching powder in an acidic medium. Any hypochlorite undergoes the same reaction, $OCl^- + H^+ = HOCl$, and thus has the ability to bleach. Chlorine, by its reaction with water, $Cl_2 + H_2O = H^+ + Cl^- + HOCl$, forms hypochlorous acid and may also be used for bleaching. Although still produced on a large scale, the relative importance of bleaching powder was decreasing by the 1960s because of the advantages enjoyed by other bleaching agents. Liquid chlorine in steel cylinders appeared on the market in 1909 and replaced bleaching powder in many large-scale operations. Later calcium hypochlorite was made commercially available. This material, largely $Ca(OCl)_2.2H_2O$, has about 70% available chlorine. It is produced by treating a suspension of lime in water, rather than the dry material, with chlorine or chlorine monoxide. The solid calcium hypochlorite, in addition to its greater oxidizing capacity, is more stable than bleaching powder. A large amount of sodium hypochlorite solution is consumed as a household bleach because of its convenience.

A later competitor of bleaching powder in the bleaching trade was sodium chlorite ($NaClO_2$) which appeared in 1940. When added to an acid solution, sodium chlorite reacts to produce chlorine dioxide (ClO_2) which is the active bleaching agent. Chlorine dioxide is reported to be less injurious to textile or paper fibres than hypochlorous acid. *See* Bleaching.

(R. P. S.)

BLEEDING HEART, a common name, in reference to the flower shape, for certain species of *Dicentra*, low or stemless perennial herbs of the fumitory family (Fumariaceae). A few of these natives of Asia and North America are cultivated for their attractive deeply cut or dissected foliage and handsome irregular flowers. The familiar bleeding heart (*D. spectabilis*) of the gardens, with showy rose-red, heart-shaped flowers, an inch or more long, is a native of Japan. The eastern bleeding heart (*D. eximia*), with pink, narrow, heart-shaped flowers, about three-fourths inch long, of the Allegheny mountain region; and the western bleeding heart (*D. formosa*), with similar rose-purple flowers, of mountain woods from California to British Columbia, are both more or less cultivated.

ROCHE

BLEEDING HEART (DICENTRA SPECTABILIS)

Other noteworthy American species related to the bleeding heart are the Dutchman's-breeches (*q.v.*; *D. cucullaria*); and the golden eardrops (*D. chrysantha*), with large panicled clusters of yellow flowers, widely distributed in California.

BLEEK, WILHELM HEINRICH IMMANUEL (1827–1875), German philologist, studied at Bonn and Berlin, where he first noted the philological peculiarities of the South African languages. In his doctor's dissertation (1851), he endeavoured to show that the Hottentot language was of North African descent. Toward the close of 1856 he settled at Capetown, and in 1857 was appointed interpreter by Sir George Grey, who appointed him librarian of the Sir George Grey collection in 1860. He introduced into European philology the word Bantu.

His works are *Vocabulary of the Mozambique Language* (1856); *Handbook of African, Australian and Polynesian Philology* (1858–63);

Comparative Grammar of the South African Languages, vol. i (1869); *Reynard the Fox in South Africa, or Hottentot Fables and Tales* (1864); *Origin of Language* (1869).

BLEKINGE, a county (*län*) of southern Sweden, lies between Småland and Skåne and the Baltic. Pop. (1960 est.) 144,568. Area 1,173 sq.mi. The coast is much indented, while the interior is smooth, sloping up toward the Småland plateau. The agriculture is much poorer than that of Skåne because of the light soils; potatoes are a leading crop, being used as a source of starch and alcohol as well as food. Ronneby is the chief commercial centre but Karlskrona, with a magnificent anchorage, has been the Swedish naval base since 1680. It only freezes one year in three and can then be kept open by icebreakers. The *län* was ceded to Sweden by Denmark under the treaty of Roskilde (1658).
(A. C. O'D.)

BLENDE: *see* SPHALERITE.

BLENHEIM, BATTLE OF. On Aug. 13, 1704, during the War of the Spanish Succession, English and Austrian forces under the duke of Marlborough and Prince Eugene of Austria defeated the Bavarians and French under the elector of Bavaria and Marshal C. Tallard and Marshal F. Marsin at Blenheim (Ger. Blindheim) on the left bank of the Danube near Höchstädt, Bavaria. This battle that saved Austria was Marlborough's most notable victory, and Blenheim palace in Oxfordshire was erected for him by a grateful English parliament.

To prevent an Austrian collapse before strong French pressure, Marlborough had marched his army to the Danube (*see* SPANISH SUCCESSION, WAR OF THE), and Tallard, knowing the desire of Marlborough and Eugene to protect Vienna, did not expect to be attacked by this slightly weaker force.

The French and Bavarians were strongly placed just behind the Nebel river with their right wing resting on the Danube at Blenheim and their left on hilly country bounded by the town of Lutzingen. In the centre were the hamlets of Oberglauheim and Unterglauheim, the former on the French side of the Nebel. The day of battle saw the French initially unprepared to fight but by noon they were reasonably ready, though basically drawn up as two separate armies with a resultant weakness in the centre. Eugene faced Marsin and the Bavarian elector at Lutzingen and Marlborough opposed Tallard at Blenheim. Against about 60,000 French and Bavarians the allies opposed about 52,000 infantry and cavalry.

Prince Eugene pushed a strong containing action on his flank while Marlborough's general Lord Cutts mounted the main assault against Blenheim. Two fierce infantry attacks were completely unsuccessful before a halt was called in that sector. Cutts' attack, however, had forced Tallard to concentrate more good troops in Blenheim than he had originally intended and the threat of a third attack held them there. Since Eugene kept Marsin fully occupied, Marlborough began the movement of cavalry across the Nebel in the centre that led to the final decision. The movement was hotly contested. Twice French charges came very close to throwing the allies back and only the personal direction of the duke and the selfless loan by Eugene of the Fugger-Kürassiere cavalry corps served to maintain the massing movement. Once successfully launched, however, the attack proved irresistible. The allied cavalry broke through the enemy centre, dividing the army of Marsin from that of Tallard, and wheeled left, sweeping Tallard's forces into the Danube. Although Marsin was able to retreat and escape in some order, 24 battalions of infantry and 4 regiments of dragoons were pinned in Blenheim and eventually surrendered. Tallard himself was taken prisoner.

While the Anglo-Austrian forces lost about 4,500 killed and 7,500 wounded, the French total losses, including prisoners, numbered about 38,000 men (the figure is disputed, however, and contemporary accounts indicate about 29,000). The battle set the seal on that near-perfect co-operation that marked the relationship between Marlborough and Eugene for the remainder of their association in this war. It demonstrated that the armies of Louis XIV were not irresistible and served notice that English soldiers and generals were not to be disregarded in continental diplomatic and military calculations.
(D. M. Sc.)

BLENNY, a name generally given to any blennioid fish, a fish in which the pelvic fins are jugular in position and have the rays reduced in number. The wolf fish, like the viviparous blenny (*Zoarces*), is a blennioid.

The families Blenniidae and Clinidae contain numerous small species in tropical and subtropical seas, mostly shore fishes that lurk under stones and weeds in shallow pools. The shanny (*Blennius pholis*) is the commonest British species. Giant kelpfish (*Heterostichus rostratus*), which may grow to two feet, live on the Pacific coast of North America. *See* also FISHES.
(C. HU.)

BLÉRIOT, LOUIS (1872–1936), French aviator who, on July 25, 1909, made the world's first overseas flight in a heavier-than-air craft when he piloted a small 25-h.p. monoplane of his own design across the English channel from Calais to Dover. This feat won him lasting fame and a prize of £1,000 offered by the *London Daily Mail*. Blériot was born in Cambrai, France, on July 1, 1872. He amassed a modest fortune as an inventor of automobile lights and accessories and took an early interest in aviation. He experimented first with towed gliders on the Seine river. Then, as lightweight engines became available, he developed a series of airplanes, one of which was the channel-crossing machine. Blériot was active in building aircraft for the French government during World War I, first with trainers of his own designs, then associated with the makers of the famous SPAD fighter. After the war his interest turned to commercial aircraft development. He was one of the group to greet Charles A. Lindbergh on his arrival in Paris, May 21, 1927. He died of a heart attack in Paris, Aug. 2, 1936.
(S. P. J.)

BLESBOK (BLESBUCK), an African antelope (*Damaliscus albifrons*) allied to the hartebeest (*q.v.*). *See* ANTELOPE.

BLESSINGTON, MARGUERITE, COUNTESS OF (1789–1849), Irish writer chiefly remembered for her *Conversations with Lord Byron* and for her London *salon*, was born near Clonmel, County Tipperary, on Sept. 1, 1789. Her father sold her into marriage at 15 to Capt. Maurice St. Leger Farmer, a sadist from whom she fled after three months. He died in a drunken brawl in 1817, whereupon Marguerite, who had been the protégée of Capt. Thomas Jenkins in England for some years, married Charles Gardiner, Viscount Mountjoy and earl of Blessington. Of rare beauty, generosity and wit, "the most gorgeous Lady Blessington," who at 18 had been painted by Lawrence, formed a brilliant *salon* and began to write essays and sketches of London life.

In 1822 the Blessingtons went abroad, accompanied by the young Comte d'Orsay, who married the earl's daughter by his first wife. They spent two months in Genoa in close intimacy with Byron, and lived in Italy, and then in France, until the earl's death in May 1829. Their extravagant tastes had drained his fortune and, returning to London accompanied by D'Orsay, whose marriage had broken up and who remained with her all the rest of her life regardless of scandal, the countess began to support herself by writing. Her first novel, *Grace Cassidy or The Repealers* (1833), was a success. Her journals furnished material for *Conversations with Lord Byron* (1834), *The Idler in Italy* (1839–40) and *The Idler in France* (1841), all of which enjoyed popularity for their personal gossip, easy style and sense of humour. She wrote several other novels and edited two annuals, *The Book of Beauty* and *The Keepsake*, to which she contributed.

In spite of her literary successes Lady Blessington could not keep out of debt and in April 1849 she and D'Orsay fled to Paris to avoid ruin. She died there on June 4, 1849, and is buried with D'Orsay at Chambourcy.

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BLETCHLEY, an urban district and market town of Buckinghamshire, Eng., lies 11 mi. E. of Buckingham by road and 46 mi. N.W. of London. Pop. (1961) 17,093. Area 7.0 sq.mi. Between Fenny Stratford, where Watling street crosses the river Ouzel, and Old Bletchley, 2 mi. W., the modern town developed after the building of a big railway junction on the main northern line.

After 1911 the three places were joined and renamed Bletchley. Through it pass the main road from London to north Wales and the Grand Union canal. Under the Town Development act, 1952, Bletchley had received about 7,000 Londoners by 1961. Industries include railway workshops, brickmaking, brushmaking, light and electrical engineering and tea and coffee blending, and there is a weekly livestock market. The church of St. Martin, Fenny Stratford, was largely rebuilt (1726–30) by Browne Willis, in whose memory small cannon called "Fenny poppers" are fired every St. Martin's day. St. Mary's, the church of the original village of Bletchley, still contains parts dating from the 12th century.

BLEULER, EUGEN (1857–1939), Swiss psychiatrist who made a number of lasting and unique contributions to the field of psychiatry, was born at Zürich on April 30, 1857. After completing his medical training, he became director of a hospital in Zürich and professor of psychiatry at the university there. His early thinking was influenced by Wilhelm Wundt and Sigmund Freud, whose orientations were diametrically opposed, and Bleuler's writings show his attempts to reconcile the rigorous laboratory approach of Wundt with the philosophical approach of Freud in studying the problems of the mentally disordered. He also could never decide whether mental disorders could be explained best on an organic or on a psychogenic basis.

Bleuler introduced the term schizophrenia as a substitute for dementia praecox. He showed the part that autistic thinking plays in the development of paranoia; he was a student of the language of the schizophrenic; he was concerned with possible regressive behaviour exhibited by schizophrenics, and believed that the discrepancy between the aspiration level and moderate ability of the individual sets the stage for the development of delusions. His best-known writings are collated in *Dementia Praecox or the Group of Schizophrenias* (1911; reprinted 1950); *Affectivity, Suggestibility, Paranoia* (1906; 2nd ed., 1926); and *Textbook of Psychiatry* (1924; later ed., 1930). He died on July 15, 1939.
(R. M. D.)

BLICHER, STEEN STEENSEN (1782–1848), Danish poet and writer of short stories describing with realism and humour the people of Jutland, was born in Vium, northern Jutland, Oct. 11, 1782, the descendant of a line of country parsons. He himself became a country parson in his native district in 1819. During a short period as a schoolmaster in 1810 he married the 17-year-old widow of his uncle, but the marriage was unhappy, and much debt and many children did not help. His wife's unfaithfulness caused him to consider divorce, but his financial situation made this impossible. He spent most of his life out of doors, shooting, walking, talking to gypsies, peasants, farmers and squires, and devoted much time to practical and political questions, often taking part in public debates. As his private life became increasingly unhappy he took refuge in drink, and his death (at Spentrup, March 26, 1848) came as a release.

As a student at Copenhagen, Blicher read Ossian, and he taught himself English in order to translate Ossian into Danish (2 vol. 1807–09). His first volume of original poems appeared in 1814 and he gradually developed his own muted style, expressing with equal felicity a melancholy acceptance and humour. His finest collection is *Trækfuglene* (1838), with its sad self-portrait of a caged bird longing for freedom, in the opening "Prelude." Many of his best poems are in Jutland dialect; in these he describes great events with characteristic irony and understatement.

Blicher's fame rests primarily on his many *noveller*, the first of which, *En Landsbydegns Dagbog* (1824), is a masterpiece of prose style, and convincing in its psychology. He ranges from resignation to humour and irony, and most of his stories, notably his brilliant dialect story *Æ Bindstouw* (1842), are about Jutland. The general feeling of his narrative style is antiromantic and realistic; life is seen as the great shatterer of illusions since it never keeps its promises. In his style Blicher was influenced by Pope, Sterne and Goldsmith, whose *Vicar of Wakefield* he translated into Danish (1837). *Samlede Skrifter*, 33 vol. (1920–34) is the authoritative Danish edition of his work. There is also an English translation of *Twelve Stories by Blicher* (1945).

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BLIDA, a town of Algeria and centre of a commune of the same name in the *département* of Algiers, lies 32 mi. S.W. from Algiers by rail. Pop. (1960) 87,000 (metropolitan). It lies 630 ft. above sea level at the base of the Tell Atlas mountains, on the south edge of the fertile Mitidja plain and on the right bank of the Wad al Kebir affluent of the Chiffa, which supplies the town with water for its numerous fountains and gardens, and provides power for mills and factories. Ft. Mimich stands on a steep hill left of the river. The town was formerly enclosed within walls, with six gates, but has spread widely outside, and new quarters have been built, especially in the villages of Joinville and Montpensier; the village of Dalmatie contains schools, a church and a religious institution.

The modern town is French in character and one of the pleasantest spots in Algeria, surrounded by orchards and gardens. It has a flourishing trade, mainly in oranges and flour, and its industries include aircraft and other workshops.

Blida (*i.e., boleida*, diminutive of the Arab word *belad*, "city") occupies the site of a Roman military station, but the present town appears to date from the 16th century. A mosque was built by order of Khair ed-Din Barbarossa, and under the Turks the town attained some importance. In 1825 and again in 1867 it was badly damaged by earthquake, but was rebuilt. After 1838 it was held by the French. The important French military air base was seized by the Allies on Nov. 9, 1942.

BLIGH, WILLIAM (1754–1817), English admiral, who was captain of H.M.S. "Bounty" at the time of the famous mutiny, was born on Sept. 9, 1754. He entered the navy in 1762 and was chosen by James Cook in 1776 to be master of the "Resolution" on Cook's last expedition. Bligh was appointed to the command of the 220-ton "Bounty" in 1787, when the vessel was engaged in a scheme for transplanting breadfruit trees from Tahiti to the West Indies. Having sailed from Tahiti as far as the Friendly Islands, the ship was suddenly seized by Fletcher Christian, the master's mate, on April 28, 1789, and Bligh and 18 others were turned adrift in the longboat. The causes of this famous mutiny have been much discussed; Bligh was no stricter disciplinarian than Cook, whose example he always followed, but he had undoubtedly insulted many of his officers. His account of the affair is probably correct: the crew "had assured themselves of a more happy life among the Otaheitans than they could possibly have in England, which, joined to some female connections, has most likely been the leading cause of the whole business." Bligh eventually reached Timor in the East Indies on June 12, 1789, after a remarkable voyage of nearly 4,000 mi. in an open boat. Captain Edwards in the "Pandora" was sent out in search of the mutineers in 1791, but by the time he reached Tahiti, Christian and eight others had taken the "Bounty" to Pitcairn Island, where the small colony they founded was undiscovered until 1808 and where their descendants still reside. Of those found at Tahiti, three were later hanged in England.

The mutiny made little difference to Bligh's career. He visited Tahiti again and successfully transported breadfruit trees to the West Indies (1792). As captain of the "Director," he was put ashore when his crew joined the mutiny at the Nore (1797). However, he commanded this ship with distinction at the battle of Camperdown that year, as he did the "Glatton" at Copenhagen (1801). He was sent to New South Wales as governor in 1805, but complaints of his "oppressive behaviour" led in 1808 to a mutiny under George Johnston, the deputy governor, who sent Bligh to England under arrest, but the mutineers were subsequently found guilty of conspiracy. Bligh was promoted rear admiral (1811) and vice-admiral (1814). He died in London on Dec. 7, 1817.

Bligh's character has been variously interpreted. He does not seem to have been unduly tyrannical, but an abusive tongue and an overzealous and overbearing manner made him unpopular as a commander. He possessed undoubted courage in action and skill as a navigator.

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BLIMP: *see* AIRSHIP.

BLIND, TRAINING AND WELFARE OF. For practical purposes, such as determining compensation for eye injury or establishing the need for assistance, a person is commonly classified as blind when vision is insufficient for use in tasks in which eyesight is essential. More exact definitions vary from country to country. This lack of a uniform definition of blindness (*q.v.*) throughout the world presents difficulties in determining the total number of the blind and in comparing figures from various countries. However, the most informed sources estimated that the total blind population of the world numbered about 14,000,000 in the 1960s.

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I. HISTORY

1. Early Developments.—From early historical times there are reports of gifted blind persons who achieved fame, but the history of organized efforts to help the blind can be traced to the enlightened philosophy of compassion toward the handicapped as exemplified by such religions as Christianity and Buddhism. Thus, in the 4th century, St. Basil opened a hospice for blind persons at Caesarea in Cappadocia. In the 5th century the hermit, St. Lymnaeus, established a refuge for blind persons at Syr in Syria, with special cottages being erected for their use. Two hundred years later in France St. Bertrand, bishop of Le Mans, founded an institution near Pontlieu. In the 11th century William the Conqueror, in expiation of his sins, it was said, founded several hospices in Normandy for blind and other infirm persons. In 1260 Louis IX of France took under his protection an institution for the care of the blind in Paris, the Hospice des Quinze-Vingts; this institution has continued to this day (*see* PARIS: *Hospitals*). Simultaneously, in the far east, the development of Buddhism as a leading religion resulted in efforts to improve the condition of the blind in countries such as China and Japan.

It was not until the close of the 18th century, however, that any real attempt was made to educate or train those without sight. Valentin Haüy (1745–1822), the man to whom the title "father and apostle of the blind" afterward was given, had his attention attracted to the problem by the contrast afforded by the public performance of Maria Theresa von Paradis, the noted Austrian blind pianist, and the spectacle presented by some untrained and illiterate blind persons who, tricked out in fantastic attire, were trying to attract custom by making mock music. Haüy opened the Institution Nationale des Jeunes Aveugles in Paris in 1784 and a philanthropic society sent him 12 blind children as his first pupils. News of Haüy's success in teaching these children to read spread, the Academy of Science examined and approved the raised print he invented, and he was received by the king. When the French Revolution broke out, Haüy's school was taken over by the state and later incorporated with the Quinze-Vingts.

The education movement soon spread to other European countries. Schools for the blind were opened in Liverpool (1791), London (1799), Vienna (1805) and Berlin (1806). Haüy was invited by Tsar Paul to come to St. Petersburg to found a school, but his experiences in Russia were discouraging, and only after many years was he able to open an institution. Other countries, however, were showing interest in the blind, two schools being opened in 1808, in Amsterdam, Neth., and in Stockholm, Swed.; another was founded in Zürich, Switz., in 1809, and many more followed. In the United States three schools were founded practically simultaneously. One of these, the New England Asylum for the Blind (1832; now called Perkins School for the Blind), was directed by Samuel Gridley Howe (*q.v.*). The two other schools, in New York (1832) and Philadelphia, Pa. (1833), were headed by John D. Russ and Julius R. Friedlander, respectively. These schools were at first supported by private means. The first entirely state-supported U.S. school for the blind was opened in Ohio in 1837.

2. Systems of Reading.—The earliest authentic records (1517) of tangible letters for the blind describe a plan of engraving the letters upon blocks of wood, the invention of Francesco Lucas, a Spaniard. In 1640 Pierre Moreau, a French notary, cast a movable leaden type for the use of the blind. Pins inserted in cushions

FIG. 1.—WILLIAM MOON'S ALPHABET WHICH IS BASED ON ROMAN LETTERS

were next tried, and also large wooden letters. Cast metal letters followed, and in Germany R. Weissembourg made use of letters cut in cardboard, and afterward pricked maps in the same material. To Haüy, however, belongs the honour of being the first to emboss paper as a means of reading for the blind; his books were embossed in large and small italics, from movable type set by his pupils. Haüy's first pupil, François Lesueur, was sorting the papers on his teacher's desk and came across a card strongly indented by the types in the press. The blind lad showed his master he could decipher several letters on the card. Immediately Haüy traced with the handle of the pen some signs on paper. The boy read them and the result was printing in relief, the greatest of Haüy's discoveries.

The first book for the blind produced in Great Britain was by James Gall of Edinburgh in 1827; it was printed in a triangular modification of the common alphabet.

In 1833 the first American book for blind people was turned out in Philadelphia in a system invented by Friedlander. Howe also worked out a system of his own, and many books were printed at his school in Boston. Most of these early systems, which appeared in England as well as in the United States, were adaptations of the regular Roman alphabet and were cumbersome to handle and difficult to learn. With one exception, they are no longer in use. The exception is the Moon type (*see* fig. 1), invented by William Moon of Brighton, Eng., which partly retains the Roman outlines and is easily learned by those who have become blind late in life. Books in this type are still in limited use by elderly persons throughout the English-speaking world.

All these types utilized raised lines and therefore could not be easily written by the blind. Louis Braille (1809–52), a blind teacher in the Institution Nationale des Jeunes Aveugles, realized this shortcoming and, inspired by a 12-cell dot system produced by Capt. Charles Barbier, developed a dot system that could easily be written with a simple instrument. Braille first published his type in 1829, and in 1837 he published a more complete elaboration of the system. It was not officially adopted by his school until 1854, two years after his death.

The braille system spread slowly at first. In the United States, in the 1860s, another dot system known as New York point was developed by William B. Wait at the New York Institute for the Education of the Blind, and in the 1870s a modification of braille called American braille was invented by a blind teacher, Joel W. Smith, of Boston, Mass. These codes were used by most of the schools for the blind in the U.S. until 1916, when Braille's alphabet and a series of contractions was officially adopted. Adoption of a universal braille code for the English-speaking world, however, did not come until 1932, when representatives of agencies for the blind of Great Britain and the United States met in London and agreed upon a braille system known as Standard English braille, grade 2. In 1957 U.S. and British experts again met in London to further clarify the system.

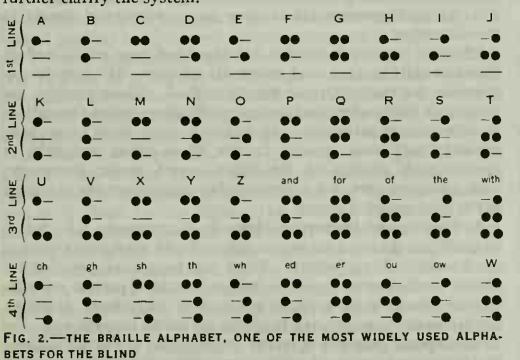

FIG. 2.—THE BRAILLE ALPHABET, ONE OF THE MOST WIDELY USED ALPHABETS FOR THE BLIND

The braille alphabet consists of varying combinations of one or more raised dots in a six-dot oblong, known as the braille cell, which is three dots high and two dots wide. There are 63 possible combinations of dots, and after the letters of the alphabet have been supplied, the remaining signs are used for punctuation, contractions, etc. (*see* fig. 2). Combinations of dots also have been worked out to signify mathematics, music and other specialized codes. Braille is written with the aid of a metal slate or on a specially constructed braille typewriter.

In 1893 Frank Hall of Jacksonville, Ill., invented a stereotyping machine for embossing on metal plates. Later, this stereotyping machine was electrified and a method devised for shifting the folded zinc plates, which serve as masters, so that they could be turned over and brailled on the reverse side as well (interpointing). Paper is inserted into the folded master, which is then run through a roller proof press; or the master is mounted in a flat-bed press, or cut apart and mounted in large rotary presses, on which many pages can be run off simultaneously, as in regular printing. Efforts are being made to carry mechanization of the process still further.

Many blind persons find it difficult to read raised type with their fingers. A survey made in the U.S. in the late 1920s revealed that less than 15% of the blind population read braille well enough to make reading a pleasure. In order to prevent the remaining large group of blind people from being shut off from a world of literature, the American Foundation for the Blind developed a new reading medium, called talking books. These are books and other reading material recorded on long-playing 12-in. vinylite phonograph disks. A printed book of average length can be recorded on 13 double-faced disks—a reading time of about 12 hours. Longer books fill many more records; the Bible, for example, runs to 170 records. The U.S. government set up under the Library of Congress a series of libraries for the blind from which braille and talking books may be borrowed. Similar library systems for the blind were developed in the British commonwealth and in other parts of the world.

3. Appliances.—Before the establishment of schools for the blind, tools such as calculating boards were frequently devised for individual use, but there was no continuity of effort. The first regularly produced apparatus were directed primarily toward the solution of educational problems. One of Haüy's first efforts was a guide for writing script, which, however, proved inadequate; for generations thereafter it was assumed that persons born blind could not be taught script. With improved guides, it has been established that such skills can indeed be taught. Raised maps have called on the ingenuity of many minds, as have mathematical aids, music devices and materials for use in handicrafts. Braille slates and braille typewriters have multiplied in variety of design.

Since the majority of blind people lose their sight as adults, and many of them have the potential of carrying on in the work for which they have been trained, the need for a richer variety of devices has been recognized. There exist micrometers, electrical measuring apparatus, thermometers, scales, slide rules and timers, in addition to household aids, clocks, collapsible canes and other less special-purpose devices. Moreover, catalogues tend to include commercial tools that, while not devised for people without sight, help solve problems resulting from blindness; pressure cookers equipped with audible signals rather than dials are an example. The typewriter, radio and telephone are other examples of commercial equipment that is especially helpful to persons without sight.

4. Optical Aids.—As the conviction grew that residual vision safely can be used up to its limits, there was a rapid increase in interest in optical aids. Australia, Great Britain and the United States took the leadership in this direction. Persons formerly regarded as having no useful vision have been enabled to read again with the aid of powerful magnifying devices, of which the variety steadily increases. Use of these requires the development of skill in holding material at the proper focus and in learning to interpret the enlarged optical cues.

5. Recreation.—Despite broadening employment opportunities, too many blind persons find time hanging heavily on their hands, so that recreational opportunities are essential. Especially among voluntary agencies, recreational programs often are emphasized.

Wrestling, bowling (with special guide rails), swimming, boating, hiking, skiing, golf, horseback riding and fishing are among the more active sports in which the blind can participate. Sprinting (often with guide wires), jumping, shot-putting and modified forms of baseball also are carried on, especially in residential schools.

Checkers, chess, Chinese checkers, bingo, cards and Scrabble are among the games that have been adapted for blind persons. Among hobbies, amateur radio, recording, cooking, sewing and even some phases of photography are followed with enthusiasm. Social and folk dancing, amateur theatricals and music are other group activities. Blind people can and do take active part in political and service organizations with sighted persons, and in this way not only serve their fellow members but also serve blind people by helping to overcome prejudiced thinking about blindness.

6. Social Adjustment.—There are situations in which the totally or almost totally blind person needs assistance from sighted people. These are fewer, however, than is commonly thought. Blind persons may be taught techniques for carrying on such routine tasks as housework, grooming, typing, handling of money and foot travel. After World War II a trend developed toward the establishment of rehabilitation centres where groups of blind people might learn such techniques. Permanent facilities for handling blinded veterans came into operation in various countries, and civilian centres were more or less patterned on experiences in these programs. An important offshoot was a systematic method for teaching cane travel techniques, especially in the United States. This involves some effort to teach the use of auditory and other nonvisual cues, as well as the safe and efficient use of the cane.

7. Dog Guides for the Blind.—Historically, many blind people are known to have relied in varying degrees on dogs for guidance and protection, but not until World War I, when the German government established a school for training such dogs, did this become an established method of travel. Only a fraction of the blind population, however, can use a dog guide successfully. Too much useful vision, advanced age or poor health, or unsuitable temperament are reasons for rejection of an applicant for a dog guide.

Dog guide schools exist in Great Britain, Italy, Switzerland, Germany and the United States (where the pioneer Seeing Eye, Inc., in Morristown, N.J., remains the best known), and trainees usually spend about a month in training with the already trained dog in order to achieve a good working relationship. In most schools the cost to the blind person is only a nominal part of the over-all cost of the dog and its training, and sometimes no charge is made to the individual.

II. UNITED STATES

The term blindness as commonly used in the United States means "central visual acuity not exceeding 20/200, as measured by the Snellen chart, in the better eye with correcting lenses; or central visual acuity greater than 20/200 accompanied by a limitation in the field of vision such that the widest diameter of the visual field subtends an angle no greater than 20 degrees." Stated simply, this means that a person is defined as blind if at a distance of 20 ft. he can see what a person with normal vision sees at a distance of 200 ft., or if his field of vision is diminished to the point where the remaining sight is of limited value.

1. Prevalence of Blindness.—Because of difficulties in securing complete reporting in cases of blindness, and in providing medical diagnosis in each case to determine the existence of blindness, no exact statistics are available as to the prevalence of blindness in the U.S. On the basis of studies made in various representative areas, however, it is estimated that there are at least 350,000 blind persons. The number of children is comparatively small, less than 10% of the total; more than 50% of blind persons are over 65 years of age. Most studies show a larger number of males than of females among the blind. These figures indicate to some extent the problems facing those in charge of the education and the rehabilitation of the blind.

2. Education of Blind Children.—The young blind child requires special training before he reaches school age. Formerly there were residential nursery schools to which blind children were sent for such training. Later, emphasis came to be placed on keeping the child in his own home, if the home environment was at all satisfactory, so that the parents could provide the training needed. In a number of states trained workers are employed to advise parents on methods of training; in several states institutes for mothers of blind children are held, providing courses of lectures, consultation service on special problems, and demonstrations. In many localities, day nursery and kindergarten training are available to blind children, either in groups of other blind children or, preferably, together with sighted children.

Blind children of school age are educated in residential schools for the blind or in public or private schools with sighted children. In the 1960s about 55% of the country's blind children attended residential schools and the balance regular schools. The latter system was first introduced in 1900 in the public schools of Chicago, Ill., and it came to be accepted as an alternative educational system in all parts of the country. In some schools a special teacher is available during the entire school day; other school systems provide teaching service at intervals.

Some special educational methods and devices are necessary for the education of a blind child—the substitution of embossed type (read by touch) for reading and writing by visual methods, special mathematical apparatus, embossed and bas-relief maps, etc. In recognition of this fact, the U.S. congress in 1879 passed a law providing a federal grant to the American Printing House for the Blind in Louisville, Ky., to furnish books and tactual apparatus to blind school children on a quota system according to the number of children enrolled. The original appropriation was increased considerably over the years.

3. Higher Education.—Blind students seeking higher education attend regular colleges, universities and professional schools. The only special provision they need is some arrangement for having printed textbooks or other material read aloud to them. Most states provide funds for the payment of readers for blind students. Of great importance also is the recording of textbooks done by organizations such as Recording for the Blind in New York city. Through the efforts of this and similar volunteer groups, student libraries of recorded textbooks are available. Some material in braille also is made available by volunteer transcribers.

4. Rehabilitation of the Adult Blind.—Work with the adult blind in the United States is of comparatively recent origin. Although there were a few workshops and boarding homes for the adult blind in the 19th century, little or nothing was done for the blind in their own homes and little recognition was given to those who lost their sight after reaching maturity. After the turn of the century it became increasingly recognized that with proper help in adjusting to their handicap, blind persons could lead normal active lives, could become self-supporting and need not be subject to segregation and dependency. This attitude was progressively strengthened through the interest taken by the federal government, which passed a number of legislative measures to enable the state governments to carry out a program of benefit to the adult blind.

The first state commission for the blind was established in Massachusetts in 1906, and eventually all states had agencies responsible for the welfare of the adult blind. These agencies are sometimes independent and sometimes divisions within the welfare or education departments. In addition, most large cities have privately supported agencies for the blind, which undertake to provide such services as the states cannot render effectively; their functions vary, but in general they supplement the activities of the tax-supported agency.

5. Vocational Opportunities.—It is commonly felt that at least 25% of the blind are employable and with appropriate training can become self-supporting. There are no special jobs for the blind. On the contrary, tens of thousands of blind persons are gainfully employed in all kinds of occupations, as farmers, salesmen, factory workers, secretaries, teachers, physicists, lawyers, etc. The choice depends primarily upon the qualifications of the individual—his abilities, aptitudes, education, personality and work experience.

The Vocational Rehabilitation act of 1920, amended in 1943 and in 1954, provides for federal funds to be expended for vocational

training and placement of physically handicapped persons, including the blind. The program is operated by the state under the administration of the office of vocational rehabilitation in the United States department of health, education, and welfare. Each year several thousand blind persons are placed in gainful employment.

There are, however, some blind persons who because of age or other limitations cannot compete in the general labour market. For them are provided special workshops or a home industries program. To facilitate the marketing of products made in workshops for the blind, congress in 1938 passed the Wagner-O'Day act, which requires that federal departments purchase brooms, mops and some 40 other approved articles from workshops for the blind at a fair market price determined by a committee appointed by the president of the United States.

6. Financial Assistance.—Blindness is so widely recognized as a cause of poverty that provision for financial aid to needy blind persons from public funds was one of the earliest forms of relief for the blind, the first state law being passed in Illinois in 1903. State after state followed the example, and in 1935 the federal government in title X of the Social Security act provided federal funds to help the states make adequate financial provision for their needy blind. Under this law each state enacts its own legislation and sets up its own administrative plan. Provided the state plan meets certain minimum requirements, the federal government pays four-fifths of the first $30 of the individual grants and 50%–65% of the balance within the federal maximum of $65 per month. In addition, the federal government pays half the administrative cost. In the early 1960s more than 100,000 blind persons received financial aid under this program. The average grant was $66 per month, but the amount varied considerably from state to state. The number of blind persons who receive direct financial aid is actually much higher, since many of them are included in the general old-age assistance program.

7. Other Provisions.—In recognition of the special expenses that blindness may entail, the federal government permits a blind person to take an extra exemption of $600 on his federal income tax and an added $600 exemption if his wife is also blind. Some states allow a corresponding extra exemption on the state income tax, and in many cases exemptions are allowed the blind person on his property tax. Some blind persons use a white cane as a mark of identification, and legislative measures in each state give a blind person carrying a white cane the right of way in traffic. In addition, a blind person with a guide may travel at the cost of one fare on most railroads and bus lines.

8. The Deaf-Blind.—It is estimated that about 6,000 persons in the United States have a serious hearing defect in addition to blindness. Deaf-blind children are educated in special departments in seven schools for the blind and one school for the deaf. Many adult deaf-blind persons are active in the professions or in industry, and many are employed in special workshops.

9. War-Blinded Veterans.—The federal government assumes full responsibility for veterans with service-connected blindness. A central physical medicine and rehabilitation unit is maintained at the Veterans Administration hospital at Hines, Ill., and domiciliary care is given at a number of Veterans administration hospitals throughout the country. The blinded veteran is entitled to receive vocational training, counseling and placement in a job, as well as a disability compensation according to degree of disability.

10. National Agencies.—The professional workers for the blind are represented by two national associations, the American Association of Instructors of the Blind and the American Association of Workers for the Blind. The National Federation of the Blind is an organization of blind people established to promote and improve social and economic conditions among the blind.

The American Foundation for the Blind, located in New York city, is a national nonprofit agency created to help those handicapped by blindness to achieve the fullest possible development of their capabilities and the maximum integration into the social and cultural life of the community. It serves as a clearinghouse on all information relating to blindness and co-ordinates the activities of other agencies for the blind. Among its activities are research, consultation and field services; publications of professional literature; special library service; and public education.

III. GREAT BRITAIN

In the United Kingdom there are two statutory definitions of blindness: (1) that applicable to children under the age of 16 is contained in s. 69 of the Education act, 1921, defining the word "blind" as meaning "too blind to be able to read the ordinary school books used by children"; (2) that applicable to adult blind persons is contained in the National Assistance act, 1948, defining "blind" as "so blind as to be unable to perform any work for which eyesight is essential." Interpreted in medical terms the latter definition means that a person is blind if his visual acuity by the Snellen tests is less than 3/60. Persons with vision from 3/60 to 6/60 may be blind if the field of vision is restricted or other complications are present.

By the early 1960s more than 90,000 blind persons were registered in England and Wales; 2,200 of these were under the age of 16; 77,000 were over 50 years of age, including 49,000 who were 70 years of age and over. The number of registered blind in Scotland was about 10,000, of whom 200 were under 16 years of age. In Northern Ireland approximately 2,600 were registered as blind. Thus it can be seen that blindness is especially associated with old age; and this is borne out by the fact that although after 1950 approximately 12,000 names were added annually to the blind register, the actual total of living persons on the list increased by an annual average of little more than 3,000.

The Blind Persons act, 1920, placed responsibility for the welfare of blind persons upon the state and local authorities (county councils and county borough councils) assisted by national, regional and local voluntary agencies, all working in close co-operation. This responsibility was reaffirmed and further amplified by the National Assistance act, 1948. The Blind Persons act, 1920, gave blind persons in need a noncontributory pension at the age of 50 similar to that received by the seeing at 70 and subject to the same means test. The age was subsequently lowered from 50 to 40. National assistance grants were made payable to those blind persons whose resources were inadequate, and such grants were made at a higher rate than those to the seeing in recognition of the extra living costs of blindness.

The National Assistance act further required that blind persons be given "instruction in their own homes or elsewhere in methods of overcoming the effects of their disabilities" and also that "recreation facilities shall be provided for them." Qualified home teachers visit the blind in their homes, ensure that they receive pensions and allowances, instruct them in the reading of embossed type, teach them handicrafts and assist in the disposal of the finished goods, arrange social gatherings and try in a variety of ways to brighten their lives. Home teachers are required to pass the examination of the College of Teachers of the Blind, which body also conducts examinations for school teachers, craft instructors and blind piano tuners.

Blind persons in need of residential accommodation were provided for under part III of the National Assistance act, 1948, such accommodation being provided either by local authorities or by voluntary agencies.

Blind persons who use a dog (which may be specially trained) as a guide or who possess a radio set were exempted from the obligation to pay for a licence; and the cost of the combined television-and-radio licence was reduced for them to the extent of the cost of a radio licence. (The British Wireless for the Blind fund, so far as its resources permit, provides a radio set on free permanent loan to every adult blind person in need of one.) Blind persons also were given permission to vote by mail in parliamentary or local elections or alternatively to have the help of a seeing person to mark their ballot. There are special postal rates for transmission of braille literature and apparatus for the use of the blind; and there are certain special travel facilities.

Members of the armed forces of the crown and the civil defense services who lost their sight on active service came under the special care of St. Dunstan's (founded in 1915 by Sir Arthur Pearson), which in the early 1960s was caring for about 2,000 blind men and women in the United Kingdom and about 600 overseas.

Braille plays an important part in the lives of the blind in both education and recreation. In addition to the various braille libraries and publishing houses in many parts of the world, there is also in London a students' library for the blind where a blind person who requires a specialized book for the purpose of pursuing his studies or following his profession may have it specially transcribed into braille.

Talking books are increasingly used by many blind persons. Books are recorded on long-playing records and issued as a library service for use on specially designed reproducing machines.

1. Education.—There were about 600 blind children under the age of five in the early 1960s. For the early training of those remaining in their own homes, parents are assisted by home teachers of the blind and by the Royal National Institute for the Blind (R.N.I.B.). A child who cannot be satisfactorily cared for at home may be admitted to one of the nine residential Sunshine Home Nursery schools, maintained by the institute. Two of these schools cater especially to retarded blind children.

The education of blind children from age 5 to 16 was made compulsory in England and Wales in 1893 and in Scotland in 1890; it is also compulsory in Northern Ireland. The first British school for the blind was opened in Liverpool in 1791, and there were 13 residential schools in the United Kingdom after World War II. In these the education given conforms as nearly as possible to that in a school for the seeing. Braille is used for reading and writing, and special apparatus is supplied for teaching mathematics and geography. Physical education plays an important part in the curriculum. As in schools for the seeing, there is a break at age 11 or above, the child of average ability passing to a senior school and the boy or girl of exceptional promise going on to one of the two residential grammar schools, Chorleywood college for girls and Worcester college for boys, administered by the R.N.I.B. At these two grammar schools general education normally continues until the age of 18 in preparation for entrance to a university or for professional training. There is also a senior selective school, the Royal Normal college, where general education is continued up to the age of 16 and then succeeded by training in some branch of music, piano tuning or shorthand and typing. The blind child who is also deaf, crippled, maladjusted or mentally or physically retarded may receive education between the ages of 8 and 16 at a special residential school established by the R.N.I.B. in 1948. Mentally defective blind children were provided for under the National Health Service act of 1946.

For a blind boy or girl leaving school at 16 or 18 years of age the education authority normally offers training, retaining responsibility for such training up to the age of 21. For the further education of blind adolescents, a first establishment was opened in 1956, with the purpose of "bringing the adolescent to a point at which a definite choice of a vocation could be made."

2. Rehabilitation, Training and Employment.—During World War II, when many civilians lost their sight as a result of enemy action, three residential centres of rehabilitation were established for the newly blind in England. A fourth was opened in Scotland in 1952. At these centres any newly blinded civilians may undertake a period of either prevocational or social rehabilitation.

Responsibility for vocational training and employment of the blind was made jointly that of the local authority and the ministry of labour under the Disabled Persons (Employment) act of 1944. In the case of those destined for sheltered employment, training is usually carried out at a workshop for the blind; in the case of those entering industry, commerce or one of the professions, it is provided at one of the ministry of labour's government training centres, at a school for blind shorthand-typists and telephone operators, at a school for physiotherapy or, sometimes, at a sighted professional training college. Local authorities frequently delegate the task of placing blind persons in industry, commerce or the professions to a specialized national placement service such as that operated by the R.N.I.B. In addition, a number of sheltered workshops for the blind carry on such trades as the making of baskets, brushes, mats, mattresses, wire goods, woodwork, soap and plastic moldings; they also carry out chair caning, piano tuning, shoe repairing, machine knitting and weaving. Trained workers living at a distance from a workshop are sometimes given employment in their own homes at piecework rates plus augmentation of wages. By the early 1960s about 12,000 blind persons were in employment: about one-third of these were engaged in sheltered employment in workshops and as home workers, the remainder in a variety of professional, commercial or industrial occupations (*e.g.*, lecturers, lawyers, ministers of religion, teachers, physiotherapists, home teachers of the blind, musicians, shorthand-typists, telephonists or factory operatives).

IV. COMMONWEALTH OF NATIONS

In the commonwealth, outside of the United Kingdom, for obvious reasons, there has not been a similar tradition of voluntary social service; nor has the development of local government followed any set pattern. In some of the dominions blind welfare work is hampered by the wide distribution of the blind and by the difficulty of correlating welfare agencies over great distances.

1. Canada.—In Canada, several residential schools have been established for the education of blind children, and some blind children also receive instruction in special day-school classes in the public schools. The dominion and provincial governments give financial aid to the needy blind.

The Canadian National Institute for the Blind is organized to give every possible type of service to the adult blind, including the training and aftercare of the war-blinded. By the early 1960s it had registered more than 22,000 blind persons and administered nation-wide library services, home teaching, workshops, home-workers' schemes, vocational training and placement service. The institute was organized in 1918 in Toronto, Ont. An Ontario division and national headquarters were first set up in that city, and gradually the work was expanded through the establishment of two divisions to cover the four western provinces, one division in the province of Quebec and a division covering the three maritime provinces. Later a Newfoundland division was organized, and a British Columbia division was made independent of existing western divisions. A common administrative pattern is observed by all divisions. Each of the provincial divisions is represented on a central national council. A board of management comprising local men and women, both blind and sighted, interested in the blind of their community, voluntarily give advice, guidance and support to the work. It is the responsibility of the board in each division to see that every possible service is rendered to the blind, and to arrange for funds to meet the cost. A divisional superintendent and staff are employed for each division.

In order to make sure that the blind in smaller places or rural districts receive the same service as those in the larger centres, field secretaries are informed and local voluntary advisory boards and committees have been set up. It is the duty of the field secretary to familiarize each blind person in his district with his legal entitlements and the services available from the institute and to arrange for the services that might be beneficial.

The Canadian Council of the Blind is an organization co-operating with the Canadian National Institute for the Blind. Clubs of the blind in all principal cities of Canada are members and are represented on the parent body. Financing of individual club activities is met by the various divisions; that of the council is met by the national headquarters of the Canadian National Institute for the Blind.

2. Australia and New Zealand.—In New Zealand, where national voluntary activity is centred in the New Zealand Foundation for the Blind, and in Australia, where voluntary organizations exist in most states, pensions for the blind have been enacted as part of the general social security legislation. In 1953 most of the state-wide and local organizations in Australia entered into a voluntary agreement for co-ordination of their activities through the creation of the Australian National Council for the Blind, while those specializing in the education of blind children formed the Australian Association of Teachers of the Blind.

3. Ceylon.—A 1953 United Nations survey estimated that there were at that time 14,000 blind persons in Ceylon. A government-recognized National Council for the Blind and Deaf maintains a

school for blind children, which was originally operated under missionary auspices, in Colombo, and a branch of the school in the northern province of Jafna. Adult services under the council's administration include vocational training, sheltered workshops, co-operative housing schemes and home industries.

4. India.—Blindness constitutes a vast and complex problem in India, which has a blind population estimated at 2,000,000. The central government's responsibility for the education and rehabilitation of the blind rests with the ministry of education, which expanded its budget during the 1950s and made further increases within the framework of the second and third five-year plans. The major purposes for which central government funds are used are (1) operation of a training centre for blind adults at Deradun; (2) maintenance of a printing plant and manufacturing centre for braille appliances at the same location; and (3) provision of cash grants to schools and agencies for the blind operated by state governments and voluntary agencies.

By law each state is responsible for providing or arranging for educational services for blind children. Under the terms of the law, many of the schools originally established by missionary bodies or other voluntary agencies were taken over by state governments, which continue to operate them, using state funds plus subsidies from the central government. Most of the services for blind adults (with the exception of the central training centre) are operated by voluntary agencies, some of which receive limited assistance from state governments and occasionally the central government, particularly for building purposes. The major portion of their funds, however, are obtained from public contributions.

The total of state and voluntary organizations throughout India exceeds 50 in number. In an effort to provide a means of national co-operation, an All India Conference on Work for the Blind was called in 1952, and this led to the creation of the National Association for the Blind (N.A.B.). Most of the agencies for the blind are affiliated with the N.A.B., which is responsible for promoting interest in the problems of the blind and in prevention of blindness, as well as for the maintenance of international contacts.

5. Pakistan.—Pakistan, with an estimated blind population of 400,000, has several schools for blind children and one centre for the training and employment of blind adults. Although most of these societies are recognized by and receive subsidies from the central or provincial governments, all are operated voluntarily. On recommendation of a United Nations survey completed in 1955, plans were made for the formation of the West Pakistan Blind society, to discharge certain centralized functions such as the production of braille. In 1957 first steps were taken toward the creation of the All Pakistan Federation for the Blind, to provide national co-ordination and to represent the blind welfare interest of Pakistan internationally.

6. Malaya.—Malaya, with an estimated total of 14,000 blind citizens, maintains schools for blind children at Penang (opened in 1926) and Johore Bahur (founded in 1955). The work of governmental and voluntary bodies is co-ordinated by a blind-welfare officer within the department of welfare. This joint activity led to the creation of the Gurney Training centre for blind adults at Kuala Lumpur, two smaller training centres in outlying districts and a large agricultural training centre outside Kuala Lumpur.

7. Other.—In the newly independent dominions and the non-self-governing territories of the British commonwealth most schools and other activities for the blind were originally launched under missionary auspices with little or no governmental or local support. Following a survey of the British colonies under the joint sponsorship of the colonial office and the Royal National Institute for the Blind, it was recognized that governmental and voluntary authorities in the United Kingdom should join in partnership with private groups in the colonies to promote more effective, co-ordinated services. In 1950 the Commonwealth Society for the Blind (then known as the British Empire Society for the Blind) was created to meet these objectives, and in the succeeding years great progress was made. Joint action was undertaken in countries of Africa, the Caribbean, the Mediterranean and the near and far east, with local participating organizations bearing a considerable proportion of financial and administrative responsibility. Approximately 1,000,000 blind persons reside in the British territories, with the greatest concentration in west Africa, where there are an estimated 335,000.

In the nonself-governing territories where formerly there was little organized work for the blind, the foundations have been laid for permanent systems of blind welfare, and many new schools and training centres have been established. The number of blind students and workers has multiplied, braille alphabets have been devised for practically every written language, and blind welfare workers from 25 countries have gone to the United Kingdom for training. Surveys to reveal the extent and causes of blindness have been conducted in areas containing 27,000,000 inhabitants, and research work has brought within reach methods of controlling blinding diseases.

With the emergence of former colonies to the status of self-governing dominions, recognition was given in 1957 to the need for constructing an interlocking framework of services for the blind throughout the commonwealth. Ghana, for example, which became an independent republic in 1960, had a population including 65,000 blind persons. A plan therefore was approved for the introduction of a program of mutual assistance, with some of the more highly developed dominions joining with the United Kingdom in providing funds, experienced workers, special appliances and other forms of technical assistance to certain of the younger dominions and those colonies whose total emergence had not yet been achieved.

In the former member of the commonwealth, the Republic of South Africa, work for the African and European blind is undertaken by a number of voluntary organizations, whose work is co-ordinated through the South African National Council for the Blind in Pretoria. The largest single organization is the Transvaal Society for the Care of the Non-European Blind, whose voluntary activities are maintained by societies located in some of the states of the union. A large eye hospital and ophthalmic research centre is maintained in Johannesburg under the direction of the Order of St. John of Jerusalem. Considerable emphasis in the national program is placed on prevention of blindness and restoration of vision where possible. The work of large eye hospitals in principal cities is supplemented by that of clinics in strategic locations and the operation of mobile eye units. Efforts are also being made to expand services for the training and resettlement of blind Africans in rural occupations and for integrating them into normal life.

V. OTHER COUNTRIES

A. Europe

1. Austria.—Austria, with a blind population of approximately 4,000, has several residential schools for the education of blind children. Great interest has been shown in industrial placement and in opening up of new vocational avenues for the blind. The Federation of Austrian Organizations for the Blind was established to unify the work of the various agencies as well as to conduct other cultural and practical activities. Work for the blind and its physical facilities suffered severely after the German *Anschluss* and during World War II, among the casualties being the world-famous library on blindness in Vienna.

2. France.—France, which observes a stricter definition of blindness than that of most western countries, has a blind population of approximately 45,000 within its definition. Under an ordinance of July 3, 1945, "those whose central vision is nil or less than 1.20 of normal" are considered blind. There were in the early 1960s, 35 schools for the blind in France; most of them may be defined as charitable institutions furnishing general education and vocational training to the blind of school age. The nationally supported school is the Institution Nationale des Jeunes Aveugles in Paris.

Traditionally the principal effort for aid of the adult blind in France has been the maintenance of residential homes and the operation of sheltered workshops in which the blind are employed principally in the manufacture of brooms and brushes. Approximately 50 institutions of this type are located throughout France, mainly under voluntary or ecclesiastical support. Many French workshops for the adult blind have facilities for permanent shelter

for a certain number of blind persons who cannot become self-supporting. The American Foundation for Overseas Blind, Inc. (A.F.O.B.), extends cultural and vocational aid to the blind through the publication of a braille magazine and the manufacture of braille slates and other equipment. Under the auspices of the A.F.O.B., a Central Committee for Blind Workers was established in Oct. 1946 to co-ordinate the distribution of raw materials to workshops and blind workers and to promote the sale of blind-made products.

A growing recognition of the ability of the blind to compete satisfactorily with the sighted in open employment led to the creation in Paris of an industrial vocational training centre where blind adults are trained for occupations in industry and commerce, particularly for light engineering, braille shorthand-typing and telephone switchboard operation. Maintained under the joint sponsorship of the French department of labour and voluntary organizations, this program also provides placement and post-placement follow-up services.

The National Committee for the Social Protection of the Blind co-ordinates the work of public and private agencies. Representatives of the most active national and regional organizations working on behalf of the blind serve on this committee.

In the field of service to the adult blind the three French organizations with national responsibility are: (1) the Valentin Haüy association, founded in 1889 by a blind man, Maurice de la Sizeranne, which boasts a library of 125,000 volumes, mostly hand-copied books; (2) the Federation of Civilian Blind of France and Colonies, including about 30 provincial associations forming a representative group of blind people; and (3) the Union of French War Blind, founded in 1918, for the benefit of those who lost their sight in combat.

3. Germany.—In 1954 responsible authorities in west Germany indicated that there were 35,000 blind persons among the residents of the German Federal Republic. Scant information is available on the German Democratic Republic, but it is estimated that the blind community there numbers approximately 15,000.

Prior to World War II Germany had a well-organized educational and welfare system for its blind citizens. Education of blind children was carried on in 25 publicly supported residential schools for about 2,700 pupils. There was also a special institution for blind university students, combined with a braille library. The two largest braille libraries were located in Hamburg (39,000 volumes) and Leipzig (26,000 volumes). World War II completely changed the status of the blind. Many schools and workshops were entirely destroyed (Düren, Soest, Hamburg), others were heavily damaged and only a few remained intact. After the war, educational authorities as well as associations of the blind became active in reconstruction work for the blind. As a first step regional organizations were created in the U.S., British and French zones of occupation, these later becoming a national organization when the Federal Republic was established. Schools, training centres and workshops were reconstructed, and great strides were made in providing legislation to meet the economic needs of the sightless and to encourage the placement of the blind in industrial and commercial occupations. The principal organizations with national responsibility in the Federal Republic are the Union of the War Blind of Germany, the Union of the German Blind, the Association of Blind Intellectual Workers and the German Association of Teachers of the Blind.

4. Italy.—The Italian blind population was estimated by national authorities to be 50,000 in 1954. The Unione Italiana dei Ciechi (founded in 1920), which works in co-operation with various government departments and maintains branches in all regions of the country, is the chief agency. The union participates in the direction of services for employment of the blind through the Ente Nazionale di Lavoro per i Ciechi. National co-ordination of programs for the education and vocational and professional training of the young blind is provided by the Federazione Nazionale delle Instituzion Pro-Ciechi. In 1955 the Opera Nazionale per i Ciechi Civili was created by the Italian government to implement statutory policies related to services for the blind.

5. Netherlands and Belgium.—In the Netherlands (5,000 blind population) and Belgium (6,000) work for the blind is of a generally high standard. Well-organized institutes for the blind are found in Amsterdam, Zeist, Grave, Brussels, Bruges, Mons and Liège.

In 1956 the Netherlands government adopted legislation providing for extended economic assistance to the blind and for more complete facilities for the location, registration, rehabilitation and placement of the sightless. These services are maintained in co-operation with the Netherlands Foundation for the Blind and the Union of the Blind, which are the country's principal voluntary organizations. In Belgium the principal voluntary organization is the Ligue Braille.

6. Scandinavia.—In Sweden (6,000 blind population), Norway (2,500) and Denmark (4,000) the generally advanced state of work with the blind is attributed in a large measure to the initiative and energy of the blind themselves. In all three countries and in Finland (4,200 blind) there exist strong associations of blind persons that advise and co-operate with the government authorities. In Sweden grants to the blind are given as old-age pensions (for those who are over 67 years of age) or as invalidity pensions (for persons under 67 years who are unable to work because of physical conditions). The amount given as invalidity pensions varies according to the blind person's income over and above a certain sum. In addition there is a flat blindness compensation and a residence subsidy to offset regional differences in the cost of living.

In Denmark a similar system is maintained, invalidity pensions being granted to all categories of severely handicapped citizens, including the blind, with a fixed amount being paid to all blind persons to offset increased living costs imposed by the handicap. In 1957 refinements to the law were adopted, including the creation of an appeals board to review grievances. In Finland the handicap allowance increases as the pensioner returns to active life and employment, thus serving as an incentive to speedy rehabilitation.

7. Spain.—In Spain (28,000 blind population) all agencies for the education and welfare of the blind were merged into a National Organization for the Blind, which serves as the official agency of the ministry of the interior. This organization conducts regular national lotteries, the majority of the blind population being employed in lottery offices or as ticket sellers. All profits are used for the operation of training centres, workshops, braille printing departments, schools and welfare facilities for the blind.

8. Switzerland.—In Switzerland (blind population 3,000) the schools and residences for blind children and adults are operated almost entirely by private agencies, although some receive governmental subsidies. Efforts toward expansion of vocational opportunities, dissemination of braille and recorded literature and improvement of economic provisions for the blind are carried on by two national organizations composed of blind members, the Swiss Central Union for the Blind and the Swiss Federation of the Blind.

9. U.S.S.R.—According to available information, the government of the U.S.S.R. has shown great interest in its blind citizens, including the large number who lost their sight during World War II. Special efforts have been made in regard to vocational training and placement in jobs.

B. Far East

In the far eastern countries blindness is much more prevalent than in most of Europe and America. Statistics are unreliable, but it is estimated that 75% to 80% of the world's sightless people reside in the countries of Asia. Modern blind welfare work has affected only a minute section of this blind population. The initial work was started in the latter part of the 19th century by missionaries and philanthropists. After World War II, however, an encouraging growth of interest and initiative on the part of governments was noted.

1. Burma.—St. Michael's School for the Blind, the first to exist in Burma (estimated blind population 50,000), was established in 1914, when a small group of blind children was gathered in the mission compound; in 1917 Father William Henry Jackson, a blind Anglican missionary, arrived to supervise the establishment of a school, which he guided until his death in 1931. Prior to World War II its services had expanded by the introduction of a voca-

tional training department, the operation of sheltered industrial workshops and the creation of a school for the education of blind girls at Maektilla. This latter school was destroyed during the war, while others were seriously damaged. Another voluntary organization, St. Mary's Workshop for the Blind, was founded in 1955 to expand employment opportunities. Under government sponsorship the National Council for the Blind was created in 1957 to prepare plans for extending national services for the blind by governmental and voluntary action. These plans were based upon recommendations resulting from a United Nations survey of blindness in Burma in 1953.

2. China.—Many of China's vast blind population, estimated at 2,000,000 to 3,000,000, have traditionally lived by practising fortune telling. Some blind persons have been able to obtain a place for themselves as musicians and in the professions, while a comparative few are known to be employed at manual operations in sheltered workshops. The larger number, however, have turned to begging.

The first school for the blind in China was started in Peking in 1876 by William Hill Murray of the Scottish Bible society. Murray was the inventor of a Chinese system of braille, but his system was later supplanted by the Union Mandarin braille, which has been accepted wherever Mandarin is spoken. A unique braille system for the Cantonese dialect later evolved by Mary West Niles is in use.

In 1947 a survey of the condition of the blind was made for the government of China and recommendations were submitted for a national program of education and welfare. This survey revealed that at that time only about 30 schools and agencies for the blind were in operation throughout China, with a total enrollment of less than 3,000 blind persons. Among the most active, in addition to the Peking school, were the Ming Sum School for Blind Girls in Canton, the David Hill School for Blind Boys in Hankow and the Institution for the Chinese Blind, founded in Shanghai in 1912 by John B. Fryer.

Little reliable information is available from the Chinese People's Republic.

The government of the Republic of China in Formosa assumed responsibility for education of blind children, maintaining provincial schools at T'ai-pei and T'ai-nan. Under the voluntary Committee for the Blind of Formosa, programs for the training and employment of the blind in industrial and agricultural occupations and for the manufacture of braille literature were introduced. Braille library services and welfare activities were maintained by the Taiwan Association of the Blind. An effort to reduce the incidence of blindness by elimination of trachoma among children was undertaken in the 1950s and 1960s by co-operation among the Nationalist government, the United Nations Children's fund (UNICEF), and the World Health organization (WHO).

3. Indonesia.—A 1953 United Nations report stated that according to accepted medical opinion the number of blind in Indonesia was approximately 600,000. This figure places Indonesia among the countries with the highest incidence of blindness in the world. In 1902 the Institute for the Blind in Bandung was founded by the Society for Improvement of the Fate of the Blind in Indonesia. Under a Dutch board of directors, the institute during its first 40 years offered a basic program of education and training in a compound accommodating both children and adults. Later the institute became a colony for the destitute and a haven for many blind beggars, and this led to many difficulties in management. A number of professional workers trained abroad in the 1950s began, with government assistance, to endeavour to improve the general standard, and training centres for the adult blind were opened in eight inland cities.

4. Japan.—The condition of the blind in Japan, conservatively estimated to number more than 150,000, perhaps has been happier than anywhere else in the east. This is largely attributed to the fact that the professions of massage, moxibustion and acupuncture became a monopoly of the blind in the 9th century, when Prince Hitoyasu, the young son of the 54th emperor, lost his sight and influenced his father in favour of the blind. These special privileges were abolished with the Meiji restoration in 1868, but the tradition persisted and the number of blind masseurs is still large. Blind Japanese are often gifted musicians, and the blind musicians' guild as well as the blind masseurs' guild has held considerable power. The pioneer modern school for the blind was opened in Kyoto in 1876, followed by the Tokyo School for the Blind (later called the National School for the Education of the Blind) four years later. By the 1960s there were about 90 schools for the blind in Japan. In the most progressive of them, students are taken from kindergarten through high school; in several, normal school training is also offered. In 1932 by edict of the emperor the education of the blind was required to conform to that available to sighted children, and in 1948 the education of the blind became compulsory by law. By the 1960s there were more than 70 residential schools, with an enrollment of over 5,000, and several other organizations, including three government rehabilitation centres, providing training and welfare facilities for blind adults. Financial provisions for the needy blind were made under the 1948 act for welfare and rehabilitation of the handicapped. Many problems persist, particularly the need for exploiting new areas of employment to supplement the traditional arts of music and massage. Three national organizations were created: (1) the Japanese United Association of the Blind, composed of blind persons resident in all parts of the country; (2) the Association of Educators of the Blind, made up of representatives from almost all of the country's schools; and (3) the Association of Welfare Institutions, whose membership contains those specializing in the care and rehabilitation of the adult blind. Delegates from each of these organizations comprise the National Committee for the Welfare of the Blind of Japan, which, together with the American Foundation for Overseas Blind, sponsored the Far East Conference on Work for the Blind, held in Tokyo in 1955. Two centres for manufacturing aids and appliances, two national braille libraries and three university courses for training teachers of the blind contributed substantially to the growth of Japan's service program for the sightless.

5. Korea.—Nearly 100,000 blind persons live in Korea, about 60,000 being located in the Republic of Korea. Modern work for the blind in Korea was started with the establishment of a school at Pyongyang city. In 1945 the Taegu school for the blind and deaf was founded and has grown substantially; it serves as the national centre for braille book production. In the 1950s other schools, some also providing for vocational training of adolescents and adults, came into being at Chunju, Pusan, Iri, Mokpo, Quanju and Chaejudo. A feature of the expanding program in South Korea is the vocational training and employment project at Taejon, where a school and other welfare facilities for the blind also are maintained. The Advisory Committee on International Aid to the Blind was formed in 1957 to further and co-ordinate the Republic of Korea's program for the blind and to expand the country's international participation.

6. Philippines.—In 1955 the government of the Philippines reported a blind population of 80,000. The country's first service to the blind, a school providing for the education of deaf as well as blind children, was established in 1908. This school later found it practical to emphasize the education of the deaf, and this caused the government to give consideration to a plan for the admission of blind children to the general education system, such pupils receiving special services from trained itinerant teachers.

In 1957 an adjustment centre for the blind and other severely handicapped persons was opened in Manila by the government social welfare administration, with direction provided by the American Foundation for Overseas Blind. The centre offers a program of training and work experience for more than 60 blind persons and is serving the far east as a teaching and demonstration unit for preparing instructors. With establishment of rehabilitation services for the blind in Manila, active steps were taken to create commissions for the blind in each province of the republic. Such provincial commissions are in operation in several cities.

7. Thailand.—Thailand, with an estimated blind population of 65,000, has only one school for blind children and no organized program for the training, employment or welfare of the adult

blind. The school in Bangkok, founded in 1937 by a blind American, Genevieve Caulfield, is administered by a Foundation for the Welfare and Education of the Blind and in the early 1960s had an enrollment of 130 pupils.

8. Vietnam.—It is estimated that the blind population of North and South Vietnam totals more than 60,000. Prior to the division of the country in 1954, Hanoi served as the national centre of work for the blind, a good residential school for blind children having been maintained there under the French colonial administration. In South Vietnam the school for the blind has an enrollment of about 50 students and provides academic studies, music and vocational training. Late in 1957 plans were completed for opening a small school in Saigon for the education of blind girls, the government providing assistance to this voluntary project.

C. Middle East

A relatively high incidence of blindness has been recorded in many areas of the middle east, and it is estimated that there are approximately 500,000 blind persons living in the region, including those in Egypt and Turkey.

As in the far east, the introduction of services for the blind in the middle east during the late 19th and early 20th centuries is mainly traceable to western missionaries. During the decades after 1940 a noticeable growth of interest among government and local groups was noted, such schools as the Ala-Iya School for the Blind in Jordan, the Queen Huziymah Institute in Iraq, the Ankara Blind School in Turkey and several in Egypt being placed under the jurisdiction of government educational and social welfare agencies. In other cases—such as the British Syrian and Swiss Armenian schools in Lebanon, the School for the Blind in Isfahan, Iran, and three small institutions in Jordan—the work of voluntary and missionary groups continued, although in most instances a degree of government recognition or subsidization was enjoyed.

A particularly significant development was the creation of a middle east demonstration project for the blind in Cairo. Opened in 1953 under the joint auspices of the Egyptian government and the United Nations, with assistance from international voluntary groups, the project serves as a focal point of the Egyptian program while being utilized as a training centre for professional workers from other Arab countries. The operation of this project caused acceleration in developments in other countries, particularly Lebanon and Syria.

In Israel (blind pop. 4,500), a residential school for blind children has existed in Jerusalem for many years, and sheltered workshops for the employment of adult blind are maintained by voluntary organizations in several cities.

Turkey also developed its training program for teachers of the handicapped, including the blind. Braille printing centres supplying school textbooks and other literature for the region are located in Egypt, Jordan and Turkey and in Jerusalem.

D. Latin America

Although few of the countries of Latin America publish reliable statistics on the incidence of blindness, it is estimated that close to 500,000 blind persons live in the area that includes Mexico, the Central American republics and the continent of South America. The earliest-known services to the blind in the region were introduced under government auspices, while certain orders of the Roman Catholic Church have made and continue to make noteworthy contributions to the operation of such services, particularly in the education of blind children. The schools having longest history of service in this region are the Instituto Benjamin Constant in Rio de Janeiro, Braz. (1854), the School for the Blind in Mexico City (1866), the School for the Blind and Deaf in Buenos Aires (1888) and the National School for the Blind at Santiago, Chile (1890).

While existing services are inadequate to meet the total need, many new activities were launched after the 1920s and every country of the region maintains some service for the sightless. There is a tendency toward co-operation among the countries, exemplified by the 1954 Pan-American Conference on the Welfare of the Blind and the Prevention of Blindness, held in São Paulo, Braz., at which resolutions were adopted for region-wide activities to meet the most pressing needs. Subsequently a regional program for the training of teachers of the blind was introduced at the University of Chile, Santiago, in April 1955.

In Brazil there are two braille printing plants, one in Rio de Janeiro at the Instituto Benjamin Constant and the second and most active, operated by the Fundação Para o Livro de Cego no Brasil, in São Paulo. These organizations publish only Portuguese braille. Argentina has one large plant that publishes a braille magazine and a few books. Uruguay manufactures machine-made books, and Peru has a small hand-operated plant that can supply enough books for classroom use in the national school but does not have the capacity for publication of a wide variety of literature for adults. Both Chile and Bolivia have small hand-operated presses.

The Centro Editorial Braille in Mexico City, with the assistance of the Kellogg foundation and the American Foundation for Overseas Blind, improved and enlarged its printing plant in the 1950s. The dissemination of braille literature in Latin America was greatly facilitated by a uniform braille code evolved during a United Nations Educational, Scientific and Cultural organization (UNESCO) braille conference held at Montevideo, Urug., in Dec. 1951.

Braille library services are maintained in Argentina, Mexico and Brazil. Services for the training and employment of the adult blind have traditionally followed the early European pattern and the Spanish practice of using the blind as lottery ticket salesmen. After 1955 Brazil endeavoured to expand employment opportunities and particularly to encourage placement of the blind in industry. In 1957 an International Labour organization (ILO) consultant was assigned to accelerate the pace of this development. Simultaneously new services for the social and vocational rehabilitation of the newly blind were introduced in Chile and Mexico. It being recognized that many Latin-American countries are non-industrialized, sheltered employment will doubtless continue to provide most job opportunities for the blind. Existing workshop practices require modernization, and an interesting program to that end has been introduced in Guatemala.

VI. INTERNATIONAL CO-OPERATION

After World War II many important international developments helped in the progressive development of services for the welfare of the blind throughout the world. As a result of a resolution adopted at the 1949 International Conference of Workers for the Blind at Oxford, Eng., the World Council for the Welfare of the Blind (W.C.W.B.) came into being in July 1951; its purpose was to provide the means of consultation among organizations of and for the blind in different countries, and wherever possible to promote joint action toward the introduction and improvement of minimum standards for the welfare of the blind in all parts of the world.

In the same year the World Braille council was formed at the conclusion of UNESCO's exploratory work for the unification of braille throughout the world. This council later became part of the World Council for the Welfare of the Blind as did the International Conference of Educators of Blind Youth, which arranged world conferences of educators in 1952 and 1957. World Council for the Welfare of the Blind, with over 40 countries in membership, also maintains standing committees on technical appliances, prevention of blindness, professional and urban employment, services to the deaf-blind, rural activities, far east, south and southeast Asian affairs and Pan-American affairs.

The council enjoys consultative status with the United Nations, UNESCO, ILO and UNICEF, and as a member of the Conference of World Organizations Interested in the Handicapped plays a part in the United Nations co-ordinated program for rehabilitation of the handicapped. In co-operation with international governmental and nongovernmental organizations and the local governments concerned, regional conferences on the welfare of the blind were held in São Paulo for the Pan-American region in 1954 and in Tokyo for the far east region in 1955; a seminar on rehabilitation of the blind for European countries was held in London in 1956. An international conference was held in Paris in 1954 for the purpose of evolving a world-wide system for the application of braille

to music of all cultures; UNESCO, World Braille council and World Council for the Welfare of the Blind co-operated in this venture, the latter publishing its international braille music manual in 1957.

The American Foundation for Overseas Blind, established in 1915, a United States private philanthropic organization, maintains a continuing program of aid to governmental and nongovernmental agencies for the blind throughout the world, including consultant service, fellowships, production of literature in braille and talking book form, establishment of demonstration projects and provision of technical equipment. With its world headquarters in New York city, the American Foundation for Overseas Blind maintains regional offices in France, Chile and the Philippines. Similar services are extended to colonial and former colonial territories by the Commonwealth Society for the Blind, established in 1950, whose headquarters are in London.

See also REHABILITATION, MEDICAL AND VOCATIONAL.

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BLINDNESS, the inability to see. This article is confined to a discussion of the causes of blindness and agencies whose purpose is to combat it. The entire subject of sight and its mechanisms is discussed in the article VISION OR SIGHT. Diseases of the eye are discussed in EYE, HUMAN, as is the anatomy of the eye. *See* also articles on diseases sometimes responsible for blindness—as DIABETES MELLITUS; LEPROSY; TRACHOMA; etc.—and on related subjects, as COLOUR BLINDNESS. Blindness as a sociological and educational problem is discussed in BLIND, TRAINING AND WELFARE OF.

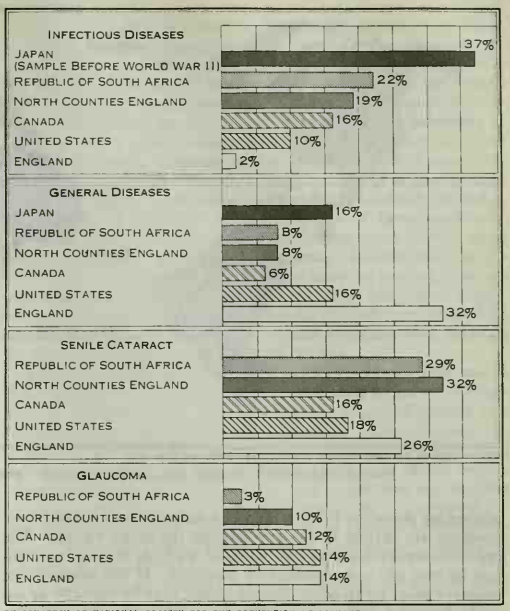
The eye functions as a mechanical device, like a camera taking pictures, but at the same time it is a living organism. As a mechanical device it must contain all essential parts, properly constructed, placed and interconnected so that it may function efficiently as the organ of sight. As a living organism, the eye is composed of parts that are actually tissues, blood vessels, muscles and nerves, similar to those found elsewhere in the body. Their vitality, and hence their function, is maintained by proper nourishment and protection from disease or injury.

Affections of the eye are diagnosed both in terms of what happens to the eye (where it is affected and the nature of the affection) and what causes it to happen (etiology). In general, the part affected and the nature of the condition determine the amount of sight lost; the underlying cause is important both in treatment and in determining the methods of prevention by which individuals or groups may be protected from loss of sight. Etiological factors are of major importance in the prevention of unnecessary blindness.

CAUSES OF BLINDNESS

The causes of blindness, like causes of illness or death, may be classified under a few general groupings. Blindness may be due to an infectious disease, to some general systemic disease, to injury or poisoning, to a tumour or to heredity or some other influence operating before birth. There are some eye diseases the causes of which are unknown. Further, only in more advanced countries can the average blind person be examined by an ophthalmologist (eye physician) to determine the cause of his blindness. In spite of the scarcity of statistics on causes of blindness, however, it is possible to bring together facts from many sources and to determine the nature and approximate size of the more important problems.

The amount of blindness, as well as the relative amount due to various causes, differs markedly in time and place (*see* fig. 1). As medical science provides knowledge of how to control certain diseases, blindness from these causes decreases. Climate, terrain and availability of good medical care also influences rates. The effect of both time and place can be seen in comparisons of causes of



BY COURTESY OF NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

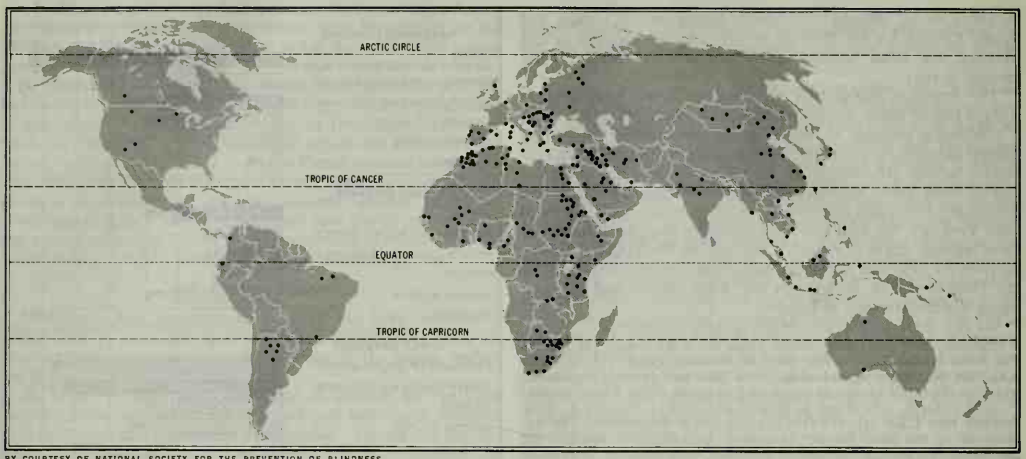
FIG. 1.—VARIATIONS IN PERCENTAGES OF BLINDNESS DUE TO SELECTED CAUSES

blindness in an underdeveloped versus an advanced country. Reports from the former will be found to show high prevalence of blindness. The high rate will be seen to be due largely to infectious diseases, but other causes may be high also because of dietary deficiencies, scarcity of medical care facilities or both. For example, a medical missionary, reporting in 1957 on his personal experience, mentioned that vitamin deficiency, trachoma, smallpox and leprosy as well as cataract are common causes of blindness in India.

In contrast, periodic studies of causes of blindness in England, Canada and the United States (all countries of high economic and health status) show the effect of advances in medical knowledge and safety measures. In these countries there have been conspicuous decreases in blindness due to infectious diseases and injury. Not all medical advances tend to reduce incidence of blindness, however. Some merely extend the life span. Thus persons affected with inadequately treated diabetes or chronic vascular disease live longer but may not avoid the serious eye complications of these diseases. Many more persons now live to an advanced age, when glaucoma may and cataract is almost certain to develop. The introduction of a new technique to save life may sometimes prove disastrous to eyes (as when excessive oxygen in incubators produced gross maldevelopment of the retina—retrolental fibroplasia—blinding thousands of premature babies between 1940 and 1954, when the cause was established).

Among other factors affecting blindness rates, age is most significant. Except in countries having exceptionally high rates of blindness due to the infectious diseases (which can be contracted at any age), the blindness rate increases with age. For example, in England as of 1954 the population aged 70 years and over was less than 10% of the total but accounted for 52% of the register of the blind and 69% of the new cases registered in that year. Estimates for 1957, believed to be a typical year, in the United States, based on samples for several states, showed between 50% and 60% of the blind in the age group 65 years and over.

Infectious Diseases.—Infectious diseases are a potential hazard to sight. The eye may be invaded directly by the living organisms that cause infection, or it may be affected indirectly by infections



BY COURTESY OF NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

FIG. 2.—TRACHOMA ENDEMIC AREAS OF THE WORLD. THE RATE OF BLINDNESS IS HIGH AMONG AFFECTED POPULATION

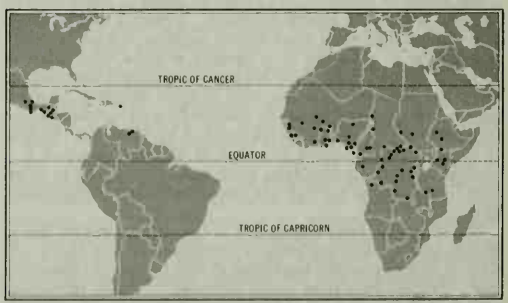
originating elsewhere in the body when the organisms or their toxic products are carried to the eye through the blood stream. The organism breaks down normal tissues of the body in order to maintain its own life and reproductive processes. If this degenerative process cannot be arrested, the eye tissues may be partially or entirely destroyed, with corresponding loss of function. Fortunately, medical science has made most notable progress in combating infections through development of antiseptics, sanitation, immunization and new drugs for effective treatment.

Trachoma.—Trachoma is actually the only infection affecting the eyes exclusively. It attacks the lining of the eyelid (conjunctiva) and the cornea (the transparent front portion of the eyeball). Its known history dates back at least 3,000 years. Starting in Asia, it spread into some areas of all five continents, causing the greatest damage among peoples having low standards of living and hygiene. Because little is known of the nature of the infecting organism except that it is a virus, trachoma remained the most important cause of blindness in underdeveloped countries up to the middle of the 20th century. The outlook for its eventual elimination was changed, however, with the discovery in 1937 that some of the sulfonamide drugs and antibiotics provide effective treatment. Real advances in its control were made after 1951, when the World Health organization of the United Nations set up an expert committee on trachoma. The Aug. 1956 issue of the *Chronicle* of WHO listed country after country in the far east and middle east where the organization had sent project teams or provided consultant services for mass treatment of affected peoples. The results were impressive: check-up examinations of hundreds of thousands of school children showed 75%–80% cured, for example, and it was stated that the affected population in some areas had taken over responsibility for checking on preventive sanitation and hygiene in homes and for some portions of their own treatment. The map (*see* fig. 2) shows areas in which high prevalence of trachoma was noted within the decade 1949 to 1958; it is inaccurate, however, because data were not available for some countries (*e.g.*, the U.S.S.R.) and could not be adjusted properly to show the effect of recent control projects in other places.

Onchocerciasis.—This disease ranks with trachoma in seriousness because of high blindness rates in areas where it is prevalent. It is a general infection transmitted to human beings by the bites of a species of fly found only in certain areas of Mexico, Guatemala and Venezuela and in larger areas stretching across central Africa (*see* fig. 3). When it bites, this fly (*Simulium; see* BLACK FLY) deposits filarial (worm) parasites under the skin; these tend to migrate in the blood stream to the eyes, causing severe destruction to the choroid and retina. For this disease, too, WHO appointed an advisory committee. Under its expert guidance a series of surveys was conducted and a method of attack on the disease was developed, involving "denodulization" (surgical removal of the swollen areas of skin where bites occur), use of special drugs for the patients and elimination of or other protection from the flies. (*See* also FILARIASIS.)

Smallpox.—Smallpox, once an important cause of blindness, has disappeared in areas where vaccination is compulsory, but the *Epidemiological and Vital Statistics Reports* of WHO showed 17 countries reporting more than 1,000 cases of smallpox in 1953 or 1954.

Ophthalmia Neonatorum.—Babies' sore eyes, or ophthalmia neonatorum, acquired from gonorrhea organisms in the birth canal of the mother, was a major cause of blindness in children in the early years of the 20th century. At that time it was responsible for approximately 30% of blindness among children entering schools for the blind in Great Britain and the United States. As the public became informed of the seriousness of this preventable condition, the use of silver nitrate drops in the eyes of infants immediately after birth was introduced, and compulsory immediate reporting of cases of babies' sore eyes was required so that adequate treatment would be assured. By 1955 the number of cases of ophthalmia neonatorum among new pupils entering schools for the blind in the United States represented only 0.1% of the total. Similarly, no new cases of blindness from this cause were reported in England after 1945. In Denmark a report on blindness among pupils in schools for the blind showed no new admissions from this cause after 1934.



BY COURTESY OF NATIONAL SOCISTY FOR THE PREVENTION OF BLINDNESS

FIG. 3.—ONCHOCERCIASIS ENDEMIC AREAS

Syphilis.—Syphilis is another cause of blindness that is decreasing in importance due to improvement in methods of diagnosis and treatment and promotion of their use where health facilities are adequate to enforce the regulations. In the United States, for example, the estimated blindness rate per 100,000 for syphilis dropped 45% between 1940 and 1957. Among approximately 31,000 cases of blindness registered between 1951 and 1954 in England, only 1% was due to syphilis; the percentage for new cases estimated from samples in the United States was 2%.

Others.—Leprosy (*q.v.*), which almost always affects the eyes, is an important cause of blindness in all areas in which the disease is found. Such other infectious diseases as tuberculosis, meningitis, measles, diphtheria and scarlet fever also can cause blindness. Many underdeveloped countries are also plagued by seasonal recurrence in "fly season" of acute eye infections among children. These are often sufficiently severe as to cause blindness in some and to reduce resistance to trachoma in others.

Eye Injuries.—Injuries cause considerable loss of sight, not only in manufacturing but also in mining, logging, forging, farming, in play and in the home. Instruments most likely to injure the eyes are explosives, sharp or pointed objects, flying particles of metal and stone, hot substances, acids and blows or falls affecting the head. When infection follows the injury, the danger of sympathetic inflammation in the uninjured eye is great. Safety measures have been developed to combat these hazards, notably the use of goggles, protective devices on machinery, adequate illumination and restrictions on the use of fireworks and air rifles by children.

Damage to the eyes may be caused by the use of ill-advised family or tribal remedies or by the malpractice of quacks. This type of injury is high among causes of blindness in India and China and is frequently reported from other areas.

Changing industrial processes can involve new eye hazards (*e.g.*, new chemicals and radiations), but in spite of this the percentage of blindness due to injury is no longer high in England and the United States (1% and 3%, respectively).

General Diseases Affecting the Eye.—General diseases of the body often affect the eyes; hence it is important to discover and treat general systemic disease in order to keep the eyes in good health. Among the general diseases that may cause blindness are diabetes, arteriosclerosis, diseases of the central nervous system, nephritis (Bright's disease), anemia and nutritional deficiencies. Because the nerves and blood vessels of the eye are linked with the entire body, a disturbance of the body metabolism caused by diabetes is likely to cause opacity of the crystalline lens within the eye (cataract) or serious retinal disease. Direct causal relationships between other eye conditions and diseases occurring elsewhere in the body can similarly be demonstrated.

Blindness from arteriosclerosis, a vascular disease of elderly persons, is increasing because degenerative changes in the blood vessels of the eyes progress with age and are not likely to be reversed by any known treatment.

Nutritional deficiencies, particularly those of high degree, are not only directly responsible for certain eye diseases such as keratomalacia (in which the cornea, which is the crystal-clear front portion of the eye, becomes soft and cloudy) but also may increase the susceptibility of the person to infections or other diseases of the eye. Nutritional deficiency ranks high among causes of blindness in children in many countries of the east and of South America.

Congenital Blindness.—Blindness of prenatal origin, or congenital blindness, comprises those cases in which the eye defect or a tendency to development of the defect is present at birth. It includes, but is not synonymous with, inherited defects, since other factors may affect the health of the pregnant woman and hence the development of the eyes of her infant. In some cases the cause may be classified, as in maldevelopment due to the presence of syphilis or of German measles in the mother during pregnancy, but often it is not known. The need for basic research into the prenatal factors producing blindness is demonstrated in studies of the causes of blindness among children in Great Britain and the United States, which show that the rate of blindness for this group remains high, whereas blindness from known causes is declining.

Other Causes.—There are other types of eye affection, the cause or causes of which are still unknown, that are responsible for a large percentage of blindness. For example, in the United States, senile cataract (opacity of the crystalline lens within the eye) is responsible for 18% of blindness, glaucoma (hardening of the eye due to high pressure within the eyeball) for 14% and malignant myopia (nearsightedness associated with diseased eye tissues) for 3%. Blindness from eye affections of unknown cause is likewise high in Great Britain. Research to establish the underlying causes is essential to the prevention of these conditions. However, proper medical and surgical treatment can prevent much loss of sight from cataract and glaucoma. To this end it is important that persons be informed of the need for prompt diagnosis and treatment when such symptoms appear as blurring or cloudiness of vision in either eye, seeing a mist or rainbow-coloured halo around distant lights, discomfort or pain about the eyes, blurring of print or eye pain associated with reading.

Problems of Prevention.—The communicable diseases, and to a lesser extent injuries, are rapidly disappearing as causes of blindness in countries where understanding and means of putting preventive measures to effective use are available. Research, however, is needed to determine methods of preventing blindness from causes about which too little is known. These are chiefly the developmental eye defects of infancy, two progressive eye diseases (cataract and glaucoma) in which blindness can be prevented but not the onset of the disease itself, and the chronic systemic diseases (diabetes, arteriosclerosis) causing progressive degenerative changes in the eye that cannot be arrested.

Underdeveloped countries need to attack the problems of elimination of the communicable diseases—trachoma, onchocerciasis, smallpox, leprosy, venereal diseases and tuberculosis. It is essential that services be developed on a scale large enough to eliminate sources of infection. Studies made by WHO have developed patterns for community projects involving case finding, treatment, immunization, sanitation, health education, etc. Most of these countries require the services of experienced foreign workers, at least in the initial stages, and many need substantial financial aid.

AGENCIES TO COMBAT BLINDNESS

In 1958, based on available medical knowledge and on statistics on causes of blindness, it was estimated that more than half the world cases of blindness were preventable. In areas where infectious eye conditions are widespread, the proportion is much larger.

Activities for combating blindness are carried on by various governmental and voluntary organizations. Departments of public health are concerned with control of communicable disease, provision of public health nursing services, maternal and child health facilities and dissemination of information on health. Several state health departments and some state education departments in the United States employ consultants on vision screening for school children and assist in arrangements for eye care. The British ministry of health and certain health departments in the United States are responsible for various aspects of medical eye care, particularly for children. Also, in the United States many state departments of social welfare make provision for medical care of indigents who have serious eye conditions.

The World Health organization stimulates and assists in programs for the control of trachoma in many parts of north Africa and the middle east, under the general supervision of an expert committee on this problem. Also under the supervision of WHO, the problem of onchocerciasis in Central America and in Africa has been attacked. In Bengal, India, a traveling eye dispensary provided by the Association for the Prevention of Blindness, a voluntary agency organized in 1930, takes eye treatment to the most remote villages, where surgery is performed in tents. Likewise, in South Africa the National Council for the Blind has provided traveling teams, including an eye surgeon, to bring the best possible care to rural areas.

Voluntary citizens' groups have played a large part in the dissemination of information, which is essential to the prevention of blindness movement. In 1882 the London Society for Prevention

of Blindness was founded, and similar agencies later developed in other countries, including in the U.S. the National Society for the Prevention of Blindness, organized originally as a New York state committee in 1908. This society has a staff that works, through its state affiliates, with public health authorities, social workers, educators, vocational counselors and safety engineers. Similar activities are carried on by the Canadian National Institute for the Blind, in Brazil by the National Society for the Prevention of Blindness and in other countries by similar organizations. The International Association for the Prevention of Blindness, established in 1929 with headquarters in Paris, stimulates development of preventive services throughout the world.

See EYE, HUMAN: *Surgery of the Eye. See* also references under "Blindness" in the Index volume.

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BLIND SPOT, the place of entry of the optic nerve into the retina, an area insensitive to light, in man having a diameter of about one-twelfth of an inch, lying about 15° from the fixation point on the temporal side. In binocular vision the spot is not noticed, because the part of the visual field covered by the blind spot of one eye is covered by a sensitive area in the other. In monocular vision objects that fall entirely within its area are not seen, but this is unnoticed because the eye is not fixed but unsteady. *See* EYE, HUMAN.

BLIND STAGGERS, often mistaken for a disease entity, is a symptom represented by a staggering gait in which the animal affected seems to be blind. Such a symptom may have many causes, such as poisoning by the ingestion of seleniferous plants (certain plants that have a tendency to accumulate selenium from soils high in that element) or of paspalum grasses infected with the fungus *Claviceps paspali;* magnesium or calcium deficiency; or inflammation of the brain (encephalitis) or brain coverings (meningitis). (NA. BR.)

BLINDWORM: *see* SLOWWORM; LIZARD.

BLINK MICROSCOPE, an auxiliary astronomical instrument. Two photographic plates of the same star-field taken at different epochs are placed in the machine and viewed one with one eye and the other with the other eye, and adjusted as in a stereoscope so that a single visual impression is given. An arrangement is provided by which the plates are alternately, in rapid succession, hidden from sight. Attention is at once called to any star image which has changed in the interval between the two epochs by the corresponding flicker. In this way variable stars and stars with large proper motion are detected.

Proper motions can also be detected without the flicker arrangement, since the displacement of the star image gives a stereoscopic effect, the star appearing to stand out in relief in front of or behind the plane of the other stars. When used in this manner the instrument is called a stereocomparator.

See also BINOCULAR INSTRUMENT.

BLISS, SIR ARTHUR (EDWARD DRUMMOND) (1891–), a distinguished and versatile English composer, also active in public musical life, was born in London, Aug. 2, 1891. He studied under Charles Wood at Cambridge, graduating in 1913, and later under Stanford, Holst and Vaughan Williams in London.

His first successes were three works for chamber ensemble with solo voice or voices, *Madame Noy, Rhapsody* and *Rout* (1918–19). These were followed by the more substantial *Colour Symphony* (1922), the four movements of which are intended to suggest the characteristics of purple, red, blue and green. Thereafter Bliss essayed most of the major musical forms and media—chamber music, choral music, ballet, concerto and opera. The ballets *Checkmate* (1937) and *Miracle in the Gorbals* (1944), the violin concerto, clarinet quintet and two string quartets are among his most admired works. His opera, *The Olympians* (libretto by J. B. Priestley) was produced at Covent Garden (1949) but was coolly received. A television opera, *Tobias and the Angel,* was shown by the BBC in 1960. His piano concerto was commissioned to represent British music at the New York World's fair in 1939. He was musical director of the BBC (1942–44), received a knighthood in 1950 and was appointed master of the queen's music in 1953.

See A. Robertson, "Arthur Bliss," *British Music of Our Time,* ed. by A. L. Bacharach (1946). (Co. MA.)

BLISS, CORNELIUS NEWTON (1833–1911), U.S. textile merchant, manufacturer and politician, was born at Fall River, Mass., on Jan. 26, 1833. He rose from the position of clerk in a prominent Boston commercial house, J. M. Beebe & Company, to that of junior partner. Moving to New York, he later organized the large textile manufacturing firm of Bliss, Fabyan & Company. As an advocate of a protective tariff, he was an organizer of the American Protective Tariff league and, for many years, its president. He was active in Republican party politics, but had no desire to hold office. He twice declined to be his party's candidate for governor of New York and only reluctantly served in President McKinley's cabinet as secretary of the interior, 1897–99. In New York, he was chairman of the Republican state committee in 1887 and later served as Republican national committee treasurer, 1892–1904. He died in New York on Oct. 9, 1911. (C. F. MCI.)

BLISS, NATHANIEL (1700–1764), fourth astronomer royal, was born at Bisley, Gloucestershire, on Nov. 28, 1700. He graduated as B.A. in 1720 and M.A. in 1723 at Pembroke college, Oxford, and succeeded Edmund Halley as Savilian professor of geometry in 1742. A correspondent and sometime assistant of J. Bradley's, he acted for him at the transit of Venus in 1761 and succeeded him as astronomer royal in 1762.

Bliss held that post for only two years, dying at Oxford on Sept. 2, 1764. (O. J. E.)

BLISS, TASKER HOWARD (1853–1930), U.S. army officer, was born at Lewisburg, Pa., on Dec. 31, 1853. He graduated from West Point in 1875, and from 1885 to 1888 was professor of military science at the Naval War college. In 1897 he went to Madrid and was military attaché at the U.S. legation. He served through the Puerto Rican campaign during the Spanish-American War and from 1898 to 1902 was in charge of Cuban customs and collector for the port of Havana. In 1903 he became commandant of the Army War college. From 1903 to 1905 he was a member of the joint army and navy board and also of the general staff. From 1905 to 1909 he held various commands in the Philippines. During the latter half of 1909 he was president of the Army War college, afterward becoming assistant chief of the staff, to which post he returned in 1915 after four years' service in command of military departments. In 1917 he was made chief of staff and promoted to the rank of general, but he retired later in the year, having reached the age limit. He was a member of the Allied conference (1917), of the Supreme War council (1918) and of the American Commission to Negotiate Peace (1918–19). He died in Washington, D.C., Nov. 9, 1930.

BLISTER, a vesicle filled with serous fluid raised on the skin by a burn, by rubbing on a hard surface, as on the hand in rowing, or by other injury; the term also is used to describe a similar condition caused artificially, by the application of mustard, of cantharides and of other vesicatories. Similar swellings, filled with fluid or air, on plants and on the surface of steel or paint are also called blisters.

BLISTER RUST, or white-pine blister rust, the most destructive disease of white (five-needle) pines (*see* PINE) in North America, causes an estimated annual loss of about 650,000,000 board feet of saw timber and more than twice that volume in immature trees in the United States. Despite control efforts costing millions of dollars per year, this disease threatens to eliminate white pine species from many areas of the United States and Canada. Blister rust does occur in other countries of the temper-

ate zone, but in these it is of less economic importance.

The causal organism, *Cronartium ribicola,* is a parasitic fungus requiring two different host plants to complete its life cycle: white pines and members of the genus *Ribes* (currants and gooseberries). On pine the fungus is perennial, growing in the bark where it causes a canker that girdles and eventually kills the affected branch or trunk. In the third or fourth spring following infection, orange blisters about the size of navy beans erupt through the surface of the canker. These blisters contain minute spores (asexual reproductive bodies) that may be carried hundreds of miles by wind to the alternate host (*Ribes* species), where they germinate and infect the leaves, causing tiny, orange, leaf spots characteristic of the "currant-rust" stage. In summer or early fall, spores produced on the undersurface of the leaves of the *Ribes* host are blown back to the pines, where infection occurs through the needles and young twigs, initiating new cankers. This spread from *Ribes* to pine rarely exceeds a few hundred yards, as contrasted with the hundreds of miles that the disease may spread from pine to *Ribes.*

Pines do not become infected unless the temperature remains below 70° F. and the air remains moist throughout the one to two day period necessary for dispersal and infection. Thus the disease on the pine host is restricted to areas with cool, moist weather in summer and early fall.

Blister rust is apparently of Asiatic origin and was introduced into North America on white pine planting stock imported from Europe. From its introduction on the east coast in the late 1800s and on the west coast in 1910, the disease spread rapidly throughout the extensive white pine forests of the northern U.S. and southern Canada. This rapid spread was due largely to the abundance of wild *Ribes* species throughout this region and to the favourably cool, moist climate. Commercial production of white pine species in much of this region is no longer feasible without direct control efforts.

The most important means of controlling blister rust (except in climatic areas extremely favourable to the disease) is through the eradication of all *Ribes* species within and surrounding (to at least 900 ft.) a stand of white pine. Infected ornamental pines can be saved by surgical or chemical treatment. The disease can be avoided by (1) selecting planting sites free from *Ribes* species; (2) concentrating white pine production on sites that are too warm or too dry for serious infection; or (3) by planting resistant varieties of white pines. The U.S. department of agriculture maintains an extensive program of *Ribes* eradication, and state and federal quarantine regulations governing the cultivation and the movement of white pines and of currant or gooseberry plants are strictly enforced.

See N.Y. State College of Forestry, Syracuse University, *Technical Publication 59* (1942); J. S. Boyce, *Forest Pathology,* 2nd ed., pp. 206–225 (1948). (J. R. Pr.)

BLITZKRIEG, literally "lightning war," a term first used in connection with the German attack on Poland in 1939 and later popularized during the rapid German drive between Dinant and Sedan in the Belgian campaign of 1940. Gen. Heinz Guderian first outlined the basis for blitzkrieg tactics in *Achtung Panzer,* published in 1938. Guderian, however, recognized his indebtedness to the British military theorists, B. H. Liddell Hart and J. F. C. Fuller, and derived some of his organizational concepts from Gen. Hans von Seeckt.

Three basic features characterize blitzkrieg as a form of war: surprise, speed and superiority in matériel or firepower. Surprise, as achieved by the Germans in 1940, was calculated to create a condition of psychological shock and resultant disorganization in the enemy forces. The employment of armour in deep, sustained operations, without pause for regrouping, enabled German columns to advance at a speed of over 30 mi. a day during the invasion of France in 1940. Superiority in applied firepower was gained by the rapid concentration of tanks and self-propelled artillery on a narrow front at the point where the enemy position was to be ruptured; it was maintained by the motorization and rapid displacement forward of all weapons.

Originally blitzkrieg was conceived as a tactical formula for applying the speed and firepower of the modern tank arm. The classic blitzkrieg operations of 1940, however, saw a degree of teamwork and tactical co-ordination between assault air forces and mobile ground forces never before achieved in war. Thereafter, the use of fast, low-flying attack aircraft against enemy troops, fortifications and lines of communications was considered a necessary ingredient of blitzkrieg tactics. The tactical formations normally employed in the German blitzkrieg campaigns consisted of a collection of "battle groups" made up of tanks, self-propelled guns, infantry in trucks or armoured carriers and mechanized engineers, the whole supported by motorized supply and bridge trains.

The tactics of blitzkrieg consisted of a splitting thrust by armoured columns on a narrow front, complete disruption of the main enemy battle position at the point of attack, followed by wide-swinging sweeps by the armoured spearheads that created large pockets of entrapped and immobilized enemy forces (the so-called *Keil* and *Kessel*—or "wedge" and "kettle"—technique). Blitzkrieg tactics were improved by Rommel during the desert campaigns in north Africa, particularly in their logistics and in the extension of the radius of operations. It remained for General Patton of the U.S. army to bring blitzkrieg to its most successful form in the European operations of 1944. (H. M. Ce.)

BLOCH, ERNEST (1880–1959), Swiss-U.S. composer, was born at Geneva, July 24, 1880. He studied harmony under Emile Jaques Dalcroze, violin with Eugène Ysaÿe and composition with Iwan Knorr.

The performance of his opera *Macbeth* at the Paris Opéra-Comique (1910) brought Bloch to the attention of the musical world. In 1916 he went to the United States where he became a U.S. citizen (1923), director of the Cleveland (Ohio) Institute of Music (1921–25) and of the conservatory in San Francisco (1925–30), and in 1939 professor of music at the University of California. As a teacher Bloch exerted a vital influence on musical development in the United States.

Of Bloch's early works, *Macbeth* best reveals the gradual emergence of a strong individuality, which flowered fully in the works of the "Jewish Cycle," in which Bloch aimed not to reconstruct Jewish music but to embody the aspirations of the Jewish people. The *Trois poèmes juifs,* the symphony *Israel,* settings of three Psalms (114, 137 and 22) and his rhapsody *Schelòmo* for violoncello and orchestra date from 1913 to 1917. The *Jewish Sacred Service* (1933) brings this phase to a monumental climax.

However, Bloch was not content to remain a purely Jewish composer. The First Violin Sonata (1921) and Quintet (1923) reveal a highly personal style and strong feeling for classic form. Noteworthy are five string quartets, a violin concerto, a piano concerto, three suites for solo violoncello and *Last Poems* for flute and orchestra.

Bloch died in Portland, Ore., July 15, 1959. (Ro. Se.)

BLOCH, FELIX (1905–), U.S. physicist, was joint recipient of the 1952 Nobel prize for physics. He was born in Zürich, Switz., on Oct. 23, 1905. His higher education was obtained at the Eidgenössische Technische Hochschule, Zürich, and at the University of Leipzig, from which he received the degree of doctor of philosophy in 1928. Working with several of Europe's leading theoretical physicists, he became known for his theoretical researches in solid state, magnetism and the stopping of charged particles in matter. In 1934, after accepting a position at Stanford university, Calif., he conceived a method for polarizing neutrons, with which he and L. Alvarez measured the magnetic moment of the neutron in 1939. After working during World War II on atomic energy and radar countermeasures, he returned to Stanford in 1945 and developed the principle of nuclear induction, which he, with W. W. Hansen and M. E. Packard, detected experimentally by observing radio-frequency signals from nuclei precessing in magnetic fields. He shared the Nobel prize with E. M. Purcell of Harvard, who simultaneously and independently discovered the same phenomenon.

After serving for a year in 1954–55 as director of the Conseil Européen de la Recherche Nucléaire in Geneva, Switz., he resumed his professorship at Stanford. Later researches extended nuclear induction to studies of nuclear and molecular structure, and he

generalized his original underlying theories of the effect.

(G. E. Pe.)

BLOCH, JEAN RICHARD (1884–1947), French essayist, novelist, playwright, and journalist active in the cause of socialism, was born in Paris, May 25, 1884. In 1910, while teaching in Poitiers, he started *L'Effort libre*, a "review of revolutionary civilization." His essays, from *Carnaval est mort* (1920) to *Naissance d'une culture* (1936), expressed his faith in a new civilization and a new art which would associate the democratic tradition with a proletarian culture. The tales in *Lévy* (1912) included penetrating studies of Jewish psychology: his Balzacian novel . . . *et Cie* (1918; Eng. trans. . . . *And Co.*, 1930) told how a family of Jewish cloth manufacturers left Alsace in 1870 and created a flourishing business in Normandy. *La Nuit Kurde* (1925; Eng. trans. *A Night in Kurdistan*, 1930) gave his imagination free scope and he paid lyrical homage to the grandeur of the east. His plays included a modern legend, *Le Dernier Empereur* (1926), and a popular fairy play, *Dix Filles dans un pré* (1930). Bloch, one of the "Clarté" group of socialist writers, spent most of World War II in Moscow. He died in Paris, March 15, 1947. (Re. L.)

BLOCH, JOSEPH SAMUEL (1850–1923), rabbi and publicist, was among the first to carry the fight against anti-Semitism into the camp of the anti-Semites. Born in Dukla, Galicia, on Nov. 20, 1850, he received a good rabbinic education and a doctorate from the University of Zürich. He was rabbi in several small communities, going finally to Florisdorf, a workers' suburb of Vienna. When August Rohling, professor at the University of Prague, claimed that he could prove the truth of the blood libel (the charge that Jews use the blood of murdered Christians in some rituals) in connection with a notorious accusation of this sort against the Jews of Tisza-Eszlár (1882), Bloch accused Rohling of ignorance and deceit. Rohling was compelled by public opinion to sue Bloch for libel, but withdrew his suit just before it came to trial. This victory made Bloch into a hero among Jews and liberals. Bloch published the documents he had prepared for the trial and subsequently included them in a volume called *Israel und die Völker* (1922), translated into English as *Israel and the Nations* (1927). From 1884 to 1921 he published a weekly, *Österreichische Wochenschrift*, financed by a Christian, in which anti-Semitism was fought with single-mindedness and courage. Bloch carried on the same fight on a nationwide platform in the Austrian parliament, of which he was a member, 1883–85 and 1891–95. Two volumes of his uncompleted memoirs appeared in 1922 under the title *Erinnerungen aus meinem Leben*, translated (1923) as *My Reminiscences*. He died in Vienna, on Oct. 1, 1923. (Sn. Gl.)

BLOCH, KONRAD (1912–), U.S. biochemist who shared the 1964 Nobel Prize in medicine and physiology with Feodor Lynen (*q.v.*) for elucidating the biosynthesis of cholesterol and of fatty acids, was born at Neisse, Ger., on Jan. 21, 1912. He received his bachelor's degree, in chemical engineering, from the Technische Hochschule in Munich in 1934. Shortly thereafter he went to Switzerland and then to the United States, becoming a U.S. citizen in 1944. Bloch obtained his doctorate in 1938 from Columbia University, where he subsequently was a research associate of Rudolf Schoenheimer in the isotopic analysis of cell metabolism. He taught at the University of Chicago from 1946 until 1954, when he became professor of biochemistry at Harvard.

Cholesterol (*q.v.*) is a solid alcohol found in all animal cells. Bloch and co-workers showed that its biosynthesis (which is in part similar to that of the fatty acids) has 36 steps, with the hydrocarbon squalene as a key intermediate. Discovery of the pathway was important to medicine, since the cholesterol level in the blood may be related, in ways not fully understood, to atherosclerosis, a common vascular disease; to physiology, since cholesterol is the parent substance of the various steroid hormones found in the sex organs and the adrenal glands; and to the chemistry of the industrially important terpenes (*q.v.*), rubber, and other isoprene derivatives, since a cholesterol intermediate, isopentenyl pyrophosphate, is closely related to isoprene.

BLOCKADE has been defined as "an act of war carried out by the warships of a belligerent, detailed to prevent access to or departure from a defined part of the enemy's coast." It differs from a pacific blockade inasmuch as the latter is not strictly an operation of war and cannot rightly be enforced against neutrals. The former may be either military or commercial. A military blockade is one undertaken to attain some specific military objective; *e.g.*, the capture of a naval port. A commercial blockade has no immediate military objective but is designed to cause the enemy to surrender or come to terms by cutting off all commercial intercourse by sea. A belligerent may, if it can, blockade the whole of the enemy's seaboard, but the mere proclamation of a blockade of the whole or any part of the enemy's coast, without anything more, is of no legal effect. Such proclamations were formerly common and were known as paper blockades. A belligerent may not blockade neutral territory unless it is in the actual control or occupation of the enemy, nor may it blockade enemy territory in such a way as to prevent access to neutral territory.

The common law of blockade rests mainly upon the principles laid down by the Anglo-U.S. prize courts, the more important of which are summarized in the judgments of Stephen Lushington and of the privy council in *The Fransiska*, Spinks 111; 10 Moo. P.C. 37. In order, therefore, to render a blockade valid under the common law and to impose penalties upon neutral vessels for breach of it, the following facts must be proved.

(1) A blockade must be duly established; *i.e.*, it must be instituted under the authority of the belligerent government. Usually the officer in command of the naval force institutes the blockade under express instructions, but if he does so without them—an unlikely occurrence in modern times—his action must be ratified by his government. In either case, although in the British view an official notification is not necessary, neutral powers are notified in practice through diplomatic channels and the blockade is officially proclaimed. The officer in command must also notify the local authorities and the foreign consuls. (2) It must be effective. Paper blockades were declared illegal by the Declarations of the Armed Neutralities of 1780 and 1800, and it was to suppress their subsequent continuance that art. 4 of the Declaration of Paris (1856; *see* Paris, Declaration of) provided that "blockades in order to be binding must be effective"; *i.e.*, maintained by a force sufficient really to prevent access to the coasts of the enemy. The continental view demanded a stricter standard of sufficiency than the Anglo-U.S. The latter, however, ultimately prevailed. (3) It must be continuously maintained and impartially enforced against all vessels alike. If interrupted—except when temporarily interrupted by adverse weather—it must be duly re-established. Certain classes of vessels are exempt from the latter part of this rule, viz., neutral warships and neutral vessels carrying distressed seamen of their own nationality sent home by the resident minister of the neutral state, and neutral vessels compelled by stress of weather, need of provisions or repairs to put into the blockaded port.

Under the Anglo-U.S. practice vessels which have received a special licence from the government of the blockading state or the commander of the blockading force are also exempt. (4) There must be some violation either by egress or ingress by the vessel. At the London Naval conference of 1909 it was generally agreed that there must be some notice, either actual or presumptive. In respect of egress the fact of blockade is sufficient. In respect of ingress, if the blockade has been officially notified notice will be presumed, if there has been sufficient time for the vessel to receive it, since it is the duty of the neutral government to communicate such notice to its subjects. If the blockade is *de facto*, express notice must be given to the vessel by the blockading force and endorsed on the ship's papers. (5) There must be actual or constructive knowledge of the blockade by those responsible for the conduct of the vessel.

A blockade terminates (1) if it is expressly raised by the blockading government or by the officer in command of the blockading force; (2) if it ceases to be effectively maintained; (3) if the blockaded place is actually occupied by the blockading state.

The penalty for breach of blockade was the loss of the ship in any event, and of the cargo if at the time of shipment the blockade was known or might have been known by the shipper: *The*

Panaghia Rhomba, 12 Moo. P.C. 168; Scott, 951 (1858).

At the London Naval conference, 1908, an attempt was made to codify the law of maritime warfare. The provisions in the Declaration of London, 1909, relating to blockade are substantially merely declaratory of the common law. Two important amendments, however, were made. By art. 17 neutral vessels may only be captured for breach of blockade "within the area of the warships assigned to render the blockade effective." Under the customary law they are liable to capture during any part of the outward or return voyage. By art. 19 the doctrine of continuous voyage was declared inapplicable to blockade. Although the declaration had not been ratified by any state, it was, subject to some additions and modifications, adopted by all the belligerents at the commencement of World War I. On Feb. 4, 1915, Germany declared its submarine blockade against Great Britain, and on March 1, the British government announced that it was the intention of the Allied governments as a retaliatory measure "to seize all ships carrying goods of presumed enemy destination, ownership or origin." Although in effect blockades, neither of these measures was legally a blockade, since they did not conform to the provisions of the law of blockade. By the withdrawal of the declaration and subsequent orders by the Maritime Rights Order in Council, July 17, 1916, and by reliance upon the law of contraband (*q.v.*), the situation was regularized for the Allied governments. (H. H. L. B.)

IN NAVAL SCIENCE

A nation fighting for its existence and depending for success on its maritime superiority cannot afford to see one of the main objects for which its naval strength was developed largely discounted by neutrals who, ostensibly taking no part in the struggle, supply its enemy with the sinews of war. The ultimate aim of a sea power is to protect its own sea communications while denying oversea supplies to the enemy. The right of a belligerent to stop contraband of war from going to its enemy has always been admitted, but it is not unnatural that the weaker maritime powers and neutrals should prefer that goods carried in neutral ships should be secure from capture, that is the principle that "the flag covers the goods" or "free ships, free goods." During the hundred years that followed Napoleon's downfall Great Britain was almost invariably a neutral and its own commercial interests found profit in this latter view. Its statesmen, who might have had longer vision, sacrificed this vital belligerent right by signing the Declaration of Paris in 1856. "I believe," said Lord Salisbury speaking in the house of lords on March 6, 1871, "that since the Declaration of Paris, the fleet, valuable as it is for preventing an invasion of these shores, is almost valueless for any other purpose."

A further check on the use of Britain's sea power for preventing supplies from going to the enemy was the Declaration of London (1909). Of the two descriptions of articles enumerated in this instrument, the absolute contraband list was small, being confined to articles of exclusive military value such as guns, explosives, etc. These were liable to capture when destined to the enemy in neutral ships either directly or through neutral territory and in this case the doctrine of continuous voyage was recognized.

The conditional contraband list was composed of articles necessary to the civil population as well as to the military forces, such as food, fuel and clothing. Such articles were liable to capture only if shown to be destined for the armed forces or to a government department of the enemy state, and if they went directly to an enemy port. They could not be touched if discharged in a neutral port for transmission by rail or inland waterway. The evidence required by the declaration to prove the innocence of a cargo could be evaded so simply as to render this class of goods practically immune from capture, and in this case even the doctrine of continuous voyage (*q.v.*) was disallowed.

BLOCKADE IN WORLD WARS I AND II

World War I.—In World War I Britain sought to justify its interference with trade between neutrals, when such trade might have an enemy destination, on the ground of changed conditions of warfare. Sir Edward Grey's note to Secretary Robert Lansing of July 23, 1915, explained that Germany's "territories are covered by a network of railways and waterways, which enable her commerce to pass as conveniently through ports in . . . [adjacent] neutral countries as through her own." The tactical disadvantage thus faced by a belligerent was not a novel geographical situation, historically speaking. In the Napoleonic wars water transportation by river and canal through the ports of the Baltic was as substantially effective in supplying France as was the "network of railways and waterways" supplying Germany in World War I. Nevertheless, the modes of application of naval blockades and the effectiveness of blockading naval operations had been greatly changed by conditions of warfare in both World Wars I and II. The extended range of shore batteries, the use of torpedo-boats and similar craft, the action of submarines and mines, and the employment of aircraft for bombing and machine-gunning surface craft had made any close blockade or any blockade by stationary vessels impossible. The blockading squadron was accordingly now constrained to operate at some distance from the enemy coast. On the other hand, the efficiency of the blockading forces was increased by the ability of the modern naval vessel to be independent of the weather, to communicate by wireless with other vessels of the squadron and with the command, to operate at high speed, to utilize radar, naval aircraft and submarines for scouting purposes, and to employ radar and searchlights for night operations.

Blockades may be breached by aircraft and submarines as well as by surface vessels. The *Report* of The Hague jurists of 1923 stated that "where a blockade has been established and an aircraft attempts to pass through into the blockaded area within the limits of the blockade, it should be liable to capture." The goods carried in any aircraft so captured, and the aircraft itself, would be subject to condemnation. This power of capture and condemnation was nevertheless subject to the rule, as the Naval War college pointed out in 1935, that "a blockade maintained by surface vessels only without means of preventing or rendering dangerous the passage of aircraft or submarine would be 'a paper blockade' in so far as such craft were concerned even though proclaimed to include these." The fact that a blockade might be ineffective as against aircraft or submarines, and therefore illegal for such purpose, would not preclude the legality of a blockade effectively maintained by surface craft against surface craft.

Retaliation.—Shortly after the outbreak of World War I belligerents began to resort to the practice of mine-laying on the high seas with a view to cutting off access by ships to enemy coasts. On Nov. 3, 1914, Great Britain declared "that the whole of the North Sea must be considered military area" within which "merchant shipping . . . will be exposed to the gravest dangers from mines." On Feb. 4, 1915, Germany countered by declaring the entire English channel and the waters surrounding Great Britain and Ireland to be "an area of war" within which it would "endeavour to destroy every merchant vessel that is found." This action was sought to be justified as an act of retaliation, "just as England has designated the area between Scotland and Norway an area of war." Retaliation was likewise relied on as the basis for the British Order in Council of March 11, 1915, whereby neutral ships carrying goods of presumed enemy destination, ownership or origin were to be taken into port, the goods there to be discharged and detained for the duration of the war. On Jan. 31, 1917, Germany and Austria-Hungary announced a policy of unrestricted submarine warfare in certain zones, which Germany again sought to justify as a means of meeting "the illegal measures of her enemies." Great Britain retaliated by an Order in Council of Feb. 16, 1917, which declared that any vessel found at sea on its way to or from a port in any neutral country affording a means of access to enemy territory, without having first called at a British or Allied port, should be presumed to be carrying goods with an enemy destination or of enemy origin until the contrary was established.

The British measures lacked the essential characteristics of a blockade and the Orders in Council carefully avoided the use of this term. Rather they appeared to be the assertion of an enlarged right of capture, not limited to contraband, but dependent on the

test of enemy origin or destination. Belligerents did not seek to uphold the legality of their practice independently of retaliation. Neutrals uniformly protested the application of such measures to their shipping and to the goods of their nationals and refused to admit their legality but were unable to thwart the imposition of such measures. The intervention by the United States in World War I and its resort to stringent measures of economic warfare, instead of reliance on its traditional attitude of "neutrality" (*q.v.*), prior to World War II, tending to establish in practice a blockade of the axis powers, strengthened this tendency to obliterate the traditional limitations on the exercise of the right of blockade.

Blockade through Exercise of Sovereign Rights.—In World War I Great Britain found that its strategic control of shipping facilities, including bunker supplies and ships' stores, furnished a powerful means of subjecting neutral shipowners and traders to conformance with the basic British policy that "no vessels owned, chartered or controlled by them (*i.e.*, neutrals) should carry any cargoes proceeding from, or destined to, an enemy country." These shipping facilities could be granted or withheld in the exercise of sovereign discretion, or they could be granted subject to compliance with desired conditions. Examples of this technique of blockade will be found in the succeeding paragraphs.

Bunker Control.—Nearly all the bunker depots in the world, except the U.S., were in Allied territory or were dependent on supplies from such territory in World War I. This fact was made the basis for an effective system of licensing supplies of fuels to neutral vessels in Allied ports. Among other things, such supply was made subject to the condition that the vessel should not trade with any port in an enemy country or carry cargo to black-listed persons. A black list of vessels to be refused bunkers at British ports was established as was also a white list of ships which were to receive bunkers freely, their owners having agreed to observe the various conditions stipulated by the British.

Embargoes.—Embargoes on the export of specified commodities were announced by Germany and France on July 31, 1914, and by Great Britain on Aug. 3, 1914. The practice rapidly expanded both as to commodities affected and territories prohibited. The belligerents evidenced a willingness to relax the embargoes as to specific strategic commodities desired by neutrals, by Germany with respect to such commodities as chemicals, dyestuffs and medicines, and by Great Britain with respect to such commodities as rubber, jute, chrome, manganese and tungsten ore, upon guarantees by such neutrals that they would not re-export such commodities to the opposing belligerent. A co-operative system of enforcement was accordingly established by agreements with the neutral importer. Private organizations such as the Netherlands Overseas Trust and the merchants' guild of Copenhagen assisted the Allied Powers in carrying out their plans.

Black Lists and the Financial Blockade.—In the exercise of its sovereign power over British subjects, Great Britain prohibited all transactions by them with neutral merchants "known or suspected to be furnishing supplies to the Central Powers." Various firms in neutral countries, including the United States, were so black-listed. The consequences of such a loss of trade constrained many neutral firms to a policy of co-operation with the Allied Powers and further cut off Germany from access to neutral sources of supply and trade. A so-called financial blockade accompanied this practice under which British subjects were prohibited from having financial as well as commercial relations with black-listed persons.

Rationing.—Since neutral coasts were not subject to blockade, neutrals facing the sea and also having land boundaries adjacent to belligerent territory could be made a source of supply for such belligerents in avoidance of a blockade. A system of rationing such neutrals was accordingly worked out by the British war cabinet in World War I whereby "rationing schedules showing the normal requirements of all the European neutrals in respect of all the more important commodities which they obtain from overseas" were implemented by agreements with neutral shipowners and traders containing rationing clauses under which the British government could automatically terminate many of the excessive shipments. The rationing system sought to limit neutral imports only to such stocks as would be needed for home consumption.

World War II.—The most important instance of a formal blockade in World War II occurred with the Soviet Union's announcement of a blockade of the Finnish coast and adjoining islands in Dec. 1939. Finland questioned the Soviet Union's right as a belligerent to establish the blockade since Russia had previously denied the existence of a state of war with Finland. The effectiveness of the blockade was also questioned. The issues thus raised were not, however, resolved before the war ended.

In April 1940, Germany announced its intention to destroy all neutral ships sailing to British ports and in Aug. 1940 proclaimed a total blockade of the British Isles and the establishment of a zone of military operations off the North Atlantic coast within which every ship would be sunk. Submarine and air warfare were used to carry out these policies. A British Order in Council of Nov. 27, 1939, assertedly based on the right of retaliation, required that all goods laden in an enemy port, as well as all goods of enemy origin or ownership, be discharged in a British or Allied port and placed in the custody of the marshal of the prize court. Such goods were to be detained or sold or requisitioned by the crown. These retaliatory measures were thereafter extended to Italy and Japan and also made applicable to civil aircraft.

An Order in Council of July 31, 1940, substituted condemnation in place of detention for goods of enemy origin or ownership, including condemnation of the ships carrying such goods as well as the goods themselves. The order was primarily important for "regulating a system of passes for approved cargoes and ships." The order changed the rules for establishing the existence of enemy ownership, origin or destination by creating a rebuttable presumption of such status where the ship or goods were not covered by the appropriate "navicert," which the shipowner or trader could obtain by voluntary application. "Ships' warrants" could also be obtained applicable to whole shipping lines and companies which were willing to enter into agreements to utilize the system of "navicerts." In the absence of a "ship's warrant" every ship of the company in question was denied access to British shipping facilities. Breach of any agreement pursuant to which a warrant was granted subjected the vessel to liability to seizure and the company to exclusion from trading at any British port. "Ships' warrants" and "navicerts" were also withheld from vessels and goods insured with enemy companies as a means of injuring the enemies' finances.

With regard to the voluntary subjection by neutrals to such measures of control, the German prize courts ruled in the *Ole Wegger* that: "A ship which is subjected to such control thereby directly furthers and facilitates the military and economic war effort of the enemy government, and, save in exceptional circumstances in individual cases, is therefore guilty of hostile assistance."

Though the United States objected to the order of Nov. 27, 1939, and reserved its rights in the premises, it soon adopted measures of supporting the British government (*see* NEUTRALITY) and ceased to object to the British blockade measures. It will be observed, however, that World War II further demonstrated the relative unimportance of the traditional form of blockade and again led to the attempt of belligerents to apply the doctrine of continuous voyage to blockade and to utilize their sovereign powers as a means of compelling neutral compliance with policies which, if carried out by naval power exclusively, would constitute a violation of international law.

See ECONOMIC WARFARE; *see* also Index references under "Blockade" in the Index volume.

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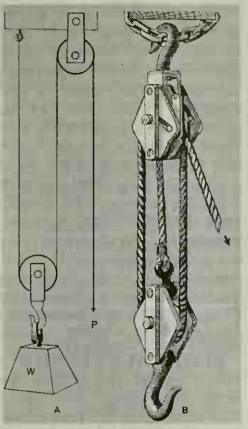
BLOCK AND TACKLE, a most useful and extensively applied mechanical device. The principle is represented by A in the diagram, showing the load W suspended by two "parts" or "falls" of rope so that a weight of 1 lb. applied at P will pull a load of 2 lb. at W; this assumes friction to be absent and the rope perfectly flexible. By increasing the number of pulleys and falls of rope, in the manner shown by B the mechanical advantage is increased according to:

$$W = nP$$

n being the number of parts of rope that support the movable block. If, for instance, there are three pulleys in the top block and two in the moving block, then the weight is supported by five parts of rope; therefore, a force of 120 lb. will hoist a load of 600 lb.



PRINCIPLE OF BLOCK AND TACKLE

(A) Two falls of rope used to increase mechanical advantage; (B) block and tackle with brake (*see* text)

Block and tackle arrangements are used for lifting loads, rigging, tightening guys and hauling. The objection that the load is not held, as it is in the differential pulley blocks and worm-geared types, may be obviated by fitting a friction brake. The top block in B is of this self-sustaining form, the act of moving the hand rope outward or to one side applying the brake.

BLOEMAERT, ABRAHAM (1564–1651), Dutch painter and engraver, born at Gorinchem, the son of an architect, was first a pupil of Gerrit Splinter (pupil of Frans Floris) and of Joos de Beer, at Utrecht. He then spent three years in Paris studying, and on his return to his native country received further training from Hieronymus Francken. He settled finally at Utrecht, where he became dean of the Guild of St. Luke. He painted and etched historical and allegorical pictures, landscapes, still life, animal pictures and flower pieces.

Among Bloemaert's pupils were his four sons, Hendrick, Frederick, Cornelius and Adriaan (all of whom achieved considerable reputation as painters or engravers), the two Honthorsts and Jacob Cuyp.

BLOEMEN, JAN FRANS VAN (1662–*c.* 1748), Flemish painter, born at Antwerp, studied and lived in Italy. At Rome he was styled Orizzonte because of his painting of horizons in his landscapes, which are reminiscent of Gaspard Dughet. His brothers Pieter (1657–1719), styled Standaert (from his military pictures), and Norbert (1670–1746) were also painters.

BLOEMFONTEIN, the capital city of the Orange Free State and judicial capital of the Republic of South Africa, lies 4,568 ft. above sea level on the Free State plateau and is the geographical hub of South Africa's rail, road and air transport systems and a focal point of distribution. Pop. (1960) 140,924, of whom 61,213 were Europeans. It has clear air and a dry, invigorating climate. Spread over hills and *kopjes* (hillocks), its natural and man-made beauties justify its name which means "fountain of flowers."

Founded in 1846 by Maj. Douglas Warden as a fort and residency, it became the capital of the Orange Free State republic. Its open spaces include the Franklin Game reserve, within the city; King's park and zoo; a modern sports stadium; Prince's Rose garden; and the Mazelspoort, the republic's premier inland holiday resort. Buildings include the City hall; the Court of Appeal, with its fine stinkwood paneled courtroom; the Raadsaal, the former Free State parliament house, now seat of the provincial council; the Old Raadsaal, a one-roomed house, now a national monument; the Presidency, former house of the republic's president; the residence of the former governors general, in old Cape Dutch style; and a modern civic theatre and art gallery. The National Women's monument, sculptured by Anton van Wouw, is a memorial to the women and children who died during the South African War. Many national conferences are held annually in the City hall; the Central Agricultural society's annual show draws visitors from all parts of the republic. Bloemfontein has an Anglican cathedral and a Moeder Kerk (oldest Dutch Reformed church) among other churches. There are extensive new housing, modern railway workshops and industrial sites, with ample power and water supplies.

It is the seat of the University of the Orange Free State (founded in 1855 as a constituent college of the University of South Africa), and there are also technical, industrial and agricultural schools. The public library receives copies of all national publications and there is a unique Central Drama library. The National museum contains important collections of skulls, including *Africanthropus Helmei Dreyer*, discovered 30 mi. N. of the city. The archaeological collection includes items representing all the Stone Age cultures of South Africa. There are also two important observatories, the American Lamont-Hussey (University of Michigan) on Naval hill and the Boyden station (partly maintained by Harvard university) at Mazelspoort.

Bloemfontein is within 24 hours by rail of any point in the republic: Johannesburg is 263 mi. distant, Durban 505 mi. and Cape Town 749 mi. A direct road links the city with the Free State gold fields. The J. B. M. Hertzog national airport, 3 mi. E. of the city, has one of the most modern terminal buildings in the republic. (P. R. Jo.)

BLOIS, capital of the *département* of Loir-et-Cher, central France, is 56 km. (35 mi.) S.W. of Orléans by road. Pop. (1954) 24,352. First mentioned by Gregory of Tours in the 6th century, Blois, was, in the earlier middle ages, the home of a powerful line of counts from whom the Capetian kings sprang (*see* BLOIS, COUNTSHIP OF; CAPET). At the end of the 14th century Blois was acquired by Louis, duc d'Orléans. It was from Blois that in 1429 Joan of Arc set out to raise the siege of Orléans. In 1498 the son of Duke Charles and grandson of Duke Louis succeeded to the throne of France as Louis XII and from then until the end of the 16th century Blois was almost a second capital of France. At the beginning of the 17th century the teachers of the French language at Blois were famous, among them was Claude Manger who had a kind of French university in London known as "Little Blois." Blois was occupied by the Germans for a short time in 1870–71 during the Franco-German War, and again in World War II from June 1940 to Sept. 1944.

Known from its association with the French royal house as the "city of kings," Blois is the centre of the Loire château country. The city lies on the slopes of hills on the right bank of the Loire and is dominated by the château and the cathedral. The oldest part of the château, the main hall, was built in the 13th century, and there the states-general met in 1576 and 1588. The northwest wing, erected by Francis I, contains the room where Henry, duke of Guise, was murdered by order of King Henry III on Dec. 23, 1588. This wing is also famous for its staircase tower with its graceful sculpture. The northeast wing, which is the entrance to the château and contains a museum, was built by Louis XII and is connected with a gallery and chapel on the southeast side of the great courtyard. On the southwest side is the wing erected by Gaston d'Orléans in 1635–38.

The Gothic cathedral was largely rebuilt at the end of the 17th century on the site of an ancient Carolingian church; it has a 10th–11th century crypt. The church of the 10th-century abbey of St. Lomer, founded by monks fleeing before the Normans, was refashioned in the 12th–13th centuries and rededicated to St. Nicolas after the French Revolution. The convent buildings (17th century) are now a hospital. Of the ancient houses in Blois the Renaissance Hôtel d'Alluye is a good example. The picturesque streets include the Rue du Chant des Oiseaux, the Rue du Lion Ferré, and the Rue Pierre de Blois, whose steep and twisting surface is paved with rose-coloured bricks. The terraces of both the château and the 18th-century episcopal palace (now the town hall), adjoining the cathedral, give views over the city and the wide Loire valley. Near the château is the pavilion where Anne of Brittany, the first wife of Louis XII, had her oratory. An 18th-

century bridge (built, as was the episcopal palace, by J. J. Gabriel) connects Blois with its suburb of Vienne, on the left bank of the Loire, where are the church of St. Saturnin (15th–16th centuries) and the *camposanto,* whose elegant 16th-century galleries now house some old stones and sculptures, relics from buildings destroyed in World War II. There is the ancient portal of the house where Cassandre, a heroine of the poet Pierre de Ronsard, was born. Though the beauty of Blois is chiefly due to its Renaissance buildings, there are some fine modern ones, among which is the basilica of the Franciscans, completed in 1949, with a carillon of 48 bells, carvings of the Stations of the Cross by Jean Lambert-Rucki and stained-glass windows by Louis Barillet.

Blois is on the main line from Paris to Bordeaux and Spain. There is an airport at Breuil, 14 km. (9 mi.) N.W. The town is a market centre for the corn-producing region of Beauce on the north of the Loire and for the Sologne to the south, where asparagus, wines, fruits and flowers are grown. Chocolate, sweetmeats, boots and shoes, clothing, furniture, caravans, toys, tapestry, saws, machine tools, cardboard and carbon paper, etc., are made, and printing is carried on. (J. M.-D.)

BLOIS, COUNTSHIP OF, a feudal title that rose to great importance in medieval France as its holders came to possess not only Blois (*q.v.*) itself and its immediate vicinity, the Blésois, but also other domains. The first recorded counts of Blois, William (d. 834) and his son or nephew Eudes (d. 865 or earlier), seem to have been only governors, individually appointed rather than hereditary. The next count, however, was Robert (*q.v.*) the Strong, duke of the whole region between the Seine and the Loire and ancestor of the royal house of Capet. He and his early successors appointed viscounts in Blois, but about 940 the title of count was assumed by Thibaut I the Old or the Cheat (d. about 975 or 977). This Thibaut, founder of the hereditary house, held moreover, not only a large part of Sologne around Romorantin to the south, but also the countship of Châteaudun and its vicinity (Dunois) to the north, and beyond that, the countship of Chartres, while to the west he was count of Tours (*see* TOURAINE), so that his domain stretched from the Indre to the Eure rivers.

From 987, when the accession of the Capetians to the French crown was finally established, the counts of Blois were the king's immediate vassals, and Thibaut I's successors Eudes I (d. 995), Thibaut II (d. 1004) and Eudes II (d. 1037) were the new royal dynasty's most dangerous rivals. Eudes I obliged Hugh Capet to grant him the countship of Dreux, north of Chartres, in return for help against Charles of Lorraine. Eudes II, though he lost much of Touraine to the Angevins (*see* ANJOU) in 1016 and had to restore Dreux to Robert II of France in 1017, began the rise of the house of Blois to even greater power by the acquisition of the countships of Sancerre in 1015 and of Champagne (*q.v.*), as Eudes I, in 1019 or 1020 (or perhaps *c.* 1023). The latter acquisition meant that the royal domain was threatened both west and east by the Blois-Champagne power. Thibaut III of Blois (d. 1089) did not at once succeed Eudes in Champagne and lost Tours itself to the Angevins in 1044, but in 1063 became himself count of Champagne (as Thibaut I). His death was followed by another partition, Blois, Chartres, etc., with Meaux in Champagne, passing to his son Stephen (Estienne) Henry (d. 1102), while Troyes and the rest of Champagne went to another son. Stephen Henry's sons were Thibaut IV (d. 1152), Henry, who became bishop of Winchester in England, and Stephen (*q.v.*), the future king of England. Thibaut IV, who reunited Champagne (as Thibaut II) with Blois in 1125, was considered the second person in France, being alternately the ally and the enemy of Louis VI and Louis VII. The countship was then at the zenith of its power. Fortunately for the Capetians, Blois and Champagne were finally divided between Thibaut IV's sons in 1152. Thibaut V (d. 1191), who inherited Blois, Chartres, etc., sided generally with Louis VII (his brother-in-law and father-in-law), became grand seneschal of France and fought against the Angevin king of England, Henry II. Under Louis I (d. 1205) and Thibaut VI (d. 1218) the countship began to decline. When Thibaut VI died childless, Chartres and Romorantin passed to his aunt Isabelle, while her elder sister Marguerite and her husband Gautier d'Avesnes retained Blois and Châteaudun.

Marguerite's daughter Marie was married in 1225 to Hugues I de Châtillon, count of St. Pol, and this brought the countship of Blois to the house of Châtillon in 1230. Their son Jean de Châtillon (d. 1279) recovered Chartres by marrying the heiress, but his daughter Jeanne (d. 1291), after the death of her husband, Pierre de France, count of Alençon, in 1283, sold Blois to her cousin Hugues II de Châtillon and Chartres to Philip IV of France (1286). A century later Guy II, the sixth successor of Hugues, sold Blois to Louis de France, duc d'Orléans. The latter's grandson became king of France as Louis XII (1498).

Gaston de France, duc d'Orléans, held Blois as an appanage from 1626 to 1660. Subsequently Louis XIV gave it to his brother Philippe, duc d'Orléans, with whose descendants it remained until the French Revolution.

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BLOK, ALEKSANDR ALEKSANDROVICH (1880–1921), one of the greatest Russian poets of all times. Born in St. Petersburg, Nov. 28 (new style; 16, old style), 1880, Blok studied at St. Petersburg university. One of the younger Russian Symbolists, he was influenced by the mystic writings of the philosopher Vladimir Soloviev (*q.v.*), but worked in the Russian romantic tradition of Vasili Zhukovski, Mikhail Lermontov and Afanasi Fet (*qq.v.*). The three volumes of his collected works of 1911–12—*Stikhi o Prekrasnoi Dame* ("Verses About the Fair Lady"), *Nechayannaya radost* ("Unexpected Joy") and *Snezknaya noch* ("Snowy Night")—reflect the stages of his poetic development—mystic idealism, romantic irony and disenchantment, and finally grim awareness of the surrounding "terrible world." In his later poetry the image of Russia became important. Closely related to the poems are his lyrical dramas (1906–08), *Balaganchik* (Eng. trans. "The Puppet Show," *Slavonic and East European Review,* vol. xxviii, no. 71, 1950), *Neznakomka* (Eng. trans. "The Stranger," *Slavonic and East European Review,* vol. xxvii, no. 68, 1948), *Korol na ploshchadi* (Eng. trans. "The King in the Square," *Slavonic Review,* vol. xii, no. 36, 1934) and *Pesnya sudby* (Eng. trans. "The Song of Fate," *Poet Lore,* vol. xliv, no. 1, 1938). Another play, *Roza i krest* (1913; Eng. trans. "The Rose and the Cross," *Slavonic and East European Review,* vol. xiv, no. 42, 1936), set in medieval France, is also concerned with Blok's major poetic themes. The remarkable unfinished narrative poem *Vozmezdie* ("Retribution"), begun in 1910, has for its themes Russia and the doom of Blok's own generation. Blok responded to the Revolution of 1917 with the poem *Dvenadtsat* (1918; Eng. trans. *The Twelve,* 1920). A description of a group of Red army soldiers marching through Petrograd by night during the winter of the Revolution, this strange balladlike poem, extraordinary in its rhythmic polyphony though ambiguous in its message, has a harsh, disturbing power. It was Blok's last major work. He wrote almost no poetry after 1918 but in Feb. 1921 delivered a striking speech on the mission of the poet at a meeting in commemoration of Pushkin.

Blok died in Petrograd, Aug. 7, 1921, from the aftereffects of malnutrition, apparently deeply disillusioned by the Revolution he had welcomed as a spiritual renaissance.

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BLOMFIELD, CHARLES JAMES (1786–1857), bishop of London and a Greek scholar of great repute, was born on May 29, 1786, at Bury St. Edmunds. After a brilliant career, which included the editing of Aeschylus' *Prometheus Vinctus* (1810) and Euripides (1821), at Trinity college, Cambridge, he held a succession of benefices and became bishop of Chester in 1824, retaining the rich benefice of St. Botolph, Bishopsgate, *in com-*

mendam. In 1828 he was translated to the see of London, where he threw himself into the task of church building with such vigour that about 200 new churches were consecrated there during his episcopate. He co-operated with the government in carrying through far-reaching schemes of church reform, through the newly formed ecclesiastical commission. He keenly supported the plan for an Anglican bishopric in Jerusalem and the colonial bishoprics fund. He raised the standards of his clergy and helped to smooth over the early tractarian disputes. In 1856 he resigned because of ill-health and died at Fulham on Aug. 5, 1857.

See his memoirs ed. by Alfred Blomfield (1863). (N. S.)

BLONDEL, DAVID (1590–1655), French Protestant theologian of considerable critical faculty, was born at Châlons-sur-Marne on Sept. 25, 1590. He studied at Geneva and later became a pastor at Houdan. In 1619 appeared his *Modeste déclaration de la sincerité et verité des Églises réformées*, a reply to Catholic attacks on Protestant doctrines. He published various other works, including *Pseudo-Isidorus et Turrianus Vapulans* (1628), in which he discredited the so-called "False Decretals," and *Éclaircissement familier de la question: Si une femme a été assise au siège papal de Rome . . .* (1646), which successfully refuted the myth of Pope Joan, to the indignation of some fellow Protestant polemicists who regretted this disposal of a useful piece of scandal. In 1650 Blondel became professor of history at Amsterdam, where he died on April 6, 1655.

BLONDEL, JACQUES FRANÇOIS (1705–1774), French architect, began life as an architectural engraver. He was among the earliest founders of schools of architecture in France, but he is now best remembered by his voluminous work *L'Architecture française*, a collection of views of famous buildings.

BLONDIN, CHARLES (real name JEAN FRANÇOIS GRAVELET) (1824–1897), French tightrope walker and acrobat, was born at St. Omer, France, on Feb. 28, 1824, and died in London on Feb. 19, 1897. When five years old he was sent to the École de Gymnase, at Lyons, and after six months' training as an acrobat, made his first public appearance as "the Little Wonder." He especially owed his celebrity and fortune to his idea of crossing Niagara falls on a tightrope, 1,100 ft. long, 160 ft. above the water. This he accomplished a number of times, first in 1859, always with different theatric variations: blindfolded, in a sack, trundling a wheelbarrow, on stilts, carrying a man on his back, sitting down midway while he made and ate an omelette. In 1861 he appeared in London at the Crystal Palace, turning somersaults on stilts on a rope stretched across the central transept, 170 ft. from the ground. His final performance was given at Belfast in 1896.

BLOOD. The blood is a fluid, circulating tissue found in all higher animals and in many invertebrates; it is a tissue, as epithelium, muscle and bone are tissues, because it contains living cells and has specific functions, chief among them being the conveyance of materials from one part of the body to another. The general principle on which the chemical life of the body is conducted is that each living cell carries out in its own substance all the chemical processes necessary to its existence. Therefore all the materials which it requires must be carried to it, and those which it discards must be removed. Throughout the body of higher animals a system of transport—the blood vascular system—has evolved, affording an efficient route for the blood and providing the necessary, intimate contact with every living cell; this system has become highly specialized in the vertebrates. *See* CIRCULATION OF BLOOD and CIRCULATORY SYSTEM for a discussion of blood transport in the body.

The principal materials which a living cell—whether it is a muscle fibre, a nerve cell or a gland cell—requires are sugar, amino acids, fat, vitamins, oxygen, salts, hormones and water. The organs of digestion convert the solid constituents of the food to such a form that the blood can absorb them and deliver them to the cells of the body. The principal substances which the cell must dispose of are carbonic acid and simple soluble compounds of nitrogen—compounds of ammonia, etc., or, in the case of the liver, urea. These are conveyed by the blood to the various organs functioning in an excretory capacity, ridding the body of noxious wastes.

In all the higher animals blood consists of a fluid part, the plasma, in which are suspended corpuscles of various kinds: the red blood cells (erythrocytes), the white blood cells (leukocytes) and the blood platelets.

PLASMA

The plasma has a faint straw colour and is clear unless a meal containing fat has been eaten recently, in which case it is somewhat milky because of the minute globules of fat which it transports. The two materials dissolved in greatest quantity are albuminous substances (proteins) and common salt.

The general nature of plasma resembles that of raw egg white, diluted with 0.9% solution of salt. In detail, its composition is roughly as follows: water, 90%; proteins (fibrinogen, globulins, albumin), 9%; salts (of Na, K, Ca, Mg, Fe, Cu, etc.), 0.9%; sugar, urea, uric acid and creatinin, traces. Water is present primarily in order to dissolve the other substances and to afford the blood a degree of fluidity sufficient to secure its easy flow through the minute capillaries.

Protein.—The chemical basis of all life is protein in a watery medium. All the cells with which the blood is in intimate relation are composed of it. The protein formed within these cells is retained, and among its properties is that of attracting water to itself; *i.e.*, osmosis. If proteins were present only in the cells and not in the blood, water would always be passing from the blood into the cells, until the latter became swollen and dropsical. The protein in the blood balances that in the cells and so the water equilibrium is maintained. The case is different with salts; they can pass to and fro with the water and therefore do not set up any permanent stream of water in any direction.

A second purpose of at least one protein, fibrinogen, is to enable the blood to clot. The clot is the first aid to the healing of a wound; it at once plugs the wound and forms a scaffold on which new tissue is built. Thus, if the chin is cut in shaving, the solidification of the blood results not from drying or exposure but from coagulation, a chemical process in the plasma in which the fibrinogen (hitherto in solution) separates out as a spongy network of fibrin which connects the edges of the wound and prevents the further passage of blood cells. See *Platelets*, below, for the role of these particles in clotting.

From the chemist's point of view the protein molecule consists of a great number of special organic acids (amino acids) held together in a particular way by links (peptide bonds; *see* PROTEINS) of which ammonia is the basis. When digestion takes place in the alimentary canal the protein is broken into the individual amino acids. These form molecules small enough to pierce the walls of the capillary vessels within the intestines, and so they are picked up by the blood and conveyed to the tissues. If the protein molecule of a cell in one of the tissues has lost a particular amino acid, the appropriate one can be acquired from the assortment which the blood carries.

Similarly, when the protein molecule of a cell loses an amino acid, the lost matter does not appear in the blood as such, but as a salt of ammonia. It is carried to the liver, where it is turned into urea and thrust back into the blood and eventually excreted.

Salts.—Sodium chloride (as sodium and chloride ions, or electrically charged atoms) in blood serves primarily to effect protein dissolution. Since most proteins in the blood do not dissolve in pure water, and since protein can form the basis of living material only if it is in solution, salt is essential. Many salts might serve equally well to dissolve the protein but they are not as innocuous as sodium chloride in other respects. For example, potassium chloride would stop the heart and ammonium chloride might cause convulsions.

The body is capable of regulating the percentage of sodium chloride in the blood with great accuracy. If it is not taken into the body in sufficient quantity, the kidney, acting to maintain the proper salt balance, ceases to excrete it, and the urine, which normally contains a considerable quantity of sodium chloride is almost free from it. The result of a deficiency of this salt may be felt by persons who carry on sustained and heavy work in very

hot surroundings (deep mines or furnaces of ships). Such persons may lose several pounds of sweat (practically a pure solution of sodium chloride) by perspiration in a few hours. By drinking water they make up the deficiency of fluid but not of salt. The concentration of sodium chloride in the blood drops to critical levels, resulting in agonizing cramps in various muscle groups. These cramps do not occur if the chloride loss is made up by taking salt tablets or other materials containing salt.

Although calcium, potassium and magnesium ions are present in much smaller quantities than sodium ions, it is not to be supposed that they are correspondingly valueless. The proper working of the heart appears to depend upon a fine balance between calcium and potassium ions. Calcium ions also have a special function related to the clotting of blood; they are essential to the reactions immediately preceding the formation of the fibrin clot from fibrinogen (see *Platelets*, below). Among the salts in plasma, sodium bicarbonate holds a special place: it helps to transport carbonic acid from the tissues to the lungs, and to maintain the blood within very narrow limits, just on the alkaline side of neutrality.

The concentration of hydrogen ions in normal plasma equals 0.4×10^{-7} g. of hydrogen per litre (pH = 7.4). Any considerable increase in hydrogen ions (lowering of the pH value, acidosis) causes increased and violent breathing; this in turn enhances the expulsion of carbonic acid from the plasma into the air, thereby tending to raise the pH value of the blood to its normal level. (*See* RESPIRATION.) On the other hand, should the blood become unduly alkaline (alkalosis) the kidney will relieve this condition by secreting an increased quantity of alkali in the urine. This balance of acid and alkali, the maintenance of which preserves the reaction of the blood at a pH of 7.4, is called the acid-base equilibrium of the blood. To give a single instance of the way in which it is maintained: when a considerable meal is eaten, acid is secreted in the stomach for the purpose of effecting its digestion. Collaterally, acid is withdrawn from the blood, which in itself would make the blood more alkaline; the kidney then secretes sodium; hence, the so-called alkaline tide in the urine.

Among fluids, blood is remarkable in that addition of either acids or alkalies produces only trifling alterations in the hydrogen ion concentration—much less than if the same acids or alkalies were added to water. This fact is expressed by the phrase "blood is very highly buffered." The buffering of blood is achieved principally by the interaction of the sodium bicarbonate in the plasma with the pigment substance, hemoglobin, in the red cells. If carbonic acid is added to the plasma, sodium is withdrawn from the sodium chloride, liberating chlorine ions; these tend to pass into the red cells and unite with some of the sodium which had previously been in combination with the hemoglobin.

Hormones.—Large numbers of very potent chemical substances called hormones are secreted into the blood by such organs as the thyroid, the suprarenal (adrenal) gland, the islets of the pancreas, the pituitary body, etc. These substances are carried by the blood from their origin to areas more or less remote where they assert their specific physiologic action.

CELLS OF THE BLOOD

The cells of the peripheral blood (blood outside the bone marrow) are divided into two groups: the red blood cells (erythrocytes) and the white blood cells (leukocytes). The latter, in turn, are subdivided into nongranular leukocytes (agranulocytes) and granular leukocytes (granulocytes). The agranulocytes consist of two subtypes: (1) the lymphocytes; and (2) the monocytes, while the granulocytes consist of three types: (1) the heterophil leukocytes (neutrophil leukocytes in man); (2) the cosinophil leukocytes; and (3) the basophil leukocytes. The names are largely based on the staining characteristics of small granules present in the cell body. The granulocytes are also called polymorphonuclear blood cells, because of the segmentation of their nuclei. In addition to these cellular elements, the blood contains the so-called blood platelets (thrombocytes).

Blood Cell Formation in Man.—The blood cells do not originate in the blood stream itself but arise in specific blood cell-forming organs. In the adult organism the following obtains: the bone marrow produces the red blood cells as well as the granulocytes; the lymphatic tissues produce the lymphocytes; and the reticulo-endothelial tissues of the spleen, bone marrow and liver produce the monocytes. (*See* also BONE MARROW; LIVER; SPLEEN.)

In the embryo, the first site of blood formation is the yolk sac. There large nucleated red blood cells are formed from basophilic cells which are descendants of the embryonic tissue cells (mesenchymal cells). Later in embryonic life the liver becomes the most important red blood cell-forming organ. The liver is soon succeeded by the bone marrow, which in adult life is the only source of both erythrocytes and granulocytes.

The erythrocytes arise in the bone marrow through a series of gradual transformations from primitive stem cells called either hemocytoblasts or myeloblasts. The different names are related to differences of opinion regarding the precise nature of the stem cell (*see* BONE MARROW). The intermediate forms preceding the mature erythrocytes are called successively polychromatophil erythroblasts and normoblasts, depending on the degree of maturity.

The white cells or granulocytes are derived from the same primitive stem cells which form the erythrocytes. The intermediate forms between the stem cell and the mature granulocytes are called myelocytes.

RED BLOOD CELLS

The primary object of the red blood cell is to transport oxygen. Its efficiency as such depends upon the quality and quantity of hemoglobin it contains. The number of red cells in a human adult male ranges normally from 4,500,000 to 6,000,000 per cubic millimetre of blood. In 100 ml. of blood 12–17 g. of hemoglobin are normally found. This amount of hemoglobin carries 21 volumes of oxygen—more than 50 times the quantity which could be dissolved in the blood in the absence of hemoglobin. The intense oxidation in the tissues of warm-blooded animals has been made possible only by the existence and utilization of hemoglobin. The number of red cells per cubic millimetre of blood varies in different animals as shown in Table I. There is a definite sex variation, males having distinctly higher hemoglobin and red cell values than females. Even in the same person the number differs considerably at different times; factors which induce rapid sweating cause an increase; the number increases also at high altitudes (*see* HYPOXIA). The size and shape also vary. In the mammals the red cells are round, except in the camel, in which they are oval. In the lower vertebrates they are oval and nucleated.

TABLE I.—*Number of Red Blood Cells in Animals*
(in millions per cu.mm. of blood)

Animal	Number	Animal	Number
Man	4–6	Fish	0.25–2
Goat	9–10	Frog	0.5
Sheep	13–14	Proteus (an ampbibian)	0.04
Bird	1–4		

The figures given in Table II are only approximate, for, as stated below, a single red cell alters somewhat in size from time to time,

TABLE II.—*Average Diameter of Red Blood Cells of Representative Animals*
(in microns [μ]; $1\mu = \frac{1}{1{,}000}$ mm.)

Animal	Long axis	Short axis
Bird		
Pigeon	14.7	6.5
Amphibian		
Frog	22.3	15.7
Newt	29.3	19.5
Proteus	58	35
Amphiuma	77 (round)	...
Mammal (round)		
Man	7.5	
Dog	7.3	
Rabbit	6.9	
Cat	6.5	
Goat	4.1	
Musk deer	2	

and in the same individual the size may vary according to the conditions of stress under which they are produced. The red cell in man consists of a minute, disclike, biconcave body having an average diameter of 7.5μ and a greatest thickness of 2μ near the edge. It is very elastic and in the small vessels may be forced into other shapes.

The red cell consists of about 60% water and 40% solids, the latter being composed almost entirely of the red pigment hemoglobin. In the larger vessels they tend to pile up in rouleaux (like rolls of coins)—an arrangement which is likely to occur in the case of any series of disclike bodies with fatty surfaces, floating in an aqueous fluid. Although in mammals the red cells are normally nonnucleated, under abnormal conditions; *e.g.* in severe anemia (*q.v.*), nucleated types may appear in the circulating blood.

The fine structure of the red cell has been a matter of much controversy, some regarding it simply as a bag of fluid and others as consisting of a spongework or stroma. In the absence of certain knowledge of the correctness of either view it may be said that discussions on the chemistry and physics of the red cells are usually carried out on the basis of the former, the cell being regarded as fluid material surrounded by a membrane possessing certain definite chemical and physical characteristics. The membrane is permeable, for instance, to water and to acid radicals, but less so to sodium ions, potassium ions, etc. These facts form the basis of complicated readjustments of equilibriums between the constituents of the cells and those of the plasma when the latter are altered. Among the materials which may pass through the membrane is water; therefore the cell may swell and shrink. Normally it swells if the medium in which it is placed is made more acid or is made hypotonic (by diluting the medium, thereby lowering the osmotic pressure in relation to that in the corpuscule).

Hemolysis.—The passing of water into the red cell may take place on such a scale as ultimately to burst the membrane. The solution of hemoglobin previously enclosed escapes into the surrounding fluid, and the structures which contained the hemoglobin are left as "shadows" or "ghosts." This process is known as laking or hemolysis and may be induced by the addition of distilled water to blood. The red cells may also be ruptured in other ways; for example, by freezing and thawing and by the addition of saponin or bile salts. More remarkable is the fact that if the red cells of one species are injected into the vessels of another they are destroyed, their contained hemoglobin being liberated. This phenomenon is not a result of osmotic or similar changes, but of some specific substance—a hemolysin—in the plasma which attacks the foreign red cells. It is one of several substances on which the immunity of the body against disease depends (*see* IMMUNITY).

Blood Groups.—The red blood cells of all normal human beings, whether their skins are white, black, yellow, brown or copper-coloured, all have an identical appearance. However, they contain materials called agglutinogens which vary in type in different individuals and to some extent in different races. The agglutinogens are probably of carbohydrate structure and have the capacity of combining with other materials called agglutinins. The latter are present in the blood plasma or serum, causing red cells to clump together (agglutinate) like bunches of grapes. Like a lock and its specific key, each agglutinogen in a red cell can be acted upon only by its specific agglutinin (*see* AGGLUTININ).

In 1900 and later, Karl Landsteiner found by studying these reactions that human beings could be divided into four large classes according to the type of agglutinogen contained in their red cells; some contained agglutinogen A, others agglutinogen B, others both A and B and still others neither A nor B; the latter type was called type O. Following the discovery of the ABO blood group system, several other systems were found, chief among them being the MN and Rh groups; these along with the more recently discovered groups are discussed in the article BLOOD GROUPS. (*See* also *Individuality of Human Blood* below.)

Life Span of the Red Cell.—The longevity or life span of the red blood cell may be determined in various ways, the simplest and most commonly used being the blood-grouping methods, the basis of which was introduced by W. Ashby in 1918. If type O blood cells are transfused into the circulation of A or B persons it is possible to follow along the O cells by using anti-A or anti-B testing serums. The O cells will not be agglutinated and can be counted. By this method, the lifetime of the red cell has been found to be approximately 110–120 days. More recent methods employing natural and radioactive isotopes to "tag" the red cell in the bone marrow have set the life span of the human red cell at about 127 days.

The red cell, which is in reality a chemical envelope containing, among other substances, hemoglobin, is gradually worn out by its numerous passages through the circulating blood and by its thousands of chemical exchanges. It probably becomes fragmented, chiefly through physical forces, following which its various constituents are liberated and either reutilized or discharged from the body. The hemoglobin fraction of the red cell is broken up into its constituent portions of globin, iron and porphyrin. Upon the opening of the ring structure of porphyrin, a yellow bile pigment called bilirubin may be formed.

Fragility of the Red Blood Cells.—All red cells are not disrupted with equal ease by hemolytic agents. Thus, while all or nearly all cells are disrupted by distilled water, salt solutions of less saline concentration than plasma will disrupt some and not others; the "fragility" of the cells differs. Thus, in the case of man, for various percentage concentrations of salt solution, hemolytic disruption of red cells is as shown in Table III. The resistance of the red cells of some animals is greater than that of others. If different animals are graded according to the resistance of their red cells to the hemolytic agent saponin, the following order (in decreasing resistance) is observed: lamb, goat, ox, cat, gray mouse, pig, gray rat, dog, white rat, rabbit and guinea pig. However, based upon the resistance of their red cells to hypotonic salt solutions the animals are listed in precisely the reverse order.

Blood Pigments.—The pigment of the red blood cells which is responsible for their capacity to carry oxygen is called hemoglobin. It consists of a compound of a protein, globin, with a pigment complex called heme.

Heme and Hemoglobin.—Heme has the formula $C_{34}H_{32}O_4N_4Fe$. Its principal chemical characteristics are: (1) it contains iron in the ferrous state (Fe^{2+}); (2) it contains four pyrrole groupings, a fact which gives it a superficial relationship to chlorophyll; (3) it is easily oxidized by chemical reagents to hematin, in which the iron is in the ferric state (Fe^{3+}). In small quantities, heme is widely distributed both in the animal and vegetable kingdoms. In the hemoglobin molecule, four heme molecules are attached to the globin molecule. Heme forms compounds other than hemoglobin with proteins; a conjunction of three such compounds is frequently found both in animals and plants and is called cytochrome. This material is of great importance in the numerous enzyme systems of the body cells. A pigment related to hemoglobin—myohemoglobin or muscle hemoglobin—functions as an oxygen reservoir in muscle fibres.

Unlike cytochrome, hemoglobin can easily be crystallized, the red cells of different animals yielding crystals of different forms. These hemoglobins present specific differences in solubility, in their power of uniting with gases and in the position of the bands in their absorption spectra. Such differences are believed to be due to the specific characters of the globin.

Oxyhemoglobin.—In the body hemoglobin is oxygenated. The reaction is reversible and is not a true oxidation; it more closely resembles a physical process rather than a chemical one. Heme, influenced by the globin portion of the molecule, combines with oxygen forming a compound—oxyhemoglobin—of so loose a nature that (1) it can be completely broken down in a vacuum and (2) the proportion of the whole hemoglobin oxygenated is a function of the partial pressure of oxygen (oxygen tension) to which it is exposed. On this property depends the value of the pigment as a carrier of oxygen.

$$\underset{\text{Hemoglobin}}{\text{Hb}} + \underset{\text{oxygen}}{O_2} \underset{\text{Low oxygen tension (as in metabolizing tissues)}}{\overset{\text{High oxygen tension (as in the lungs)}}{\rightleftarrows}} \underset{\text{oxyhemoglobin}}{\text{HbO}_2}$$

The valency of the iron in hemoglobin appears not to be affected; it remains in the ferrous condition throughout.

Carboxyhemoglobin.—Hemoglobin unites with carbon monoxide in a manner similar to that of its union with oxygen, but the affinity of the pigment for carbon monoxide is much greater than for oxygen; at the body temperature in man it is about 250 times as great (for carbon monoxide poisoning, *see* HYPOXIA).

Other hemoglobin compounds normally not found in blood are the pathological products nitric oxide hemoglobin (hemoglobin + nitric oxide gas) and sulfhemoglobin (hemoglobin + hydrogen sulfide gas).

Methemoglobin.—In all the above hemoglobin compounds the iron is in the ferrous state. A compound found in small amounts in normal blood, but occurring in greater concentration in certain cases of poisoning (*see* HYPOXIA), is methemoglobin, which differs from ordinary hemoglobin in that it contains iron in the ferric condition. It is formed by the action of potassium ferricyanide, nitrites, acetanilide, etc., on the hemoglobin of the blood.

Bilirubin.—This pigment is formed by opening up of the heme pigment molecule which has already been freed of iron. Bilirubin is a yellow pigment which is probably derived from the hemoglobin in the phagocytic cells of the reticulo-endothelial system, notably in the spleen, bone marrow, liver and lymph nodes. This yellow pigment colours the blood plasma a faint yellow and is normally present in a concentration of approximately 0.5 mg. per 100 of blood. From the blood, where it is present in a combined form, it goes to the liver cells which secrete it as "free" bilirubin into the bile. The golden-yellow colour of bile is caused largely by this pigment. Some of the bile is stored in the gall bladder, the remainder going into the intestines, where it undergoes various conversions to a pigment called urobilinogen, excreted in the stools. An index of the amount of blood destruction may be obtained from study of the fecal urobilinogen, which is normally 100 to 150 mg. per day. Trace amounts of this pigment are excreted by the kidneys and found in the urine.

Hemochromogen.—Of the other derivatives of hemoglobin which do not occur in blood, perhaps the most important is hemochromogen, in which heme is associated not with native globin but with another protein formed by the action of strong alkali on globin and known as denatured globin. The practical importance of hemochromogen lies in two facts: (1) it is easily made from old blood by the action of alkali in combination with a reducing agent; and (2) of all the blood pigments it is the one whose spectrum can be recognized in the greatest dilution. Therefore, in medicolegal cases, stains suspected of being due to blood can be tested by attempting the conversion of the pigment into hemochromogen and the observation of the material obtained with the spectroscope.

WHITE BLOOD CELLS

The blood of an adult human being contains 5,000 to 10,000 white blood cells per cubic millimetre. Thus, there is only one white cell to 400–500 red cells. The actual number varies greatly from hour to hour in the same person. Lowest counts being observed in the morning and highest in the afternoon and, particularly, after unusual muscular activity.

In man the neutrophile leukocytes constitute 60%–70% of the total number of leukocytes; in these cells contained granules are small and stain purplish with Giemsa, Wright or similar dyes. (In other mammals similar leukocytes are called heterophils; in these the size and stainability of the granules varies from species to species.) The eosinophile leukocytes contain relatively coarse granules which stain red with any of the above-mentioned stains. These cells constitute 1%–4% of all leukocytes. The basophile leukocytes form 0%–1% of all leukocytes. Their granules stain intensively with basic dyes. In addition to the differences in the granules, the three groups of granular leukocytes differ characteristically in the configuration of the nucleus. In spherical condition, the granulocytes have a diameter of 9 to 10 μ. When flattened out, as is the case in blood smear preparations, their diameter varies from 10 to 12 μ.

The lymphocytes number 20%–30% of the total number of leukocytes in adults. Infants and young children have about 30%–60% lymphocytes. These cells are generally smaller than the granulocytes. Spherically, their diameter is 6 to 8 μ, though larger ones are encountered. It is a characteristic of the cytoplasm of the lymphocytes to stain deeply with basic dyes. This is the result of the presence of nucleoproteins in the cytoplasm.

The monocytes number 2%–6% of the total number of leukocytes. They are larger than the lymphocytes and have an oval or horseshoe-shaped nucleus and a grayish cytoplasm. Because of the presence of intermediate forms between the lymphocytes and the monocytes it is sometimes difficult to determine whether a cell is a lymphocyte or a monocyte.

Role During Inflammation.—Leukocytes are an important factor in the cellular defense mechanism of the body. All of them are capable of active movement (essentially the same as the movement of an amoeba), which they exhibit only when they are outside the blood stream; *e.g.*, during inflammation. Experimentally, it has been shown that granulocytes have the ability to move toward a chemical gradient (chemotaxis) notably of carbohydrates. Upon a noxious stimulus such as a bacterial invasion, the leukocytes migrate from the blood vessels and enter the injured connective tissue. The neutrophile leukocytes, after taking up some of the bacteria or other particulate matter, die soon after they have left the vessels. The nongranular leukocytes (lymphocytes and monocytes) increase in size within a couple of days and transform into large phagocytic cells (macrophages), which engulf the particles at the site of invasion as well as the degenerated neutrophiles. The blood cells are joined in this phagocytic process by macrophages already present in the connective tissue. The functions of the eosinophils and basophils are not definitely known. (*See* also PHAGOCYTOSIS.)

Differential Counts of White Blood Cells.—The absolute and relative number of the various types of leukocytes present in the peripheral blood may undergo important changes from the normal during certain diseases. Counts of white blood cells are important clinical procedures in the diagnosis of leukemia and infectious diseases. In the so-called differential count the relative proportion of the different types of white blood cells is determined.

PLATELETS

The blood platelets are very small cellular bodies (not actually cells) which are derived from the largest cells of the bone marrow, *i.e.*, the megakaryocytes. They vary in size from one to three microns, have a small amount of light blue cytoplasm and a deeply staining inner structure. They number normally about 200,000 to 400,000 per cubic millimetre of blood, although their enumeration is rendered difficult by their tendency to stick together. This agglutinating tendency is of great importance since it quickly plugs small loopholes in the blood vascular apparatus. When the plate-

TABLE III.—*Normal Values of the Blood*

Total blood volume	
Adult male	5,000 ml.
Adult female	4,000 ml.
Red blood cell volume	
Adult male	2,250 ml.
Adult female	1,800 ml.
Plasma volume	
Adult male	2,750 ml.
Adult female	2,200 ml.
Hematocrit (percentage volume of red cells)	45%
Hemoglobin	
Adult male	12 g. to 17 g. per 100 ml.
Adult female	11 g. to 15 g. per 100 ml.
Red blood cell count	
Adult male	4,500,000 to 6,000,000 per cu.mm.
Adult female	4,000,000 to 5,500,000 per cu.mm.
White blood cell count	5,000 to 10,000 per cu.mm.
Platelet count	200,000 to 400,000 per cu.mm.
Differential count of the white blood cells	
Neutrophiles	60%–70%
Lymphocytes	20%–30%
Monocytes	2%– 6%
Eosinophiles	1%– 4%
Basophiles	0%– 1%
Bleeding time	1– 3 min.
Coagulation time (venous blood)	6–10 min.
Hypotonic fragility test	
Hemolysis begins at .45% NaCl solution	
Hemolysis complete at .33%–.30% NaCl solution	
Blood groups (a few of the more important factors)	
O (type IV, Moss), universal donor	
A (type II, Moss)	
B (type III, Moss)	
AB (type I, Moss), universal recipient	
M MN Rh positive	
N Rh negative	

lets are greatly diminished or completely lacking the blood tends to seep out of the circulation into the skin and mucous membranes, resulting in black-and-blue areas (ecchymoses) and in tiny blood spots or petechiae. The platelets have other functions as well: production of the clotting factor thromboplastin, which initiates the series of chemical reactions that produce the fibrin clot; and aggregation about foreign particles, including bacteria, within the circulation.

BLOOD VOLUME

The body of an adult male contains about five litres of blood, that of a woman or child less. The quantity may be measured in one of two ways. Each depends upon putting a known quantity of some substance into the body, and, after it has been distributed uniformly in the whole circulating fluid, measuring the degree of dilution which has taken place. The two substances most commonly used are carbon monoxide and Evans blue dye, T-1824.

Carbon monoxide to the extent of about 250 cu.mm. (the exact quantity being known) is inhaled from a special apparatus; the gas unites with the hemoglobin of the blood, producing a compound the concentration of which can be measured spectroscopically.

Evans blue dye, T-1824, is a pigment which in the amounts ordinarily injected does not leave the blood for some time but in its entirety remains dissolved in the plasma. A known quantity of the dye is injected into a vein, blood samples are withdrawn and centrifuged, the plasma is tinted blue with the dye, and the depth of the tint is a measure of the degree to which the dye has been diluted and thus of the blood volume.

Probably different species, and indeed different individuals in the species, differ considerably in the quantity of blood contained in their vessels. As a very rough estimate the blood volume is about one-fifteenth to one-seventeenth the body weight in man. It is believed to increase at great heights, under tropical conditions and in polycythemia.

Considerable loss of blood may take place without serious ill effects, but if the volume decreases beyond a certain point the blood pressure commences to drop and a condition of shock supervenes. Besides the blood which actually circulates in the arteries, veins and capillaries, the body possesses reserves which can be mobilized. One such is known to be located in the spleen. At the onset of hemorrhage the spleen shrinks, squeezing blood as from a sponge into the circulation. Thus some animals may lose one-fifteenth of their blood without the volume of that fluid in circulation suffering any appreciable decrease, the spleen contributing as much as is lost by the hemorrhage.

The blood volume may diminish from causes other than hemorrhage; *i.e.*, through severe injury (traumatic shock), especially to the visceral organs. In this condition, the capillary walls appear to become unduly permeable and dilated; the plasma then escapes into the tissue spaces, and the number of corpuscles per cubic millimetre of blood increases. Ultimately the volume of blood becomes so small that the arterial pressure cannot be maintained. This condition is known as surgical shock, and it is distinguished among other features by a great reduction in plasma volume. The introduction of human plasma in states of shock is often life-saving and was of extreme importance in the treatment of war casualties in World War II and the Korean war (*see* SHOCK).

(W. DK; P. P. H. DE B.)

INDIVIDUALITY OF HUMAN BLOOD

Evidence of the individuality of human blood originated in 1900 with the discovery of the ABO blood groups and was followed in 1928 by descriptions of factors M, N and P. Beginning about 1940, numerous agglutinable properties or factors (antigens) in normal human red blood cells were discovered, among which Rh was, medically speaking, the most important (*see* BLOOD GROUPS). The term Rh is derived from "rhesus" to indicate a particular blood property common to man and the rhesus monkey. The combination of Rh positive father and Rh negative mother was shown to be the most frequent cause of a disease of the newborn infant, erythroblastosis fetalis or preferably hemolytic disease of the fetus and newborn. The destruction of the infant's blood results from transfer *in utero* of an antibody produced by the Rh negative mother whose fetus is Rh positive. The application of this fundamental phenomenon—transplacental isoimmunization—resulted in the discovery of many new blood factors, because in the smaller group of affected infants at least 30 different factors other than Rh are responsible for maternal antibody production and its subsequent destructive effect on the infant's red blood cells.

With the aid of these antibodies, as well as those produced by transfused patients or others that may be physiological for certain normal persons, it is possible to identify a variety of blood factors by simple agglutination or clumping reactions.

With each blood factor there are two variations; *i.e.*, presence or absence of agglutination with its particular antibody. Assuming independence of the blood factors, the number of individual variations is an exponential function of the number of different factors. Thus, given ten factors, there are 2^{10} or 1,024 different combinations, or with an additional ten blood factors 2^{20} or 1,048,576 combinations.

In the early 1960s, 11 independent blood group systems were known, in addition to many low (private) and high (public) incidence antigens (*see* BLOOD GROUPS). Since about 70 antigens have been detected and 20 or more are assumed to exist, the number of combinations possible among the general population is truly staggering. And it has been said that some of these possible combinations have not even occurred yet in all the time that man has existed. The individuality is still greater if one takes into account the 78 Rh genotypes listed by R. R. Race and Ruth Sanger.

Some of the blood factors exhibit striking racial differences. The type Fy(a−b−), which has not been found in Caucasoids as yet, has an incidence of 68% in New York Negroes and about 90% in West African Negroes. The antigen V is found in 27% of New York Negroes, but its presence in pure Caucasoids is still to be established. The Diego blood antigen is absent in Caucasoids and is found only in American Indians, Japanese and Chinese. Numerous other examples are cited in the text by Mourant (see *Bibliography*).

Aside from their importance in studying racial differences (population genetics), blood factors are useful in the determination of monozygotic (identical) twins and are employed in medicolegal matters such as the exclusion of paternity or maternity and the accidental interchange of infants. Some blood factors are present also in leukocytes, platelets, sperm cells, epithelial cells of the skin and mucous membranes of the mouth.

Individual differences in blood proteins such as hemoglobins, haptoglobins and gamma globulins have been observed. Using paper electrophoresis, a method of analysis based on the movement of colloidal particles in an electrical field, it is possible to demonstrate about 18 different types of hemoglobin, of which only hemoglobin A is the normal form; all the others are associated with diseased states called hemoglobinopathies. Some of these abnormal hemoglobins (*e.g.*, S and C) are commoner in Negroids. They are inherited as single genes.

Hemoglobins A, C and S differ from each other in the position of only one of nine amino acids in a particular peptide chain. Glutamic acid of hemoglobin A is replaced by valine in hemoglobin S, and by lysine in hemoglobin C.

Three types of haptoglobins can be demonstrated by differences in the capacity of part of the α_2 globulin to bind hemoglobin; these are types 1–1, 1–2 and 2–2. Another type more frequent in Negroes is 1–2m, a modified form. The incidence of types 1–1, 1–2 and 2–2 in the Caucasoid population is 15%, 50% and 35% respectively. The incidence varies in Negroids. There are three genes and six genotypes, two of them not identifiable by current methods. These are normal variations genetically independent of Gm groups (*see* below) or hemoglobin types.

The serological test used in diagnosing rheumatoid arthritis (*i.e.*, agglutination of red cells sensitized with antibody bearing globulin) revealed a specific difference in normal human serum. About 60% of normal human serums can inhibit this agglutination. These are known as Gm(a+) and the remaining 40% that failed to inhibit agglutination are called Gm(a−). The letters Gm refer to gamma globulin, which may or may not inhibit the reaction. The two

groups are inherited according to simple Mendelian laws, Gm(a+) being dominant over Gm(a−). Recent studies reveal additional hereditary differences in normal gamma globulins called Gm(x+) and Gm(x−). These studies reveal also normal hereditary differences of transferrin, the iron binding protein present in the β_1 globulin fraction.

See BLOOD, DISORDERS OF; LYMPH AND LYMPHATIC SYSTEM; *see* also Index references under "Blood" in the Index volume.

(P. LE.)

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BLOOD, DISORDERS OF. The disorders of the human blood are pathological conditions that involve the cellular elements of the blood and the tissues in which they are formed.

The blood is composed of a watery fluid, the plasma, in which are dissolved various essential and nutritive substances, salts and wastes. Suspended in the plasma are three types of corpuscles: the red cells (erythrocytes), the white cells (leukocytes) and the blood platelets (thrombocytes). The chief function of the red cells (formed in the bone marrow) is the containment of hemoglobin, a pigment especially adapted to combining with oxygen in the lungs and releasing it in the tissues, and to combining with carbon dioxide in the tissues and releasing it in the lungs. The white cells are composed of three types: granulocytes, monocytes (both formed in the bone marrow) and lymphocytes (formed in the lymph glands); all three types of white cells are involved mainly in the resistance of the body to infection and in the repair of tissues. The blood platelets (formed in the bone marrow) are cellular particles concerned with the clotting of blood. (*See* BLOOD; BONE MARROW.)

In some blood disorders, one type of corpuscle is affected; in others, two types or all three types are influenced.

Methods of Study.—The study of any disease in a patient involves an inquiry into the circumstances of its development, the symptoms produced and the course of the illness (the history). A thorough physical examination coupled with specific laboratory tests are essential prerequisites for an intelligent approach to the treatment of most diseases.

In the case of disorders of the blood, certain features of the physical examination are especially important in diagnosis. These include the presence or absence of pallor or, the opposite, an excess of colour; the presence or absence of small purple spots or larger bruises in the skin; enlargement of lymph glands (nodes); enlargement of the spleen; and tenderness of the bones.

Laboratory studies particularly valuable in diagnosis include: (1) determination of the existence of anemia or polycythemia (*see* below); (2) a study of the white corpuscles, their number and their proportions as to type; (3) enumeration of the blood platelets and a study of the blood clotting process; and (4), in many instances, a study of the bone marrow. Further, it is sometimes necessary to remove a lymph node for microscopic examination, and X-ray examinations may be necessary for the detection of organ or lymph node enlargement or bone abnormalities. The more unusual cases may require examinations which involve the use of isotope tracers or special biochemical procedures.

DISORDERS AFFECTING RED CELLS

The quantity of red blood cells in normal human beings varies with age and sex as well as with external conditions, primarily air pressure. At sea level an average normal male adult has 5,400,000 red blood cells per cubic millimetre of blood. These carry an average of 16 g. of hemoglobin per 100 millilitres of blood. If such blood is centrifuged so that the red blood cells are packed in a specially devised tube known as the hematocrit, they are found to occupy 47% of the volume of the blood. In the average female, the normal figures are lower than this (red cell count 4,800,000; hemoglobin 14 g., volume of packed red cells 42%). In the newborn they are higher but decrease in the course of several weeks to levels below those of the normal female; thereafter, they rise gradually. The differences in male and female blood begin to appear about the time of puberty. It should be noted, however, that these figures represent average values; the values found in normal persons range approximately 15% on either side of this mean.

Changes in Numbers of Red Cells.—A temporary increase in the number of red cells (erythrocytosis) is observed under conditions of high altitude (the increase is directly proportional to the altitude), and in certain emotional states and shock. The sustained increase in red cells in persons who reside permanently at high altitudes is a direct result of the diminished oxygen tension in the environment.

No significant reduction in the number of red cells occurs in situations of high barometric pressure; *e.g.*, in areas lower than sea level such as deep mines, etc.

A pathological increase in red cells is called polycythemia; a pathological decrease is called anemia.

Polycythemia.—A consistent pathological excess of red cells, or polycythemia, is indicative of a serious disruption of the normal condition in the body. Primary polycythemia is a blood disease of unknown cause; polycythemia resulting from an existing pathological condition is termed secondary polycythemia.

Primary polycythemia, also known as polycythemia vera or erythremia, is a condition in which the number of red cells, and often white cells and platelets, is increased and the spleen often enlarged. Because of the excessive quantities of red cells, the blood is unusually thick and its flow retarded; it sometimes clots in the vessels (thrombosis) of the heart, the brain or the extremities with very serious consequences. Patients with this disease have an unusually ruddy complexion and may complain of headaches, dizziness, a feeling of fullness and other symptoms. The simplest method of treatment is to remove the blood, one pint at a time, from a vein until the cellular level approaches normal and the symptoms disappear.

Another useful method involves the injection of radioactive phosphorus; this material is carried to the bones, where the radioactivity acts directly upon the blood-producing elements in the bone marrow and impairs their production capacity. The administration of the isotope is repeated, when necessary, at intervals of three months or longer.

Secondary polycythemia results from other organic disorders and certain types of poisoning. This condition represents the response of the bone marrow to low oxygen tension in the arterial blood. It is observed in patients with certain types of congenital heart disease in which part of the blood is shunted out of its normal path in such a way that all the blood does not pass through the lungs and therefore fails to renew its full supply of oxygen, resulting in a deficiency of oxygen in the tissues (hypoxia). The body attempts to make up for the hypoxia by producing more red cells. Other conditions associated with secondary polycythemia include various types of lung disease that impair aeration (*e.g.*, emphysema) and excessive consumption of certain drugs (phenacetin, acetanilid, etc.) that convert hemoglobin to pigments incapable of carrying oxygen (methemoglobin, sulfhemoglobin, etc.). The treatment of secondary polycythemia involves the correction or alleviation of the primary pathological disturbance, thereby relieving the polycythemia.

Anemia.—Anemia is a pathological reduction in the number of red cells, in the quantity of hemoglobin and in the volume of packed red cells to levels below normal according to the age and sex of the patient. In essence, anemia is not a disease but a symptom of disease. There are many different types of anemia,

each of which is treated according to its cause. (*See* ANEMIA.)

DISORDERS AFFECTING WHITE CELLS

White cells include granulocytes (neutrophiles, eosinophiles and basophiles), lymphocytes and monocytes. Normally, the white cell count in an adult ranges from 5,000 to 10,000 cells per cubic millimetre of blood. (*See* BLOOD: *Cells of the Blood.*)

The granulocytes as a group make up between 61% and 75% of the white cell total. The three subgroupings are based on the type of dye absorbed by the cytoplasmic granules when the cells are stained in preparation for microscopic examination. Neutrophiles, which absorb neutral dyes, are the largest group, numbering 3,000 to 7,000 per cubic millimetre of blood in an adult, or about 60% to 70% of all the white cells. Eosinophiles, which take up acidic dyes such as eosin, number from 50 to 400 in an adult, or 1%–4% of the total. Basophiles, which take up basic stains, number from 0 to 50 in an adult, or up to 1% of the total.

Lymphocytes, of which there are from 1,000 to 3,000 in an adult (20% to 30% of all white cells), possess a round nucleus that occupies most of the cell. Monocytes, which number from 100 to 600 (2% to 6%), have a lobulated nucleus and are the largest of all the white cells.

Changes in Number of White Cells.—Variations in the number of white cells occur normally from hour to hour, the highest counts being recorded in the afternoon and the lowest in the early morning. Temporary increases also normally occur during muscular exercise, menstruation, pregnancy and childbirth as well as in emotional states.

Abnormal changes in the count, appearance or proportion of the various white cells are indicative of pathological conditions in the body.

Leukocytosis.—The condition in which white cells are present in greater numbers than normal is termed leukocytosis. It is usually due to an increase in the number of granulocytic leukocytes (especially neutrophiles), some of which are immature (myelocytes). Most often leukocytosis is the result of the presence of an infection, usually caused by pyogenic (pus-producing) organisms such as the streptococcus, staphylococcus, gonococcus, pneumococcus or meningococcus. Examples of leukocytosis are found in association with inflamed appendix, lobar pneumonia, meningitis or a boil. Leukocyte counts of 12,000 to 20,000 per cubic millimetre during infections are not unusual, but values greater than this are less common. As the number of cells increases, the proportion of immature cells usually rises, perhaps because the demands on the leukocyte-producing tissues in the bone marrow have increased to the point at which there is an insufficient number of mature cells for delivery into the circulation. This picture of immaturity is referred to as a "shift to the left." As the infection subsides, the number of younger forms and the total white cell count decrease and ultimately return to normal. During the period of repair following an inflammatory reaction, the monocytes may increase in number, and subsequently the lymphocytes become more numerous.

Lymphocytosis.—Certain types of infection are characterized from the beginning by an increase in the number of small lymphocytes unaccompanied by increases in monocytes or granulocytes. Such lymphocytosis is seen in whooping cough and occasionally in infectious lymphocytosis, a benign disorder probably of viral origin. Moderate degrees of lymphocytosis are encountered in certain chronic infections such as tuberculosis and brucellosis.

Monocytosis, an increase in the number of monocytes in the blood, is encountered in association with certain infectious processes, especially subacute bacterial endocarditis and malaria.

Eosinophilia, an increase in the number of eosinophilic leukocytes, is encountered in many allergic reactions and parasitic infections. It is especially characteristic of infestation by trichina larvae ingested when infected, poorly cooked pork or pork products are eaten.

Leukopenia.—Abnormally low leukocyte counts (below 5,000 per cubic millimetre) are encountered in certain types of infection such as typhoid fever, malaria and measles. In persons sensitive to chemical agents such as aminopyrine, severe leukopenia occurs on taking the drug, and a very serious syndrome known as agranulocytosis (*q.v.*) may develop. If exposure to the toxic agent is not stopped immediately and any developing infection is not treated effectively, death will ensue. Leukopenia is also encountered in various diseases involving the bone marrow, such as aplastic anemia, leukemia and multiple myeloma, as well as in certain disorders that affect the spleen.

Infectious Mononucleosis.—This disorder, seen frequently in young persons, is of unknown cause but most probably is due to a viral infection. It is accompanied by fever, sore throat, enlargement of the spleen, grippelike symptoms and enlargement of the lymph glands; at the same time, there is a leukocytosis, primarily an increase in the number of lymphocytes. The lymphocytes in infectious mononucleosis (*q.v.*) have a characteristic appearance, being larger than normal and often having vacuoles in their cytoplasm. Leukocyte counts of 15,000 to 30,000 per cubic millimetre are common. There is no accompanying anemia or alteration in platelets (rarely, the latter may be decreased in number). The condition can be further identified by demonstration in the blood serum of a characteristic antibody that causes the red cells of sheep to clump together (sheep cell agglutinin or heterophil agglutinin). The disease is mild, recovery taking place, as a rule, within several weeks. It has been mistaken for acute leukemia, the symptoms of which are sometimes similar.

Leukemia.—This term means "white blood" and arose from the discovery of very large numbers of white blood cells in the blood of certain patients; counts as high as 500,000 per cubic millimetre and even 1,000,000 per cubic millimetre may be found in some instances. Leukemia (*q.v.*) is a very serious and ultimately fatal disorder of the blood that is characterized by unrestrained, morbid new (neoplastic) growth of white blood cells and ultimately by changes in various tissues, such as in the spleen and lymph glands, as well as by the development of anemia and a reduction in the number of blood platelets. The course of leukemia varies greatly, ranging from the acute type that may cause the untreated patient to die in a few weeks or months (rarely six months or a year) to the chronic type, which may produce little or no ill-health for ten or more years.

The cause of leukemia is unknown. Although hereditary transmission is known to occur in mice, it appears to be of no importance as an etiologic factor in man. Irradiation seems to play a role; there is a higher incidence of leukemia in the survivors of atom bombings than in the general, unexposed population. Attention also has been called to the higher incidence of leukemia in radiologists, as compared with other physicians. This has been attributed to improper shielding of X-ray apparatus, resulting in exposure to undue amounts of scattered radiation. Experimentally produced leukemia in animals indicates that many additional factors are influential in the development of leukemia, among them chemical agents and hormones such as the estrogens (the female sex hormones). For some time attention has focused on the search for a possible viral agent as the cause of leukemia. Fowl leukemia has been known for decades to be due to the presence of a virus, and a viral agent in the development of mammalian leukemia (mice) has been demonstrated. An increasing amount of evidence suggests that leukemia in man also may be related to a viral agent.

Acute leukemia, of which there are three types, may be associated with an unrestrained development of lymphoblasts, which are immature lymphocytes; this variety (acute lymphoblastic leukemia) is commonest in children. Another type, acute myeloblastic leukemia, is characterized by an overgrowth of cells thought to be related to myeloblasts, the immature polymorphonuclear leukocytes. A third, and the least common, variety is acute monocytic leukemia; this is characterized by the presence of very immature forms of monocytes. Myeloblastic and monocytic leukemia occur more commonly in adults than in children. In general, acute leukemia occurs in young persons, but no age group is exempt.

Although the total white cell count is usually increased, often greatly, in acute leukemia, it is not uncommon for the count to be normal or lower than normal (leukopenic). In cases of normal

or below-normal counts, nevertheless, the blood will often show the presence of a few leukemic cells, and such cells can be demonstrated in great abundance when the bone marrow is examined.

Acute leukemia is often associated with symptoms such as unusual fatigability, fever, sore throat and lymph gland enlargement and may at first be mistaken for a common infection. Usually by the time the diagnosis is made, anemia has already developed, and frequently the number of platelets (thrombocytes) is reduced as well. When the thrombocytopenia (*see* below, *Bleeding Disorders*) becomes severe, bleeding manifestations occur; there may be serious bleeding from the nose and gums and bleeding into the skin.

Two types of agents have been found beneficial in the treatment of acute leukemia. (1) In acute lymphoblastic leukemia the administration of steroids such as prednisone causes all evidences of the disease to disappear in approximately 65% to 80% of cases. These agents have little or no value in the other types of acute leukemia. (2) Effective in all types are two antimetabolites (*q.v.*), "amethopterin," an antifolic compound, and 6-mercaptopurine, which may be an antipurine; they interfere in the chemical processes necessary for the growth and development of white blood cells. Patients are usually treated with one of these agents at a time, since ultimately the patient fails to respond to one agent but may still be responsive to another. These agents have prolonged life in acute leukemic patients, keeping them in good condition for many months. Permanent cures have not been achieved.

Another approach to the treatment of acute leukemia is total irradiation (using X-rays and/or radioactive substances) of the body to destroy all the leukemic cells. In the process, all the normal blood cells are also destroyed, and the body's capacity to form new cells in the bone marrow is lost; other tissues, especially the gastrointestinal tract, may be damaged as well. To make up for the bone marrow damage, normal marrow is transplanted in the victim following irradiation. This method of treatment appeared, in the 1960s, to be promising only in cases where an identical twin was available as the source of bone marrow for transplantation; under other conditions the method failed because hemorrhage, infection, damage to other tissues and failure of the grafted marrow to function always interfered with recovery.

Chronic leukemia is of two main varieties, myelocytic and lymphocytic. Chronic myelocytic leukemia is a disorder characterized by the appearance in the blood of large numbers of myelocytes, immature white cells of the granulocytic series. At the same time the spleen becomes enlarged (ultimately, very greatly), anemia develops and the patient loses weight. This disease is most commonly encountered in persons between the ages of 20 and 45. The disorder can be alleviated temporarily by X-irradiation of the spleen or by the administration of certain chemical agents, particularly busulfan. By these methods the size of the spleen can be greatly reduced, the leukocyte count falls to normal and the anemia is relieved. Ultimately, however, all treatment fails and death ensues in about three and one-quarter years after onset of the disease. There is considerable individual variation, however, some patients dying sooner and others living as long as ten years.

Chronic lymphocytic leukemia is the most benign form of leukemia. It occurs most often in people over 50 years of age and is characterized by an increase in the number of lymphocytes, by lymph gland enlargement and, to a lesser extent than in chronic myelocytic leukemia, by splenic enlargement. There may be some weight loss, but patients often may carry on for years without treatment and without any major symptoms developing. In this disorder, as in chronic myelocytic leukemia, X-ray treatment of the lymph glands and spleen is useful, as is the administration of various chemical agents such as chlorambucil. Under treatment, the patient can be kept in reasonably good health for many years; the life span in this disease is measured in terms of 5, 10 and even 15 years, occasionally longer. Ultimately, however, severe anemia develops, accompanied by a reduction in blood platelets and hemorrhagic manifestations, and death ensues. Other forms of leukemia are encountered rarely.

Other Neoplasms: The Lymphomas.—Disorders related to leukemia, *i.e.*, associated with neoplastic growth of cells formed in the blood-forming organs, lymph glands and elsewhere, are reticulum-cell sarcoma, lymphosarcoma and Hodgkin's disease, each of which also represent overgrowths of other types of cells found in the blood-forming organs and lymph glands. (*See* LYMPH AND LYMPHATIC SYSTEM.) In these disorders there may be no striking abnormalities in the blood even though large tumours develop in the lymph glands, spleen, bone and other tissues and in organs such as the stomach, liver, etc. Like all malignant growths they advance relentlessly into normal tissues. Their rate of advance varies, however. In general, the course of reticulum-cell sarcoma is brief, the patient succumbing in months or a year or two. The course of lymphosarcoma may sometimes be slower than this, while the course of Hodgkin's disease may vary greatly, ranging from six months in the rare case to several years in the majority and to many years in a few. Like chronic leukemia, these conditions are subject to treatment by irradiation as well as by certain chemical agents. Nitrogen mustard has been particularly valuable in the treatment of Hodgkin's disease.

Hodgkin's disease is the commonest of these conditions and differs from the others in that its course sometimes resembles that of an infectious disease rather than a tumour. There may be fever as well as glandular enlargement; leukocytosis often occurs. The disease generally starts as a painless lump, often in the neck. However, glands in many locations in the body, such as the chest cavity and the abdominal cavity, ultimately enlarge, as does the spleen. Anemia and weight loss ensue, and death ultimately occurs.

Multiple Myeloma.—Another neoplastic disorder, probably related to the above conditions, is multiple myeloma, which is characterized by a malignant overgrowth of plasma or plasmalike cells within the bone marrow. This severely painful disorder causes bony defects in the skull, the ribs, spine and pelvis that ultimately result in fractures. As the bone marrow becomes more and more involved, anemia develops and hemorrhages occur: leukopenia may develop, and abnormal myeloma or plasma cells can be demonstrated in the bone marrow. This disorder is associated with a peculiar disturbance in protein metabolism. Certain globulins may be found greatly increased in the blood, and the urine often contains a peculiar type of protein called the Bence Jones protein. A type of chronic kidney disease often develops, probably as result of the high concentration of Bence Jones protein in the kidney tubules; this frequently is the ultimate cause of death. In some cases the condition remains quiescent for a time, but death is inevitable. Adrenocorticosteroids and chemotherapeutic agents such as urethane and melfalan have been used in the treatment of multiple myeloma and, of these, the latter is the most promising.

BLEEDING DISORDERS

Several different agents keep blood from flowing out of the blood vessels and into the tissues: the lining of the blood vessels, the blood platelets (thrombocytes) and certain compounds and enzymes in the blood that tend to promote the formation of a clot.

The capillaries (minute blood vessels in intimate contact with the tissues) are elastic and have smooth linings; when the capillaries are cut, the linings normally retract about the injured area, serving to prevent further blood loss. The blood platelets are very small cellular particles (not actually cells) derived from the largest cells of the bone marrow—the megakaryocytes. The platelets number normally 200,000 to 400,000 per cubic millimetre of blood. (*See* BLOOD: *Platelets.*) They plug small leaks in blood vessels and participate in the clotting process. Disintegrating platelets release substances that take part in a series of complex chemical reactions in the blood that result in the production of a firm blood clot.

Causes of Bleeding Disorders.—*Vascular Weakness.*—In cases of vitamin C (ascorbic acid) deficiency (*see* SCURVY), capillary integrity is lost, and blood oozes into the tissues; under these conditions, *i.e.*, widespread capillary injury, the normal number of platelets (which tend to plug small breaks in blood vessels) is not sufficient.

Thrombocytopenia.—Reduction in the number of blood platelets is termed thrombocytopenia and accompanies various disorders of the blood such as aplastic anemia and leukemia. In such cases

thrombocytopenia is accompanied by changes in red cells and white blood cells. Thrombocytopenia may occur also in the absence of other changes in the blood: (1) it may be the result of sensitivity to some chemical agent, such as chlorothiazide, meprobamate, quinidine, various antihistamines, tranquilizers and other agents in common use; (2) it may be the effect of the action of chemical agents such as benzol or arsenic; or (3) it may result from irradiation. There is also a form of thrombocytopenia of unknown cause (idiopathic). Thrombocytopenia, if sufficiently severe, is accompanied by spontaneous bleeding from the capillaries; this causes either tiny purplish spots (petechiae) or larger black and blue areas (ecchymoses) to appear in the skin; bleeding occurs commonly from the nose and gums and occasionally from other sites such as the urinary tract and the intestines. When hemorrhage occurs in the brain, it is usually fatal.

Faulty Coagulation.—Deficiencies in any of the chemical and enzymatic factors involved in coagulation result in hemorrhages following minor injuries. In some of these disorders a specific deficiency is due to a heritable defect (*e.g.*, hemophilia); in others, a pathological condition may be responsible for the deficiency (*e.g.*, hypothrombinemia, etc.).

Purpura.—The general clinical disorder associated with the appearance of petechiae or ecchymoses is called purpura (*q.v.*). If it is associated with thrombocytopenia it is known as thrombocytopenic purpura; if it is associated with inherent vascular weakness it is termed a vascular purpura. Idiopathic thrombocytopenic purpura occurs not uncommonly in children; it is often self-limiting and may follow an infection. In some instances in children, and usually in adults, it is persistent. In such cases the removal of the spleen has been found to be effective in curing the disorder in about two-thirds of the cases.

Purpura also may occur in the absence of thrombocytopenia; it may be mild or quite serious. It is not unusual, especially in women, for black and blue spots to appear spontaneously, often on the thighs and to some extent on the arms. These ecchymoses, which may be painful, may be related to the menstrual cycle.

In Schönlein-Henoch purpura (allergic purpura) there may be associated joint or abdominal pain; this condition may be the consequence of some sensitivity, *e.g.*, to certain foods, drugs or infectious organisms. Recurrent streptococcal infection is a common cause of such a sensitivity reaction. Purpura may also occur in association with various infections such as meningitis and in scurvy.

Coagulation Disorders.—*Hemophilia and Related Disorders.*—In addition to the purpuras mentioned above, bleeding disorders due to various defects in the process of coagulation may occur. The best known of these is hemophilia, which is due to an inherited defect transmitted by the female but expressed only in the male. The abnormal bleeding, sometimes spontaneous but often the result of slight injuries, occurs as a consequence of a lack of antihemophilic globulin and may threaten the life of the victim or cripple him as a result of hemorrhages into joints.

The term "bleeder" once was considered to be more or less synonymous with hemophilia. Now that many other causes of abnormal bleeding besides deficiency of antihemophilic globulin have been discovered, the term "bleeder" has no specific meaning.

A closely related disorder is PTC (plasma thromboplastin component) deficiency, or "Christmas disease." The inheritance of this bleeding disorder is like that of hemophilia, but a different substance is lacking. As more knowledge has been gained concerning the intricate process of coagulation of blood, more and more bleeding disorders have been discovered. These include PTA (plasma thromboplastin antecedent) deficiency and various types of prothrombin deficiency. Many of these conditions are due to inherited defects, but others occur as result of action by toxic agents or other factors.

Hypoprothrombinemia, a deficiency in prothrombin, occurs most commonly in cases of obstructive jaundice, in which the flow of bile into the bowel is interrupted. Bile is necessary for the absorption of vitamin K, which is needed in prothrombin formation. When biliary obstruction is prolonged, vitamin K deficiency occurs and hypoprothrombinemia develops. Similar changes may take place when absorption of vitamin K is impaired, as in chronic diarrheas such as sprue (*q.v.*). Hypoprothrombinemia also occurs in the newborn as hemorrhagic disease of the newborn. This form of prothrombin deficiency can be prevented by administering vitamin K to the mother during labour. Hypoprothrombinemia can also be produced deliberately by the use of agents such as bishydroxy-coumarin in attempts to prolong clotting time.

Fibrinogenopenia refers to a reduction in the amount of fibrinogen (a plasma protein) in the blood. Fibrinogen is another substance necessary for coagulation. Fibrinogenopenia is seen in rare instances as a heritable disorder, but more commonly it is found as a complication of labour following pregnancy.

See M. M. Wintrobe, *Clinical Hematology,* 5th ed. (1961).

(M. M. We.)

BLOOD BANK. The blood bank, a key organization in medical care, collects, stores, processes and transfuses blood. The safety of stored blood was demonstrated by Oswald H. Robertson of New York while working with the British army in World War I. The first U.S. blood bank was established in 1937 at Cook County hospital, Chicago, by Bernard Fantus. Previously, the physician typed the patient's relatives and friends until the proper type was found, performed the crossmatch, bled the donor and transfused the patient.

The discovery of many new blood types important in transfusions, and of several new crossmatching techniques, led in the 1940s to the rapid development of blood banking as a specialized field and to a gradual shift of responsibility for the technical aspects of transfusion from practising physicians to skilled technicians and clinical pathologists.

The practicality of storing fresh blood for future needs made possible such dramatic innovations as exchange transfusions of "Rh babies," artificial kidneys and heart-lung pumps for open-heart surgery. Unfortunately, fresh blood can be stored only for a limited time; this creates the difficult problem of maintaining a steady supply of donors.

At some of the first blood banks, plasma was sometimes separated from the red corpuscles and used separately. Other fractions of blood subsequently became available. These included platelets to control bleeding; concentrated red corpuscles to correct anemia; and plasma fractions, such as fibrinogen to aid clotting, gamma globulin to prevent or modify measles and albumin to augment the blood volume in shock. Thus a single pint of blood might serve the varying needs of five or more patients.

See Blood: *Individuality of Human Blood;* Blood Transfusion; Blood Groups.

(F. H. A.)

BLOOD FEUD, a continuing series of killings and counterkillings among members of two consanguinal kin groups. It exists among many primitives and also in some folk communities within civilized societies where there is an absence of legal forms and procedures that lead to the punishment of an original homicide in a way that is acceptable to both parties.

Among most primitives the consanguinal kin group is characterized by a strong sense of collective solidarity which functions to protect its individual members against assault and injury by outsiders. It holds all the members of any other such group collectively responsible for any injury it suffers at the hands of the members of that other group. Thus a killing by a member of a particular group may mean that any member of this group may be killed in retaliation by his victim's kinsmen. If the counterkilling is done by "due process" and is by custom universally acknowledged as just and proper, there will be no blood feud. If, however, the counterkilling is not accepted as right and proper, and in consequence touches off a counter-counterkilling, blood feud is under way.

Institutional devices to forestall blood feud or to bring it to a close seem to have been developed in most primitive societies. Even though many peoples, such as the Trobriand islanders in Melanesia and the Nuer of the African Sudan, profess that honour demands revenge, composition for the homicide is the rule rather than the exception. Regulated combat was frequently used by the Australian aborigines as a substitute for blood feud. The establishment of a strong centralized political authority generally results in the suppression of blood feud.

In general, it may be said that the existence of blood feud represents a condition of internecine warfare contingent upon an absence of law or a breakdown in legal procedures. The threat of feud may also be seen as a factor inducive of legal settlement of serious wrongs. *See* also VENDETTA.

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(E. A. HL.)

BLOOD GROUPS. Blood groups are biological categories found in man and many other animals. Members of a particular group have in common certain specific substances (antigens) on the red blood cells. The name was applied originally to the four categories of human blood discovered first—those with antigen A, those with antigen B, those with both A and B and those with neither. These are the four classical blood groups A, B, AB and O discovered by Karl Landsteiner in 1900 and found to be of great importance in blood transfusion. Subsequently many other blood group systems, each based on different antigens on the red blood cell, have been discovered. An individual's blood group is determined by the genes he inherits from his parents. Since the groups are not normally alterable in healthy people, they have assumed considerable importance in forensic medicine (*e.g.,* cases of disputed parentage, identification of blood stains), in the analysis of genetic variability, and in the study of human genetics (*q.v.*) and anthropology. (*See* BLOOD: *Individuality of Human Blood;* HEREDITY.)

Blood groups are discussed in this article in three main sections: Blood Groups in Man; Blood Groups and Human Disease; and Blood Groups in Animals.

BLOOD GROUPS IN MAN

Blood consists of two phases; one includes the red cells, white cells and platelets; the other is a colloidal suspension—the plasma. When blood is taken from the body it separates into a solid clot and liquid serum. Serum contains all the circulating elements of plasma except those used up in the formation of the clot.

The red cells, which transport oxygen and carbon dioxide, also incidentally carry a number of antigenic substances that characterize the blood groups of the individual. An antigen has been defined as a substance that reacts, under suitable conditions, with another substance called its antibody. Antibodies are present in plasma. Blood group antibodies may occur naturally—that is, they may be present in an individual without artificial stimulation—or they may be of an immune type—that is, produced by artificial stimulation (by exposing the individual to an antigen he lacks). Artificial immunity may be produced deliberately, as in immunization to prevent disease, or unintentionally, if fetal red cells enter the maternal circulation in pregnancy. (*See* IMMUNITY.)

The reaction between an antigen and its corresponding antibody takes several forms, but the basis of blood group determination is the agglutination reaction, in which red cells clump together when they are treated with an antibody.

There are nine well-established major blood group systems in man. They are, in chronological order of discovery, ABO, MN, P, Rhesus, Lutheran, Kell, Lewis, Duffy and Kidd. As far as is known these blood group systems are inherited independently of one another. The independence of the more recently discovered Diego and Js systems is not yet fully established. In addition, a number of blood group antigens have been described that are called "private" because they are possessed by only a few people, usually members of the same family. When a new antigen is discovered care must be taken to exclude the possibility that it fits within a previously discovered system.

Antigens possessed by the majority of people are called "public." Two such antigens have not yet been fitted into a known blood group system; they are Vel (L. N. Sussman and E. B. Miller, 1952) and Yt^a (B. R. Eaton *et al.,* 1956).

ABO Blood Group System.—The naturally occurring antibodies in the plasma of one person may be capable of agglutinating the red cells of another person. These individual differences were discovered by Landsteiner, who formulated the classical ABO blood group system. Human beings may have either of the antigens A and B on their red cells, they may have both (type AB) or they may have neither (type O). The antibody corresponding to the antigen(s) which a person lacks is present in his blood plasma (*see* Table I). Exceptions to this rule occur in babies under six months old and in extraordinary cases.

TABLE I.—*The Antigens and Antibodies of the ABO Blood Group System*

Blood group	Antibody in serum	Antigen on red cells
A	anti-B	A
B	anti-A	B
O	anti-A and anti-B	neither
AB	neither	A and B

ABO Groups in Blood Transfusion.—In transfusion the important factor is the reaction between the donor's red cells and the recipient's antibodies. Thus, group O blood may be given to people of all groups, A blood may be transfused into A and AB recipients and B blood into B and AB recipients. Blood that is considered to be safe for transfusions is said to be compatible. An ABO incompatible transfusion can result in the death of the recipient, because of intravascular hemolysis and kidney failure. Before a transfusion is given it is standard practice to do a crossmatch test in which the donor's cells are tested against the recipient's serum. If there is no reaction in the crossmatch test the transfusion will be a safe one. This test also screens the recipient for antibodies, other than those of the ABO system, which could also influence the safety of the transfusion. In general the anti-A and/or anti-B present in the donor's blood does not adversely affect the safety of the transfusion, but occasionally the titre (*i.e.,* strength) of a donor's anti-A may be so high that his blood should not be given to group A recipients. (*See* also BLOOD TRANSFUSION.)

The ABO antigens have been found both in a fetus a few weeks old and in aged persons. The antibodies are not present in an infant at birth, but they begin to develop during the first year of life. If the blood from the umbilical cord contains any anti-A or anti-B this is maternal in origin.

Inheritance of ABO.—It has been established that the blood groups of children are determined by the genes passed on from the parents. The material that carries the inherited information is contained in the chromosomes. The chromosomes are present in all nucleated cells. In man there are two sets of 23 chromosomes in the ordinary cells, but in the reproductive cells only one set. The double number is restored at fertilization when the egg fuses with a sperm, the resulting cell being called a zygote. All inherited characters are determined by chromosomal units known as genes, each of which has a definite locus (position) on a chromosome. Genes that may occupy the same locus are termed alleles; thus, for instance, the genes of the ABO system form an allelic series, since only a single *A, B* or *O* gene is present at the locus on its particular chromosome. A person having type AB blood has received an *A* determining gene from one parent and a *B* from the other; such a person is heterozygous. A person who has received the same type of gene from each parent, *e.g., OO,* is homozygous. If a child receives a dominant gene from one parent this will be expressed in the child regardless of the contribution from the other parent; since both *A* and *B* are expressed in the heterozygote one is not dominant to the other. If a child receives an *A* or *B* gene from one parent and an *O* gene from the other, only the *A* or *B* gene will be expressed so both A and B are dominant to the recessive *O*. The *OO* "genotype" is homozygous recessive. A child's phenotype can be defined by a laboratory test, but the genotype can be described only if the contribution from both parents can be deduced. The four phenotypes and six genotypes of the *ABO* system are shown in Table II.

In 1911 a subdivision of the A phenotype into A_1 and A_2 was described. The A_1 gene is dominant to A_2, and A_2 is dominant to *O*, so that there are six phenotypes and nine genotypes. The presence of B does not prevent the detection of A_1 or A_2. It is not usually necessary to consider the A_1, A_2 differences in blood transfusion.

TABLE II.—*ABO Blood Group System*

Phenotypes	Genotypes	
	Homozygous	Heterozygous
A	*AA*	*AO*
B	*BB*	*BO*
AB	—	*AB*
O	*OO*	—

ABO Groups and Anthropology.—In different populations the number of persons belonging to each phenotype of a particular blood group system is not the same. The results may be expressed as a simple percentage that gives the phenotype frequency. From this may be computed, if the sample is adequate, the percentage of persons carrying a particular gene; *i.e.,* the genotype frequency.

In the ABO system a high frequency of group O is found in northwestern Europe, southwest Africa, parts of Australia, and in the Indians of south and central America. Proceeding eastward across Europe into Asia the frequency of B rises and the maximum is reached in central Asia and northern India. The frequency of A is high in Europe, western Asia and among the aborigines of the southern part of Australia, and is highest of all in certain American Indian tribes. The distribution of ABO groups among white Americans reflects their European origins—O, 45%; A, 41%; B, 10%; AB, 4%.

The distribution of the ABO groups may show very local variations that can be detected by large sample surveys. For example, in England there is a slight fall in A and rise in O from the south to north. The frequency of the ABO groups in one survey in southern England was found to be: O, 45%; A, 43%; B, 9%; AB, 3%. In the United Kingdom 20% of A individuals belong to the A_2 phenotype.

Secretion of Blood Group Substances.—As they occur on the red cells, the ABO blood group substances are in an alcohol-soluble form. In the United Kingdom and among white Americans about 75% of the population secrete ABO blood group substances in a water-soluble form in the tissue fluids and glandular products such as saliva, gastric juice and tears. Persons whose secretions do not contain ABO blood group substances are called nonsecretors. The secretor phenotype is determined by the presence of at least one *Se* gene. A person, if a secretor, produces only the ABO substances present in his own red cells: thus, an A secretor secretes A substances, a B secretor secretes B substances and an AB secretor secretes both. The substance secreted by O secretors is called H substance, and it is not peculiar to group O individuals. H substance occurs in the secretions of secretors of all groups, and so it cannot be regarded as the specific product of an *O* gene. The secretor system is inherited independently of the ABO system, indicating that the genes of the two systems are probably on different chromosomes.

MNSs Blood Groups.—In 1927 Landsteiner and P. Levine described the MN blood group system. The antibodies anti-M and anti-N were produced in experimental animals by immunization with human blood; in general they do not occur naturally. All human blood can be classified as M, MN or N. The antigens are determined by two independent genes, *M* and *N*. At this uncomplicated stage the groups provide a simple example of Mendelian inheritance in man (*see* Table III).

In 1947 the Ss subgroups of MN were discovered by R. Sanger and her co-workers. Both S and s antigens can now be identified in a positive way because both anti-S and anti-s antiserums (serums containing antibodies) have been discovered. A parent hands on to his child *MS, Ms, NS* or *Ns* as a unit so that, for example, the children of an MSNs father receive either *MS* or *Ns* from him, but not *NS* or *Ms*. The genetical interpretation is either that the MNSs locus is occupied by a single complicated gene or that two genes with adjacent loci are involved.

TABLE III.—*MN Blood Group System*

Parents		Children
Phenotype	Genotype	Genotype
M×M	*MM*×*MM*	All *MM*
M×MN	*MM*×*MN*	½*MM* ½*MN*
M×N	*MM*×*NN*	All *MN*
MN×MN	*MN*×*MN*	¼*MM* ½*MN* ¼*NN*
MN×N	*MN*×*NN*	½*MN* ½*NN*
N×N	*NN*×*NN*	All *NN*

The MNSs blood groups are not important in transfusion except in special cases. Other rare antigens belonging to the MN system are known, besides those discussed above.

The P Blood Group System.—Landsteiner and Levine discovered the P blood group system concurrently with the MN system in 1927. The first antibody was made in an experimental animal, but the same antibody can occur naturally in man, horses, rabbits, pigs and cattle.

The P groups are not important in transfusion. P subgroups have been identified.

The Rhesus Blood Group System.—The Rhesus (Rh) blood group system was discovered by Landsteiner and A. S. Wiener in the United States in 1940. Rabbits and guinea pigs formed an antibody in response to immunization with red cells from the Rhesus monkey. The agglutination or nonagglutination of human red cells in vitro with this anti-Rh antibody made possible the recognition of two phenotypes, Rh-positive when the red cells agglutinated and Rh-negative when they did not. The frequency of the Rh-negative type in western Europeans is about 15%. (Subsequently antibody with the same specificity as the original anti-Rh was found in the serums of Rh-negative women who had had Rh-positive children, and among Rh-negative recipients of Rh-positive blood. (See *Blood Groups and Human Disease,* below.)

In the present state of knowledge a full understanding of the genetics of the Rh system is not possible. The question of nomenclature is also controversial. There are two alternatives: first, the nomenclature of R. A. Fisher based in the first instance on his interpretation of the findings of R. R. Race and others in the United Kingdom; secondly, the notation of Wiener, which is in use in laboratories in the United States. It is not the facts that are disputed, but the interpretation of the reactions of certain critical antiserums, and the properties of the various Rh antigens.

A large number of different antigens that certainly belong to the Rh system can be detected on the red cells. These antigens are detected by antiserums, formed through immunization in human subjects, which have a different specificity from that of the original anti-Rh antibody. It is possible to explain most of the experimental observations made up until 1953 on the basis of a series of allelic genes arranged in three pairs at adjacent loci.

All Rh-positive persons have D antigen on their red cells; the D antigen is absent from the cells of Rh-negative individuals who are assumed to be genotype *dd*. The antigens C, C^w, c, E and e can be recognized in a positive way with the corresponding specific antibodies; d antigen cannot be positively identified. The Rh gene complexes that are common in western Europeans are shown in Table IV.

Wiener regards the Rh system as being controlled by a single locus with multiple alleles.

Rare Rh Antigens (in Fisher Notation).—D^u antigen gives some but not all of the reactions of a regular D antigen. Certain forms of D^u antigen are due to the presence of rare alleles at the D locus. C^x, C^u, c^v are rare alleles at the C locus. E^u and E^w are rare alleles at the E locus.

A Rare Rh Chromosome.—Several examples of blood that appear to lack all antigens of Cc and Ee series have been described. (The genotype is represented — D — / — D — in the Fisher notation.) A small loss of genetic material has been postulated as an explanation. In the homozygous form the D antigen is extremely powerful. Heterozygotes can be detected.

Developments After 1953.—After 1953 R. E. Rosenfield and his co-workers discovered two additional antiserums, the reactions of which cannot be satisfactorily explained by postulating additional allelic pairs on the Rh chromosome. The first of these, anti-hr (f or ce), reacts with a compound antigen presumed to be the product of the genes *c* and *C* but only when they are together on the same chromosome. The second antiserum, anti-rh_i (Ce), reacts with the products of *C* and *e* when they are on the same

TABLE IV.—*The Rh Chromosomes Common in Western Europeans*

Fisher's notation*	Shorthand British notation	Wiener's notation	Frequency (in England)
CDe	R_1	R^1	40.7%
cde	r	r	38.9%
cDE	R_2	R^2	14.1%
cDe	R_0	R^0	2.6%
C^wDe	R_1^w	R^{1w}	1.3%
cdE	R'	r''	1.2%
Cde	R'	r'	1.0%
CDE	R_z	R^z	0.2%

**CdE, C^wDE* and *C^wdE* are also known to exist.

chromosome. Thus it would appear that the genetic sites that determine the C and E antigens overlap.

An Rh antigen called G, discovered in 1957 (F. H. Allen), threw into question the specificity of serums that are mixtures of anti-C and anti-D.

Rh Antigens Rare in Europeans.—The antibody anti-V was discovered by A. DeNatale and co-workers in 1955. The V antigen is extremely rare in whites, but about 40% of West Africans and 26% of New York Negroes have the antigen. The antigen has been detected only in combination with cDe and cde.

Certain peculiarities that have been found in Negro blood samples in connection with their reactions with anti-C have been attributed to racial differences in compound Rh antigens.

Genetic Linkage.—Genes that are on the same chromosome are said to be linked. During the process of formation of gametes (cells for sexual reproduction) there is often an interchange of genetic material between partner chromosomes. Genes that are on the same chromosome in the parent may by this process of recombination be separated in the offspring. Genes that are very close together will rarely, if ever, be separated. If a gene is regarded as a unit of recombination it has not been proved that the Rh genes occupy more than a single locus. The concept of the gene is changing so rapidly that all that may safely be said is that the Rh complex is determined by a certain section of genetic material on a particular chromosome. Genetic linkage exists between the Rh locus and the locus of one type of inherited oval red cells (normal red cells are round) (S. D. Lawler, 1953).

Other Blood Group Systems.—*Lutheran.*—This blood group system was described by Race and S. T. Callender in 1946. The anti-Lutheran (anti-Lu^a) antibody was an immune one. There are two phenotypes Lu(a+) and Lu(a−). The genes are *Lu^a* and *Lu^b*. Anti-Lu^b has been described by M. Cutbush and I. Chanarin. The Lu(a+) phenotype has a frequency of about 7% in western Europeans. The Lutheran blood group does not normally need to be considered in transfusion. The Lutheran blood group locus is genetically linked to the secretor locus (J. Mohr, 1951).

Kell.—This system was discovered by Race, R. R. Coombs and A. E. Mourant in 1946. The antibody (anti-K) was immune; about 9% of western Europeans are Kell positive. The gene *K* has a positively identified allele *k*. The Kell system has been complicated by the discovery, by F. H. Allen and co-workers in Boston, Mass., of new antigens that belong to it.

Lewis.—The Lewis system was originally described as a blood group system by Mourant in 1946. There are now two Lewis antibodies anti-Le^a and anti-Le^b. Four different phenotypes may be identified when testing red cells. Le(a+b−), Le(a−b+), Le(a−b−) in adults and children and Le(a+b+), which is found only in young infants. Everyone with Le(a+b−) red cells is a nonsecretor of ABH substances, and everyone who is Le(a−b+) is a secretor. Le(a−b−) persons may be secretors or nonsecretors. The Lewis substances are not only present in the red cells but also in the secretions. A Lewis positive individual is best defined as one who secretes Lewis substances in the saliva. The Lewis locus in this sense is inherited independently of the ABH secretor system, but the expression in the phenotype depends on the interaction with the *Sese* genes. The Lewis groups are not usually important in transfusion.

Duffy.—This system was discovered by Cutbush, P. L. Mollison and D. Parkin in 1950. There are now two antibodies, anti-Fy^a and anti-Fy^b, and four phenotypes: Fy(a+b−), Fy(a+b+), Fy(a−b+) and in Negroes Fy(a−b−). The genes *Fy^a* and *Fy^b* are alleles, and there may be a third allele common in Negroes.

Kidd.—This system was discovered by Allen *et al.* in 1951. There are two antibodies, anti-Jk^a and anti-Jk^b, and the phenotypes are Jk(a+b−), Jk(a+b+), Jk(a−b+); an example of Jk(a−b−) has been described. The groups are technically difficult to determine but the families that have been studied support the hypothesis that *Jk^a* and *Jk^b* are alleles.

Diego and Js.—The Diego system (M. Layrisse *et al.*, 1955) has been shown to be independent of most of the known systems. The Di^a antigen has been found only in the blood of American Indians, Japanese and Chinese. The independence from the known systems of a new antigen called Js, found in the blood of Negroes (E. Giblett, 1958), was not fully established by 1960.

BLOOD GROUPS AND HUMAN DISEASE

During pregnancy a mother may be exposed to antigens that she herself lacks because fetal red cells may leak into the maternal circulation. If this results in the formation of antibody then the action of this on the red cells of the fetus may produce the disease known as hemolytic disease of the newborn. This disease, also called erythroblastosis fetalis, is usually caused by the Rh antibody anti-D (anti-Rh_0) and occurs once in about 166 births in the United Kingdom and the United States. Slightly more than half the infants born with this disease require treatment, consisting of partial replacement of the child's blood. An adequate maternity service should test the blood of every Rh-negative mother for Rh antibodies. Since hemolytic disease of the newborn is almost unknown in a first pregnancy in the absence of previous exposure to the Rh antigen D (Rh_0), care must be taken that Rh-negative females do not receive Rh-positive blood, which would sensitize them to the Rh antigen D. A Rh-negative woman who is married to a Rh-positive man usually does not produce Rh antibodies until after her first or second pregnancy. (*See* FETAL DISORDERS: *Erythroblastosis Fetalis;* PREGNANCY: *Rhesus Factor.*)

Hemolytic disease also can occur as the result of the formation of "immune" anti-A in the group O mothers of A_1 children. ABO incompatibility between mother and fetus usually does no harm. Anti-Kell antibody has been the cause of severe hemolytic disease on many occasions.

It has been shown in large sample surveys that there is an association between the ABO blood groups and certain diseases. For example, individuals of group A are about 20% more likely to develop cancer of the stomach than persons of groups O and B.

BLOOD GROUPS IN ANIMALS

Blood group differences between animals of the same species have been described in birds and mammals including chickens, doves, rabbits, pigs, horses, sheep, cattle, goats, cats, dogs, rats and mice. The blood groups of cattle, in particular, have been extensively investigated.

Hemolytic disease of the newborn, due to incompatibility between female parent and offspring, has been described in mules, pigs and thoroughbred foals. Substances similar to human A and B are found in many living organisms from bacteria upward. The blood groups of Primates can be determined with human anti-A and anti-B serums. All chimpanzees belong to groups O or A, orangutans are group B, gorillas may be B, and gibbons of groups A, B and AB have been described. The lower Primates have no antigens on their red cells, but they secrete ABO antigens in saliva. Old-world monkeys are mostly group A and so are new-world monkeys, except for a few that have a B-like antigen in their saliva. Antigens resembling human M are found in some Primates. The chimpanzee has been found to possess M and N. Rh antigens are found in Primates.

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BLOOD INDIANS: *see* BLACKFOOT.

BLOOD PRESSURE is the force exerted by the blood against the walls of the blood vessels. It is created by the pumping action of the heart. For an understanding of the term, a brief consideration of the conditions under which the blood circulates in the body is necessary. The blood passes from the heart throughout the body by way of a system of tubes, blood vessels, that eventually return the blood to the heart. This movement through the various vessel circuits is so rapid that a given drop of blood usually requires less than one minute to complete a circuit from and back to the heart.

A single tube leading from the heart divides into smaller and smaller vessels, the arteries. Finally, the smallest arteries branch into the most minute blood vessels, the capillaries. Through the thin walls of the capillaries the blood supplies the body with oxygen from the lungs and food materials from the intestine and collects the waste products of the body for subsequent removal by the kidneys and other avenues. Beyond the capillaries the branching process is reversed. The capillaries unite to form slightly larger tubes, which in turn join to form larger vessels, known as veins, and eventually the blood is returned to the heart by two large veins.

The blood is moved through this system of vessels chiefly by the heart, which, by its rhythmic pumping action, creates within the arteries pressure that is gradually spent in moving blood through the vessels back to the heart. The blood pressure is, of course, greatest in the arteries and least in the veins.

In common medical usage, however, blood pressure means the pressure of the blood in the arteries and specifically the pressure in the large artery of the arm where it is usually measured. The greatest pressure, which occurs during contraction of the heart, is known as the systolic, and the lowest pressure, during the relaxation or rest period, is known as the diastolic. In normal man, the average systolic blood pressure is equal to the pressure exerted by a column of water 5½ ft. high or a column of mercury 120 mm. high. The average diastolic pressure is 80 mm. of mercury.

The blood pressure varies from one individual to another and in the same person from time to time. Thus it is lower in children than in adults and increases gradually with age. The blood pressure of women is slightly less than that of men. It is slightly increased in those who are overweight. During sleep the pressure is decreased slightly; during exercise it is increased. Likewise, a rise in pressure frequently occurs during emotional excitement—the basis for the recording of blood pressure as part of the so-called "lie-detector" test. These increases are temporary and simply reflect normal adjustment of the heart and blood vessels to meet an emergency.

High Blood Pressure.—When the blood pressure remains persistently or permanently above the normal range, the condition is known as high blood pressure (hypertension). High blood pressure and hardening of the arteries are the principal causes of heart and kidney disease in later years. While the exact cause of the common form of high blood pressure remains unknown, there is evidence that the nervous system, the endocrine glands and the kidneys are involved. In some way these organs cause constriction or narrowing of the smallest or microscopic arteries of the body. As a result, the heart must pump more forcefully to move the blood through the narrowed vessels into the capillaries, thereby increasing the blood pressure. High blood pressure has been produced experimentally in dogs by partial constriction of the renal arteries supplying the kidneys.

Certain drugs, under medical direction, are efficacious in the treatment of high blood pressure. A low salt diet is effective in about 10% of patients treated. Overweight should be combated by a moderate reducing diet. A nerve-sectioning operation produces what is tantamount to a cure in about 10% of patients, but it is used only infrequently because of the effectiveness of drug treatment.

Low Blood Pressure.—Low blood pressure (hypotension) usually means a condition in which the pressure remains persistently below normal without any evidence of disease. Persons with this condition have a longer life span than those with normal blood pressure because they are less likely to develop hypertension.

See ARTERIES, DISEASES OF; CIRCULATION OF BLOOD; HEART, DISEASES AND DEFECTS OF; *see* also references under "Blood Pressure" in the Index.

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(G. E. W.)

BLOODROOT (*Sanguinaria canadensis*), a North American plant of the poppy family, Papaveraceae, called also red puccoon, common in rich woods in eastern North America. It is a low, smooth, bluish-green perennial which blossoms usually before its own leaves or those of its native woodland unfold. The showy white or pinkish flowers, about two inches broad, are usually borne singly on stalks about eight inches long. The flower stalks and the large, rounded, many-lobed leaves rise from a horizontal rootstock, often an inch thick and several inches long. The rootstock, together with other parts, is surcharged with an acrid, orange-red juice, whence the name. The plant contains an alkaloid, sanguinarine, used in medicine. Throughout its range the bloodroot is one of the most attractive early bloomers and is often transplanted for ornament.

PHOTOGRAPH, J. HORACE MCFARLAND CO.

BLOODROOT (SANGUINARIA CANADENSIS) IN BLOOM

In Great Britain the name bloodroot is sometimes applied to the tormentil (*Potentilla tormentilla*) and the crimson cranesbill (*Geranium sanguineum*).

BLOODSTONE (HELIOTROPE) is a dark-green variety of cryptocrystalline silica or quartz, having nodules of bright red jasper or impure opaque quartz distributed throughout its mass. Polished sections therefore show red spots on a dark-green background, and from the resemblance of these to drops of blood it derives its name.

The word heliotrope is derived from the Greek *helios*, "sun," and *trope*, "turning," in reference to its supposed power to turn the sun's rays red.

It was greatly prized in the middle ages and used in sculptures representing flagellation and martyrdom; it later became of small importance. On heating, the red spots turn black and the green background changes to gray.

See also GEM; SILICA.

(W. A. W.)

BLOOD TRANSFUSION. The development of blood transfusion, from the vague illusions in the early mythologic period to the modern scientific and therapeutic procedure, forms one of the most fascinating chapters in medical history. The fairly late advances in this field and the simplification of apparatus and methods make blood transfusion so easy that in most modern hospitals, instead of having an expert or a specialist—the transfusionist, formerly called upon to perform all necessary blood transfusions—the youngest intern usually is responsible for the transfusions performed each day.

The antiquity of the concept of blood as a therapeutic agent is difficult to establish. It began with the origin of medicine itself. Ancient Egyptians used blood baths for resuscitation and recuperation, and Romans were said to have rushed into the gladiatorial arena to drink the blood of dying victims as a method of rejuvenating themselves. Probably in all such cases the blood was taken by mouth rather than by vein and therefore had very little beneficial effect. Certainly blood transfusion as it is now understood could not have been practised at a time when the circulation of the blood was not recognized. So it is difficult to determine exactly when transfusion in the modern sense (injection into the circulation of the patient) was first performed, and con-

siderable controversy exists regarding claims of priority. For example, there is the oft-quoted and supposed transfusion of Pope Innocent VIII in 1492. In an effort to bring the elderly pontiff out of a state of coma, he was supposed to have received the blood from three young men, but to no avail. Not only did he succumb promptly but so did the donors. Quite probably here, too, the blood was administered as a drink.

In the evolution of the modern practice of blood transfusion there are certain outstanding historical landmarks, first in 1628 when William Harvey announced his theory of the circulation of blood. His discovery made possible a clear idea of blood transfusion as a therapeutic measure and led to devising means of transferring blood from a vigorous to a debilitated subject; it started energetic experiments on the injection of various substances into the blood stream. However, it was not until after the middle of the 17th century that authentic references to blood transfusion are found. Descriptions of four or five different methods, using hollow goose quills, hollow metal tubes (mostly of silver) and even crude valves are found in medical literature. One of the first authenticated reports is that of Richard Lower, who performed a successful transfusion in 1665. Quills were used by Lower at first, and later silver tubes, to convey the blood from the artery of one dog to the vein of another. Two years later, he transfused a healthy but mildly insane man with the blood of a lamb. This is described in the Pepys' *Diary;* a demonstration was given before the Royal society in London. Apparently there was little effect, either in disturbing the recipient's good physical state or mending his poor mental one.

At about the same time in Paris, Jean Baptiste Denis, physician to Louis XIV, performed the first authentically recorded successful transfusion on human beings. The story is that a young patient who had obscure fevers had been treated by the common prevalent method of repeated bloodletting from his veins until he was in a state of extreme exhaustion and profound anemia. Denis administered about a half pint of blood of a lamb and the boy made a "remarkable" recovery. In view of modern knowledge that the blood of one species cannot be transfused into another without fatal or near-fatal reaction, this is indeed remarkable if true. Denis performed several more transfusions, one of which, however, was fatal. Charges were preferred against the physician and following a long legal battle he was exonerated of murder but remained in such disrepute that both he and the procedure of transfusion were decreed criminal by the Faculty of Medicine in Paris and banned, supposedly forever. A short time later, the English parliament also specifically prohibited the operation and the magistrates of Rome followed suit. Interest in transfusion thereafter quickly lapsed throughout Europe.

Reintroduced in England.—It was not until early in the 19th century that transfusion of blood was once more considered as a possibly useful therapeutic procedure. An English obstetrician, James Blundell, revived interest in it because he was overwhelmed by his helplessness in combating serious and often fatal hemorrhage during childbirth. After many experiments on animals, he devised a special apparatus for performing transfusions and saved a certain number of anemic patients by his efforts. Many physicians followed his lead.

During the third quarter of the 19th century, transfusion was performed with increasing frequency. Until this time there had been only 347 human blood transfusions and 129 cases in which animal blood was used. Then, new and more practical needles, syringes, valves and apparatus in general were devised. With a better understanding of physiology, more physicians and scientists became aware of the possible dangers of the use of blood from animal sources in human transfusions and emphasized the fact that the serum of one species "may be a direct poison for the blood cells of another." The lack of knowledge of blood groups and incompatibilities had resulted in severe reactions and increased fatalities. This again resulted in the eventual consideration of transfusion as a hazardous procedure to be used only as a last resort. Moreover, salt solution was introduced at about this time and its safety and efficacy for injection were demonstrated, so that blood transfusion again was virtually abandoned and not considered seriously until the beginning of the 20th century.

Probably the greatest achievement and the most important single discovery in the history of blood transfusion was the demonstration by Karl Landsteiner in 1900 of the blood groups in humans and their practical significance in helping to choose blood compatible for transfusion. The adoption of an international nomenclature as proposed by Landsteiner using the letters A, B and O overcame the difficulties of numerical classification used in many countries.

Asepsis had been perfected with the advent of improved surgical techniques, thereby making injection of materials into the body much safer. Apparatus was devised as the need arose and in the modern period the development of transfusion became dependent upon the recognition of mechanisms of blood clotting and attempts to prevent blood from clotting so that its transfer could be effected from one individual to another. The next great advance was the use of an anticoagulant chemical, sodium citrate, which permitted blood to be taken into a container during constant mixing with a solution of the citrate and transfused without danger of clotting through delay of only a few minutes. This addition of a chemical was called the indirect method of transfusion; as its simplicity and safety were appreciated the former direct method consisting of connecting the blood vessel of the donor with that of the recipient became outmoded. In 1915 Richard Lewisohn perfected the technique and standardized the dosage addition of sodium citrate to blood, thereby rendering transfusion extremely simple and practical. Its standardized use in military medicine during World War I increased its popularity. Later, the difficulty of preserving blood for longer than a few days was solved by the introduction of new diluent solutions composed of sodium citrate, citric acid and glucose, which permitted the storage of blood at ordinary refrigerator temperatures up to 21 days with a survival of 70% or more of the red cells and thereby made the modern blood bank a practical life-saving asset in most hospitals.

In the 1930s the plasma, or fluid part of the blood, first began to be used as an effective weapon to combat serious shock, particularly when whole blood itself might not be needed. Since 70% to 80% of battle wounds are accompanied by shock, it was realized at the very beginning of World War II that the fluid part of the blood would be extremely useful in treatment of the wounded. Plasma has important advantages over whole blood for such treatment, since once the red cells have been removed, typing of the blood is less necessary because plasma from one individual can generally be given to anyone else regardless of the blood groups. Another advantage is that plasma can be stored for months since it does not deteriorate as do the blood cells and can be kept well preserved either in a frozen state or dried to a powder that can be dissolved in sterile water when needed for injection. The British began collecting blood needed to produce plasma for the battle fronts in 1939. In 1941 the American Red Cross, at the request of the army and navy and under guidance of the National Research council, began to collect blood for preparation of plasma for the U.S. armed forces. Most of the blood collected was converted to dried plasma, although late in the war a considerable amount was flown to the battle fronts and used as whole blood in the treatment of battle casualties.

Cohn's Fractionation.—A significant advance in the use of blood and portions of the blood was the result of the work of Edwin J. Cohn and his associates at Harvard university. Through the development of methods of separating and purifying the various protein fractions of plasma in unaltered form, they were able to extend the usefulness of portions of the blood and to indicate the path of future progress in treating specific diseases and deficiencies of the body with special blood derivatives. The first practical application of Cohn's new methods of separation or fractionation of the plasma was the development of serum albumin. This fraction accounts for 50% of all the protein in the plasma and is mainly responsible for the shock-combating value of plasma, since it helps to hold fluid in the blood stream. During World War II, several pharmaceutical firms produced serum albumin, by Cohn's methods, from plasma collected by the American Red Cross. Serum albumin had the great advantage of being

five times as concentrated as the plasma; being bottled in liquid form, it did not need reconstitution with water as did the dried plasma; it could be transported ready for use in a much smaller package. Finally, through a method of pasteurization, it could be freed of contamination by the virus of serum hepatitis, which was a serious complication occurring in a small percentage of plasma-treated patients.

Serum albumin was thus the first of a series of products from blood that are specific and better for certain medicinal uses than is whole blood. Other fractions of blood that came into common usage and have specific value included immune serum globulin, fibrinogen and antihemophilic globulin.

Immune serum globulin, or gamma globulin, is a relatively small portion of the plasma that contains the antibodies or chemical substances that help fight disease caused by invading bacteria and viruses. Most of these antibodies are highly specific and have developed in the human body as the result of former contact with a specific organism or virus. Thus, the individual who has had an attack of measles develops specific antibodies or chemicals that attack the germ causing the measles and thereby prevent its usual recurrence. Or when such antibodies in gamma globulin are injected into a susceptible person, they protect the recipient for three or four weeks.

Gamma globulin was also found useful in the treatment of the form of liver disease called infectious jaundice, or infectious hepatitis. Later, following field trials in epidemic areas, it was thought that infantile paralysis may be temporarily prevented or extensive crippling avoided by injection of gamma globulin into susceptible contacts. It was found that by collecting plasma from individuals with a recent specific disease such as mumps and fractionating this plasma into the gamma globulin portion, a serum could be obtained to modify certain diseases and possibly protect against them for a short period of time. This was of special value in certain epidemic diseases like mumps and German measles (which may be serious for women in the early stages of pregnancy because it may harm the fetus).

Fibrinogen is a plasma protein that is specifically necessary in the clotting of blood and thereby stops hemorrhages or fills breaks in blood vessels following injury. In certain disease states where the fibrinogen level of the blood becomes depressed or the body is unable to produce sufficient fibrinogen to prevent bleeding, the injection of this blood fraction may be life-saving or may restore to normal activity an individual whose low fibrinogen level had produced hemorrhages and danger of bleeding. Fibrinogen also proved of value when prepared in a solid form and used locally as a sponge or as a film to control bleeding and to protect denuded areas.

A little-known fraction of the plasma was found to be most important in speeding up the clotting of individuals suffering from the hereditary bleeding defect called hemophilia. This fraction, called antihemophilic globulin, must be prepared from fresh plasma shortly after blood is removed from the body because of the fragility of this protein and its rapid rate of deterioration. The fraction, injected intravenously into patients suffering from hemophilia, controlled the tendency to bleed.

The greatest handicap to the long-time preservation of whole blood was the relatively rapid deterioration of the red cells after collection through rubber-tubing into glass bottles; this technique permitted the cells to undergo more rapid destruction after three to four weeks of storage even at constant refrigerator temperatures. In the early 1950s, plastic tubes and plastic containers were developed. These presented a nonwettable surface to which blood would not stick and cell degeneration was less rapid. At the same time, methods of quick-freezing red cells were introduced, and, for the first time, truly prolonged storage and stock-piling of blood became possible, thereby making economy in the use of blood a reality. It was necessary, however, to develop refrigerated centrifuges to separate plasma from red cells rapidly and then by addition of glycerol to protect the cells from damage as they were brought to a temperature of −80° C. or lower. In numerous tests, it was found that at this low temperature, even at the end of many months, most of the red cells were normally viable after removal of the glycerol and transfusion. Multiple units suitably prepared and crossmatched were given to recipients with the expected benefit and no untoward reactions.

New Surgical Techniques.—In the late 1950s, complicated surgery on the heart and great vessels became possible; part of its success was due to the availability of large amounts of relatively fresh, as well as stored, blood. Open-heart operations, in which the circulation of blood through the body is taken over by a variety of mechanical pump-oxygenators while the heart's action is stopped by drugs and the interior exposed for various repair and shunting operations, requires the use of large amounts of blood, often from 5 to 20 pints per patient.

Surgical procedures on the heart, blood vessels, lungs, brain and other delicate organs, previously considered impossibly lengthy or dangerous, could then be undertaken. These operations introduced new problems: in blood procurement, the need for large amounts of rare types for patients with unusual blood types; in use of other anticoagulants such as heparin and chelating agents (which remove all the calcium from the plasma and thus prevent clotting) instead of citrate solutions formerly used safely for single or small volume transfusions but toxic in large quantity; in crossmatching not only the recipient's blood sample against the blood of each donor but also that of each donor against all other donors.

Thus, blood transfusion came to serve much more than its earliest purpose, which was to save the life of a bledout patient. It developed as important replacement therapy for shock and protein deficiency through the use of plasma or albumin, for chronic anemia through the use of red cells without plasma, for clotting-factor deficiencies remediable by plasma and special plasma fractions like fibrinogen and for lack of antibodies through injection of gamma globulin. With the need for large pools of blood for extensive surgery and extra-corporeal circulation (the function of the heart and lungs being replaced by a mechanical pump and oxygenator), transfusion services with their complicated laboratory procedures and a variety of blood-banking methods became not just an important but a truly vital part of modern hospital operations.

See Blood Bank; Blood Groups; Hemorrhage.

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BLOOD VESSELS, SURGERY OF. Surgery of blood vessels consists of various operative procedures directed toward cure of vascular abnormalities of congenital origin or produced by injury or disease. Such surgery was envisioned from the earliest times, and beginning in the 18th century a number of methods of treatment were proposed; most of these were palliative rather than curative and the results were generally poor. Lack of knowledge of asepsis, anesthesia and blood transfusion precluded performance of this type of surgery past the experimental stage, and even such pioneers as Alexis Carrel and R. Matas in the late 19th century were hampered in their efforts to suture blood vessels successfully. It was not until the early 1950s that an aggressive approach was directed toward cure by extirpating the lesion and restoring normal function of the vessel.

Congenital lesions include such anomalies as coarctation of the aorta (constriction of the largest blood vessel in the body, which impedes the flow of blood to vital parts; fig. 1[A]). The commonest and most serious of acquired diseases are aneurysm (swelling due to destructive weakness of the vessel wall; fig. 1[B]), arteriosclerotic occlusive disease (fig. 1[C]) and injuries. All these may be considered to have a poor prognosis, associated with progressively disabling symptoms and ultimately lethal complications.

The stimulus for modern interest in blood vessel surgery was probably provided by the reports of R. E. Gross and of C. Crafoord and G. Nylin in 1945 of successful treatment of a case of coarctation of the aorta by resection and re-establishment of continuity of the vessel by sewing the cut ends together. Developments from that time were rapid and led to the use of homografts

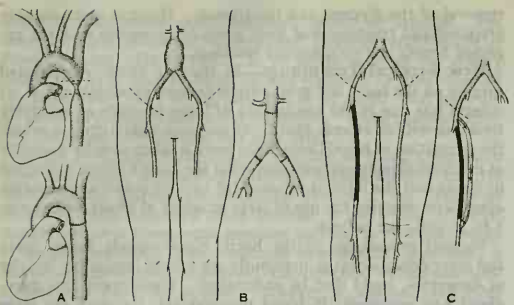

FIG. 1.—SURGICAL REPAIR OF (A) COARCTATION OF AORTA; (B) ANEURYSM OF ABDOMINAL AORTA; (C) ARTERIOSCLEROTIC OCCLUSIVE DISEASE

and later to tubes made of nylon, Dacron or Teflon fabric to replace excised segments, thereby permitting application of this form of therapy to various lesions.

In general, three operative methods may be employed depending upon the nature and extent of the disease:

1. Excision of the diseased segment and restoration of continuity by end-to-end anastomosis or by means of a graft. This is illustrated in fig. 1. The constricted segment of aorta between

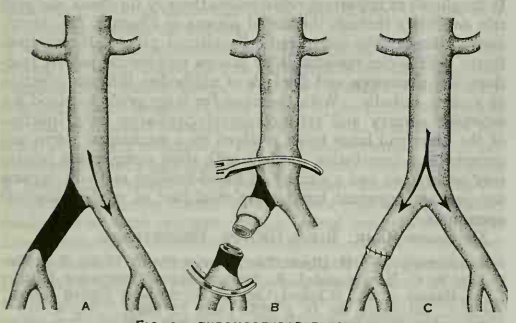

FIG. 2.—THROMBOENDARTERECTOMY

(A) Shaded area represents obstruction in common iliac artery produced by arteriosclerosis. (B) Clamps are applied to vessels above and below obstruction to arrest circulation temporarily and, after dividing artery, outer wall is "peeled" away from inner diseased segment and removed. (C) Upper and lower open ends of vessel are then joined together by silk sutures and clamps removed permitting normal blood flow

the interrupted lines in the upper drawing (fig. 1[A]) is excised and the upper and lower ends are joined together by fine silk sutures, as shown in the lower drawing, to restore normal lumen and blood flow. In some instances in which the constricted segment is much longer, a graft may be used to replace the defect. In fig. 1(B), illustrating graft correction of aneurysm of the abdominal aorta, the operation consists in clamping the vessels above and below the aneurysm to arrest circulation temporarily while the aneurysm is removed and then replaced by graft (drawing on right).

2. Use of a bypass graft, which may be attached by end-to-side anastomoses to the normal artery above and below the obstructed diseased segment, thereby shunting blood around it. Fig. 1(C) illustrates this in a case of arteriosclerotic occlusive disease, represented by the shaded area in the femoral artery in the right thigh (drawing on left). On the right a bypass graft has been attached to the sides of the artery above and below the obstruction to restore normal blood flow into the lower leg.

3. Thromboendarterectomy, which may be used in arteriosclerotic arterial obstruction, consists in the removal of the occlusive lesion from within the vessel (fig. 2).

See ARTERIES, DISEASES OF; VEINS, DISEASES OF.

(M. E. DE B.)

BLOODWORM, the slender, red-coloured, aquatic larvae of certain midges of the dipterous family Chironomidae (*see* FLY). Their coloration is due to the presence of the respiratory pigment, hemoglobin, by means of which the larvae extract dissolved oxygen from water. The term is also applied to red-blooded marine polychaete worms (phylum Annelida) of the genus *Glycera*, occurring along the middle Atlantic coast of the United States. They are six to eight inches long. Dug from sand or mud, they are used as bait in fishing. (G. W. Bs.)

BLOODY ASSIZES, the name given in English history to the commission conducted by Chief Justice Jeffreys after the Monmouth rebellion in the west of England in 1685. About 320 persons were condemned to death; and about 800 were transported to Barbados. Although modern research has acquitted Jeffreys, in certain cases, of any technical irregularity, the trials generally were conducted with a ferocity which has, with reason, made his name notorious. *See* JEFFREYS, GEORGE JEFFREYS; LISLE, ALICE.

BLOOMER, AMELIA (née JENKS) (1818–1894), U.S. dress-reformer and women's rights advocate, was born at Homer, N.Y., on May 27, 1818. She married Dexter C. Bloomer in 1840. In 1849 she took up the idea—previously originated by Mrs. Elizabeth Smith Miller—of a reform in women's dress, and the wearing of a short skirt, with loose trousers, gathered around the ankles. The name of "bloomers" gradually became popularly attached to any divided skirt or knickerbocker dress for women. Until her death on Dec. 30, 1894, Mrs. Bloomer took a prominent part in the temperance and woman suffrage movements.

BLOOMFIELD, LEONARD (1887–1949), U.S. linguist, whose book *Language* was the most important general treatment of linguistics published in the first half of the 20th century and the one which almost alone determined the course of linguistic science in the U.S., was born on April 1, 1887, at Chicago, Ill. He was educated at Harvard, Wisconsin, and Chicago (Ph.D., 1909). Bloomfield taught successively at the universities of Wisconsin, Cincinnati and Illinois, Ohio State university, The University of Chicago, and Yale university, where he was Sterling professor of linguistics from 1940 until his death.

Behaviouristic—and thus nonmentalistic—in general theory, *Language* (1933) presented a complete synthesis convincingly; it stated the view and demonstrated the fact that linguistic phenomena could properly and successfully be studied scientifically only when isolated from their nonlinguistic environment. Dedication to this principle has given linguistics in the United States an astringent scientific austerity productive of results more clear and certain than those achieved in any other social science but open to the charge of an excessively pragmatic and gradual approach to large problems of human linguistic behaviour.

Trained as an Indo-Europeanist and Germanist, Bloomfield turned in the second half of his life to the study of other language families, among them Malayo-Polynesian and Algonkian. Of Algonkian in particular he wrote many descriptive and comparative studies. It was no doubt this first-hand acquaintance with languages of widely differing structure that gave him the breadth of view so apparent in his masterwork; but his devotion to science and his belief in it as a means to the bettering of man's condition arose from a depth of humanity which far transcended his professional interests. He died on April 18, 1949, at New Haven, Conn.

The list of Bloomfield's publications is long (a bibliography is published in the journal *Language*, vol. 25, No. 2, April-June, 1949); but it is certain that his greatest work and the one on which his fame most firmly rests is his book *Language*.

(MY. F.)

BLOOMFIELD, MAURICE (1855–1928), U.S. Indological and philological scholar, best known as a student of the Vedas, was born on Feb. 23, 1855, in Bielitz, Austria. He went to the United States in 1859, studied at The University of Chicago, Furman university, Greenville, S.C., Yale university and at Johns Hopkins, to which he returned as professor of Sanskrit and comparative philology in 1881 after a stay of two years in Berlin and Leipzig. He translated, for Max Müller's *Sacred Books of the East*, the "Hymns of the Atharva-Veda" (1897);

contributed to the Bühler-Kielhorn *Grundriss der indo-arischen Philologie und Altertumskunde* the section "The Atharva-Veda and the Gopatha Brahmana" (1899); was first to edit the Kaucika-Sutra (1890); published in conjunction with Richard von Garbe of the Tübingen university a chromophotographic reproduction of the Paippalada version of the Atharva-Veda (1901). In 1906 he published, in the Harvard "Oriental Series," *A Vedic Concordance;* in 1905 *Cerberus, The Dog of Hades,* a study in comparative mythology; in 1908 *The Religion of the Vedas;* in 1916 *Rig-Vida Repetitions;* in 1919 *The Life and Stories of the Jaina Savior, Parcvanatha.* The bulk of his work is laid down in articles on Indic and linguistic and ethnological subjects printed in the journals of the U.S. and Europe. He died in San Francisco, Calif., June 13, 1928.

See the bibliography at the end of the foreword to *Studies in Honor of Maurice Bloomfield,* by a group of his pupils (1920).

BLOOMFIELD, ROBERT (1766–1823), English poet, author of *The Farmer's Boy,* a long poem in heroic couplets, owing much to 18th-century pastoralism, was born at Honington, Suffolk, Dec. 2, 1766. His father died soon afterward, leaving a large family. His mother, who kept the village school, taught him to read and write, and at 11 he went to work on his uncle's farm. Proving too frail, at 15 he joined his brothers in London to learn the trade of shoemaker. A fellow lodger in the garret where they lived lent him *Paradise Lost,* and also Thomson's *Seasons,* which inspired him to write of the Suffolk countryside. He composed *The Farmer's Boy* while making shoes with several other men, keeping the lines in his head until he could write them down. It was refused by several publishers but published in 1800 by Capel Lofft, with woodcuts by Thomas Bewick. It harmonized with the new mood of Romanticism and in two years sold 26,000 copies. Essentially the work of a simple countryman who loved nature, it was criticized by Lamb, but praised by Hazlitt. Bloomfield followed up his success with *Rural Tales* (1802), *Good Tidings* (1804), *Wild Flowers* (1806) and *The Banks of the Wye* (1811). He lost his savings in a publishing venture and died in poverty, at Shefford, Bedfordshire, Aug. 9, 1823. His *Remains*—verse and an essay on the making of aeolian harps (in which he was expert)—were published in 1824, with a biography by J. Weston. *Selections From the Correspondence of R. Bloomfield* was edited by W. H. Hart (1870); *Selections of Poems by R. Bloomfield* was edited by R. Gant (1947). (P. M. Y.)

BLOOMFIELD, a town of Essex county, in northern New Jersey, U.S., is a residential and industrial suburb of Newark. It received its present name in 1796 in honour of Joseph Bloomfield, a general in the American Revolution and later governor of New Jersey. It was set apart from Newark in 1812, and from its territory have been taken Montclair, Belleville, Glen Ridge and Nutley. It was among the first U.S. towns and cities to produce papermaking machinery using the Fourdrinier. process invented in France. During the Civil War large quantities of cloth for Union uniforms were produced there. The development of electrical equipment at the end of the 19th century gave impetus to Bloomfield's expansion. Industries are highly diversified and include the preparation of automobiles for export, the production of projectors for motion-picture theatres, pharmaceuticals and phonographs. Pop. (1960) 51,867. For comparative population figures *see* table in NEW JERSEY: *Population.* (E. R. D.)

BLOOMINGTON, a city of an agricultural area of rich prairie land, in central Illinois, U.S., and the seat of McLean county since 1831, is 125 mi. S.W. of Chicago. First settlement was in 1822 at a site known as Keg Grove, later as Blooming Grove, and in 1831 as Bloomington when the town was platted. Bloomington was incorporated as a city in 1850, and in 1953 established council-manager government. The city is headquarters of the Illinois department of the American Legion, of the Illinois Agricultural association and of a large mutual insurance company. Illinois Wesleyan university (1850) is in Bloomington, and Illinois State Normal university (1857) and Illinois Soldiers' and Sailors' Children's home are in contiguous Normal.

An annual spring event since 1923 is the production of the American Passion Play. Bloomington is the birthplace of the author Elbert Hubbard and was the home of the U.S. supreme court justice and senator David Davis, of the U.S. vice-president Adlai E. Stevenson, and of the Illinois governors John Hamilton, Joseph Fifer and Adlai E. Stevenson. Abraham Lincoln delivered a famous speech on slavery at a convention there in 1856 when the Illinois Republican party was organized.

Many of its products are farm-related, and Bloomington is a transportation centre of the state corn belt. Industrial products include candy, communications equipment, electrical appliances, refrigerators and heating and air-conditioning equipment. For comparative population figures *see* table in ILLINOIS: *Population.* (T. J. C.)

BLOOMINGTON, a city and the seat of Monroe county, in southern Indiana, U.S., is 49 mi. S.W. of Indianapolis. It is the home of Indiana university which was founded in 1820 (*see* INDIANA: *Education*). Bloomington is the centre of the great Indiana limestone belt, with extensive lime and cut stone quarries and mills, and within 25 mi. of six of the state parks and forests. According to tradition the flowers were in full bloom when the first settlers arrived and it was named Bloomington. Of the early immigrants, Kentuckians were the more numerous. When the first lots were laid out and sold in 1818, there were about 140 inhabitants. It was incorporated as a city in 1877. The public library extends contract service throughout the county. Bloomington has several parks and a children's swimming pool. Industries include meat packing, railroad shops, and the manufacture of radio, television, electronic and electrical equipment. For comparative population figures *see* table in INDIANA: *Population.* (E. W. H. L.)

BLOOMSBURY GROUP, the name given to a number of English writers and artists who frequently met between about 1907 and 1930 at the houses of Clive and Vanessa Bell and of Vanessa's brother and sister Adrian and Virginia Stephen (later Virginia Woolf; *q.v.*) in the Bloomsbury district of London, near the British museum. They discussed artistic and philosophical questions in a spirit of honest agnosticism and were strongly influenced by G. E. Moore's *Principia Ethica* (1903) and by A. N. Whitehead and Bertrand Russell's *Principia Mathematica,* three volumes (1910–13), in the light of which they searched for definitions of the good, the true and the beautiful and questioned accepted ideas with a "comprehensive irreverence" for all kinds of sham.

Nearly all the "Bloomsberries," as they were nicknamed, had been at Trinity or King's college, Cambridge, with Leslie Stephen's son Thoby (1880–1906), who had introduced them to his sisters Vanessa and Virginia. Most of them had been "apostles," *i.e.,* members of the "society," a select, semisecret university club for the discussion of serious questions, founded at Cambridge in the late 1820s by J. F. D. Maurice (*q.v.*) and John Sterling. Tennyson, Arthur Hallam, Edward Fitzgerald and Leslie Stephen had all been apostles and in the early 1900s, when those who later formed the core of the Bloomsbury group were elected to the society, the literary critic Lowes Dickinson, the philosophers Henry Sidgwick (*q.v.*), J. M. E. McTaggart, A. N. Whitehead (*q.v.*) and G. E. Moore and the art critic Roger Fry (*q.v.*), who became one of the Bloomsbury group himself, were members.

The group included the novelist E. M. Forster, the biographer Lytton Strachey (*qq.v.*), the art critic Clive Bell, the painter Duncan Grant, the economist John Maynard Keynes (*qq.v.*) and the Fabian writer Leonard Woolf and his wife Virginia, who together founded the Hogarth press (1917). Other members were Desmond Macarthy, Arthur Waley, Saxon Sidney-Turner, Robert Trevelyan, Francis Birrell, J. T. Sheppard (later provost of King's college) and the critic Raymond Mortimer and the sculptor Stephen Tomlin, both Oxford men. Bertrand Russell, Aldous Huxley and T. S. Eliot were sometimes associated with the group, as was the economist Gerald Shove. It survived World War I but by the early 1930s had ceased to exist in its original form, having by that time merged with the general intellectual life of London, Oxford and Cambridge. Although its members shared certain ideas and values, the Bloomsbury group did not constitute a school. Its significance lies in its being an extraordinary constel-

lation of talented persons whose achievements were in many instances both distinguished and influential.

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BLOSIUS, FRANCISCUS LUDOVICUS (LOUIS DE BLOIS) (1506–1566), Benedictine monastic reformer and mystical writer, was born a member of the Wallonian nobility at Don-Étienne in Hainaut. As a page at the court of the future emperor Charles V he received his early education from the future pope Hadrian VI. In 1520 he entered the Benedictine order at Liessies, becoming abbot ten years later. His concern for the renewal of monastic spirit occasioned his writings, which, for a time rivaled the *Imitation of Christ* in popularity. Doctrinally Blosius was a successor to the earlier Lowlands mystics, without however their speculative interests, and a forerunner of St. Francis of Sales.

The best edition of Blosius' writings is that of De Winghe, *Ludovici Blosii opera omnia* (1632), to which must be added Berlière's edition, the first complete one, of the *Statuta monastica* (1929). The more important treatises are translated in B. Wilberforce and D. R. Huddleston, *The Works of Louis de Blois* (1925–26).

The anonymous *Vita*, still the basic biographical document, is given in De Winghe as well as in the Bollandist *Acta sanctorum*, vol. i, pp. 430–456. *See* also Georges de Blois, *A Benedictine of the Sixteenth Century* (1878). (E. O'B.)

BLOUNT, CHARLES (1654–1693), English writer on deism (*q.v.*), was born at Upper Holloway, Middlesex, on April 27, 1654. His father, Sir Henry Blount, personally supervised his education and arranged for his marriage at 18. Blount admired Dryden and Hobbes and his first publications were two pamphlets, *Mr. Dryden Vindicated* (1673) and *Last Sayings and Dying Legacy of Mr. Thomas Hobbs* (1679), the latter consisting chiefly of extracts from *The Leviathan*. He also contributed to Dryden's translation of Lucian (1711).

An extreme Whig in politics, in religion Blount followed the deistical tenets of Lord Herbert of Cherbury (*q.v.*). In 1679 he published *Anima Mundi*, expressing such unorthodox views on immortality that it was suppressed by the bishop of London. *The First Two Books of Philostratus Concerning the Life of Apollonius Tyaneus* . . . (1680) was banned in 1693 because, in its notes, Blount supported natural rather than revealed religion.

Although not an original thinker, Blount cared sincerely for freedom and materially contributed to that of the press by two pamphlets, signed "Philopatris" (1693), based on Milton's *Areopagitica*, which caused the downfall of the licenser, Edmund Bohun. Blount committed suicide in Aug. 1693 because he could not marry the sister of his deceased wife. A collection of his letters and pamphlets was published by Charles Gildon, entitled *The Oracles of Reason* (1693). *Miscellaneous Works* (1695) is a fuller edition, with a preface by Gildon defending suicide.

See A. Kippis, *Biographia Britannica* (1780); J. Leland, *View of the Deistical Writers* (1837); Lord Macaulay, *History of England*, ch. xix (1855).

BLOUNT (BLUNT), **EDWARD** (fl. 1578–1632), English publisher and translator who, with Isaac and William Jaggard, printed the First Folio of Shakespeare's plays, was the son of Ralph Blount, merchant tailor of London. On June 24, 1578, he was apprenticed to William Ponsonby, the publisher of Sidney and Spenser. In 1588 he became a freeman of the Stationers' company and opened a bookshop "in Paul's Churchyard at the signe of the Black Beare."

His early publications include Giovanni Florio's Italian-English dictionary (1595) and his translation of Montaigne's essays (1603), and Marlowe's *Hero and Leander* (1598) with a dedication to Sir Thomas Walsingham in which he claims close friendship with the dead poet. He translated *Ars Aulica, or the Courtier's Arte* from the Italian of Lorenzo Ducci in 1607, and *Christian Policie* from the Spanish of Juan de Santa Maria in 1632. In 1612 he published Thomas Shelton's translation of *Don Quixote*, the first English version. The First Folio of Shakespeare's plays, entitled *Mr. William Shakespeares Comedies, Histories and Tragedies. Published According to the True Originall Copies*, appeared in 1623. It had been produced by Shakespeare's colleagues at the Globe theatre, Henry Condell and John Heming, but Blount probably acted as editor though not as an entirely accurate one. In 1632 Blount published the first collected edition of *Sixe Court Comedies* by John Lyly. Nothing is heard of him subsequently. His dedicatory prefaces reveal wide education and a pleasant sense of humour.

BLOUNT, SIR THOMAS POPE (1649–1697), English author whose painstaking collections of critical opinions are of some interest in the development of critical theory, was born at Upper Holloway, Middlesex, on Sept. 12, 1649. He represented St. Albans in parliament under Charles II and later became knight of the shire, having been created a baronet in 1679. He compiled for his own use a bibliographical dictionary of eminent European writers, recording their opinions of one another, and finally allowed its publication in 1690 as *Censura celebriorum authorum*. A version translating the quotations into Latin for the benefit of foreign scholars was published in 1694. In 1693 he wrote *A Natural History, Containing Many Not Common Observations Extracted Out of the Best Modern Writers*, and in 1694 *De re poetica, or Remarks Upon Poetry, with Characters and Censures of the Most Considerable Poets*, which included comments on Shakespeare, Milton, Spenser and Ben Jonson, all of whom had been omitted from the *Censura*. His gifts as an original writer are best revealed in *Essays on Several Subjects* (1692), written in a mood of cheerful cynicism. He died at Tittenhanger Park, Hertfordshire, on June 30, 1697. He was the elder brother of Charles Blount (*q.v.*).

See A. Kippis, *Biographia Britannica*, vol. ii (1780). For an account of Blount's family *see* Robert Clutterbuck, *History and Antiquities of the County of Hertford*, vol. i, pp. 207–212 (1815).

BLOUNT, WILLIAM (1749–1800), U.S. political leader, was born in North Carolina, March 26, 1749. He was active from the beginning in the American Revolution, serving in the continental congress and in the Constitutional Convention of 1787. From 1790 to 1796 he was superintendent of Indian affairs for the region known as the "Territory south of the Ohio River." When Tennessee became a state, he was elected one of its U.S. senators. Implicated in an American conspiracy to seize Spanish-owned Florida and Louisiana for England, then at war with Spain, he was expelled by the senate on July 8, 1797. He was impeached by the house of representatives in the same year, but the impeachment trial, the first to come before the senate, was terminated in Jan. 1799, when the senate decided it had no jurisdiction. Blount then resumed his political career in Tennessee. He died at Knoxville, Tenn., on March 21, 1800. (E. E. R.)

BLOW, JOHN (1649–1708), English organist and composer, remembered for his church music and for *Venus and Adonis*, which may be regarded as the first true English opera. Born at Newark-on-Trent, Nottinghamshire, where he was baptized on Feb. 23, 1649, he was probably educated at the Magnus Song school there, and in 1660 became a chorister at the Chapel Royal. There he composed several anthems, including the so-called *Club Anthem* with William Turner and Pelham Humfrey. His voice broke in 1664, and after a musical apprenticeship he was appointed organist of Westminster abbey (1668). In 1669 he became one of the king's musicians for virginals and in March 1674 was sworn in as a gentleman of the Chapel Royal, succeeding Humfrey in July as master of the children. He held this position until his death, and had great influence on the choristers under him, among them William Croft, Jeremiah Clarke and Daniel Purcell, and also on Henry Purcell, who was taught by him at this time. In 1676 or 1677 he became one of the Chapel Royal organists, and in 1677 the dean and chapter of Canterbury conferred on him a doctorate of music —the first reference to what became known as a Lambeth degree in music.

In 1679 Blow was succeeded as organist at Westminster abbey by Purcell; he was reappointed after Purcell's death in 1695. The years 1680–1700 were the most productive and prosperous of his life. He acquired several London properties; at his death he

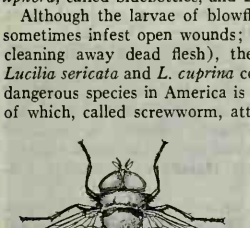
owned at least eight houses, in one of which, in the Great Sanctuary, Westminster, he and his family lived (he had married in 1674 and had five children). In 1687 he became master of the children of St. Paul's, a position he held for 16 years, and in 1699 he received his last appointment, as first composer to the Chapel Royal. He died at Westminster, Oct. 1, 1708, and was buried in the abbey.

Blow's official positions entailed the writing of much ceremonial music, both religious and secular. Fourteen services and more than 100 anthems are extant and many remain in regular use. He was at his best in the writing of full anthems in a simple chordal or contrapuntal style with melodies of great strength and sweetness developed over a ground bass. In his verse anthems his style is quieter than that of Purcell; he lacks the brilliance and sustained power of invention needed for complete success in that most baroque of musical forms. His style is seen at its best in the motet for six voices, "Salvator mundi"; in the verse anthems "I Was Glad When They Said Unto Me" (for the opening of St. Paul's cathedral, 1697) and "Lift Up Your Heads, O Ye Gates"; in the "Ode for St. Cecilia's Day" (1684); the "Ode on the Death of Mr. Henry Purcell" (1696) and "Awake, Awake My Lyre" for the University of Oxford; and in the full anthems "My Days Are Gone Like a Shadow" and "Be Merciful." He excelled also in the writing of services: outstanding is his Service in G. His *Venus and Adonis*, written between 1680 and 1685 for performance at court and called by him *A Masque for the Entertainment of the King*, has an important place in the development of English opera. It is the first dramatic work in which the whole text is set to music without either dialogue or extraneous musical entertainment. His songs for one, two, three and four voices, which appear in many contemporary collections, and also in his own *Amphion Anglicus* (1700), are notable for their charm of melody. Purcell's comment on him, that his "character is sufficiently known by his works, of which this very instance (the Gloria from his *Jubilate in C major*) is enough to recommend him as one of the greatest masters in the world," may be taken as the tribute of a grateful pupil rather than as a considered critical comment, but it reveals an appreciation of the debt he owed to Blow, which in itself would ensure his fame.

BIBLIOGRAPHY.—Modern editions of Blow's works include the Oiseau Lyre editions of *Venus and Adonis* (1939), of *Six Songs*, ed. by A. Lewis (1938) and of two sonatas for two violins, viola da gamba and bass, ed. by W. G. Whitaker (1936); *Harpsichord Pieces*, ed. by J. A. Fuller Maitland (1921); *Awake, Awake My Lyre, Salvator mundi* and the 1684 *Ode for St. Cecilia's Day*, ed. by H. Watkins Shaw (1949–50) and the Schott edition of the *Complete Organ Works* (1958). *See* also W. H. Cummings, "Dr. John Blow," in *Proceedings of the Musical Association*, vol. xxxv (1909); H. Watkins Shaw, *Blow, Doctor of Music* (1937); E. J. Dent, *Foundations of English Opera* (1928); E. H. Fellowes, *English Cathedral Music* (1941). (B. P.)

BLOWFLY, the common name for large flies of the family Calliphoridae; they are metallic blue, green or bronze in colour and very noisy in flight. Their habits and life cycles are like those of the common house fly except that they breed chiefly in carrion and excrement. Several genera are important, among them *Calliphora*, called bluebottles, and *Lucilia*, green-bottle flies.

Although the larvae of blowflies feed on decaying meat, they sometimes infest open wounds; while they prevent infection (by cleaning away dead flesh), they will also eat healthy tissue. *Lucilia sericata* and *L. cuprina* commonly infest sheep. The most dangerous species in America is *Callitroga hominivorax*, the larva of which, called screwworm, attacks livestock and other animals in the southern United States and tropical regions. Several species of *Calliphora* are the most serious offenders in Australia; sheep are frequently killed as a result of attack. *Chrysomya megacephala* is widely distributed in the Pacific, oriental and Australian regions, occurring in enormous numbers, breeding in decaying vegetation, manure, human excrement and carcasses. It is a most important vector of dysentery and probably of jaundice and anthrax. Treating latrines with sodium arsenite, garbage disposal, use of screens and baited flytraps are employed in control.



FROM CURRAN, "INSECTS OF THE PACIFIC WORLD" (THE MACMILLAN CO.)

CHRYSOMYA MEGACEPHALA, A DANGEROUS CARRIER OF DYSENTERY IN THE PACIFIC AREA

Species of *Protocalliphora*, small bluebottle or green-bottles, attack nestling birds, particularly the American robin and bluebird; the larvae live in the nests and suck blood, often being so numerous as to kill the nestlings. The cluster fly, *Pollenia rudis*, of Europe and North America, is a parasite of earthworms; the adults often enter houses to hibernate within the walls or in attics and on warm days may cause a loud buzzing sound; they return outdoors in spring. (For the plant bluebottle *see* CORNFLOWER.)

The closely related flesh flies (*Sarcophaga*) have black and gray stripes on the thorax and a checkered abdomen. They mostly deposit living maggots on dead animals but also may infest wounds. *See* FLESH FLY.

See W. B. Herms, *Medical Entomology* (1939); E. O. Essig, *College Entomology* (1943). (C. H. CN.; X.)

BLOWGUN (sometimes called BLOWPIPE) is a hunting weapon made of a wooden tube 7 to 16 ft. long through which is blown a small dart by means of a sudden puff of breath at the mouthpiece of the tube. Blowguns were used by the aboriginal peoples of eastern South America, the Antilles, the southeastern United States and southeastern Asia.

Among the Indians of the tropical forests in South America the blowgun was usually 8 to 10 ft. long, but sometimes as much as 16 ft. It was made of suitable wood or cane and consisted of two complete tubes, one within the other or of an inner tube within a casing of two split halves or of a single tube composed of two halves.

Darts, usually of palmwood the thickness of a knitting needle, were 9 to 16 in. long and wrapped at their butt ends with a fluffy plant fibre to trap the blown air that propelled the dart through the tube. The sharpened points of these wooden darts were smeared with curare, a lethal poison. The darts were kept in quivers made of basketry or sections of bamboo.

In the South American forests and the Antilles the blowgun was used only for the hunting of birds and small tree-climbing animals. It had an effective range to 120 ft. and was noiseless enough to allow the hunter to kill a number of animals in one small area.

The blowgun of southeastern Asia was a wooden tube about seven feet long with a bore of about one-third of an inch and an external diameter diminishing from about one inch at the mouth to three-quarters at the outer end. The tube was made of a light rigid wood found commonly throughout Borneo and Malaya. A piece free from knots having been selected, it was roughly shaped, then bored with an iron rod, eight feet long, having a cutting edge at one end. From 8 to 10 hours were necessary to bore through the pole. Although the sharpened iron rod did fine work, the inside was polished with a rattan. When the bore was satisfactory, the outside was whittled away to the required size and smoothness.

The darts were made of splinters of palmwood eight to ten inches long, sharpened at one end. At the butt was a cone of soft pith, having the same size bore as the blowgun. The pointed end of the dart was smeared with a poison that was either *Strychnos* or *Antiaris*. Small baked clay pellets were sometimes used in marginal areas.

Except in the southeastern United States where it was unimportant, the blowgun depended upon the use of poison for its effectiveness. It seems moreover to have been limited in use to tropical forest regions where birds and small arboreal animals are abundant. (G. I. QV.)

BLOY, LÉON HENRI MARIE (1846–1917), French Catholic writer who preached the virtues of poverty and suffering. Born in Périgueux (Dordogne), July 11, 1846, he worked as a railway clerk and fought in the Franco-German War (1870–71), becoming a fervent Catholic after meeting Barbey d'Aurevilly (*q.v.*). The only masters he acknowledged besides Barbey (his most constant friend) and Villiers de L'Isle-Adam (also a friend), were Ernest Hello and Thomas Carlyle, whom he called his "cousin german, in literature." He described himself as "a very humble, artless clamourer," not to be judged "from any human point of view," because he was "writing for God only." An apocalyptic Catholic, he declared in his last years that he was only awaiting

"the advent of the Cossacks and the Holy Ghost." Although he was a visionary rather than a true mystic, his savage onslaught upon the lukewarm Christians whom he "vomited" resulted in the conversions of Huysmans (*q.v.*) and Jacques Maritain. The source of his undeniable power lies in his style, coarse and filthily abusive when he was inveighing against Ferdinand Brunetière and Paul Bourget (*Les dernières Colonnes de l'eglise,* 1903) but hauntingly beautiful when he expressed his thirst for justice and his faith in the redeeming virtue of suffering. The outstanding works of this "entrepreneur de démolitions," as he called himself, are his autobiographical novels, *Le Désespéré* (1887) and *La Femme pauvre* (1897; Eng. trans. *The Woman Who Was Poor,* 1939), and his *Journal* from 1892 to 1917, in eight books: *Le Mendiant ingrat* (1898), *Mon Journal* (1904); *Quatre ans de captivité à Cochons-sur-Marne* (1906), *L'Invendable* (1909), *Le Vieux de la montagne* (1911), *Le Pèlerin de l'absolu* (1914), *Au Seuil de l'Apocalypse* (1916), *La Porte des humbles* (1920). He died at Bourg-la-Reine (Seine), Nov. 3, 1917.

See J. Bollery, *Léon Bloy,* 3 vol. (1947–54). (RE. L.)

BLÜCHER, GEBHARD LEBERECHT VON (1742–1819), Prussian field marshal famous as a commander during the Napoleonic wars, was born at Rostock, Mecklenburg-Schwerin, on Dec. 16, 1742. His early career was unusual: against the wishes of his family he enlisted at the age of 14 in a Swedish cavalry regiment. His first campaign was against the Prussians who took him prisoner, but later he joined the Prussian army and served in the Seven Years' War with the hussar regiment responsible for his capture. Disgruntled at being passed over for promotion he resigned and took up residence in Silesia, where he became a very successful farmer. On the accession of Frederick William II he returned to his regiment as a major and greatly distinguished himself in the campaign of 1793–94. In 1794 he was promoted to major general and was given a command on the lower Rhine. The years 1805–06 found him on active service again. After the Prussian defeat at Jena (Oct. 14, 1806) Blücher commanded the rear guard with great courage and devotion. It was in these circumstances that he first met Scharnhorst and, although they were both forced to surrender at Rakau, near Lübeck, the meeting started one of those almost traditional German military partnerships, typified later by Hindenburg and Ludendorff, Mackensen and Seeckt and others.

Blücher was described by a contemporary as a rough, ill-educated man, but endowed with common sense, fiery energy and indomitable courage. He was the first Prussian officer to appreciate the value, to a commander such as himself, of a highly trained chief of staff.

Soon after his capture at Rakau, Blücher was exchanged for the French marshal Victor. After the peace of Tilsit he was employed for a time in the war department and was subsequently given command in Pomerania; but Napoleon succeeded in getting him deprived of this appointment and he again went into retirement.

In 1813 war between France and Prussia broke out again and Blücher, although 71 years old, returned to the colours. He distinguished himself at Lützen (May 2, 1813) and was responsible for a heroic resistance at Bautzen (May 20, 1813). Three months later, at Katzbach, he decisively defeated the French under Marshal Macdonald, capturing 18,000 prisoners and more than 100 guns. For his part in the battle of Leipzig (Oct. 16–18, 1813) he was made a field marshal.

Blücher crossed the Rhine on Jan. 1, 1814, and after much hard fighting entered Paris, with other victorious allied troops, on May 31, 1814. Soon after he retired to his estates, but was soon back in service again on the news that Napoleon had escaped from Elba. He at once assumed command of the Prussian troops in Belgium and, together with Gneisenau his chief of staff, began coordinating the employment of his force with that of the British and allied forces under the duke of Wellington. At Ligny (June 16, 1815) he was defeated by Napoleon; but, in order to ensure cooperation with Wellington later, he withdrew his army toward Wavre although by so doing he endangered his own communications. Blücher was in the thick of the fighting at Ligny and barely escaped with his life. His troops took no part in the early stages of the battle of Waterloo (June 18, 1815); but, urged on by the veteran field marshal, they carried out an exhausting countermarch and appeared on the French right flank in the late afternoon, at a critical stage of the battle. This, together with a general advance by the British, completed Napoleon's defeat. Blücher's cavalry continued the pursuit in the direction of Paris throughout the night. The allied powers heaped honours on him for his service in this, his last campaign, and his own sovereign named him prince of Wahlstadt. Blücher was a man with little knowledge of the higher art and science of war and required a good chief of staff to guide him. On the battlefield his determination and personal courage and example was worth its weight in gold. He died at his chateau of Kriblowitz in Silesia on Sept. 12, 1819.

See C. A. L. Varnhagen von Ense, *Leben des Fürsten Blücher* (1827); E. F. Henderson, *Blücher and the Uprising of Prussia Against Napoleon, 1806–15* (1911). (C. N. B.)

BLUEBEARD, the villain of a story entitled *La Barbe bleue* and included in the collection by Charles Perrault (*q.v.*), first printed in 1697 as *Contes de ma mère l'Oye* (*Mother Goose's Tales*). The story has parallels in European, African and eastern folklore, but Perrault's version probably derived from Brittany, and it has been suggested that it was based on the career of Gilles de Rais (*q.v.*), or of Comorre the Cursed, a Breton chief of the 6th century.

In Perrault's story Bluebeard is a rich *seigneur* who, soon after his marriage, goes away, leaving his wife the keys to all the doors in his castle, but forbidding her to open one of them. She disobeys and finds in the locked room the bodies of his former wives. On his return, Bluebeard discovers on one of the keys a telltale spot of blood and threatens to cut off her head as a punishment for disobedience. She persuades him to delay and sends her sister to the top of a tower to look out for help: her pathetic question "Sister Anne, sister Anne, do you see anybody coming?" is perhaps the best remembered part of the story. Her brothers arrive in the nick of time and kill Bluebeard.

The essentials of the story in folklore are the locked room, the curiosity which tempts the wife to her fate and the 11th-hour rescue. Bluebeard is a typical "folk villain" in his strength and repulsiveness, his wealth and power and his barbaric cruelty. In an Estonian version he is credited with having already killed 11 wives, and the 12th is rescued by a gooseherd (or sometimes a page), a friend of her childhood, who kills her husband and marries her. In a legend included in Grimm's *Hausmärchen* three sisters are the intended victims, the first two being rescued by the third, who in turn is rescued by her brothers. Perrault does not give the number of Bluebeard's former wives and sister Anne is not herself an intended victim. The identification in some stories of Bluebeard with the devil and of the locked door as the gate of hell are probably later additions.

See Andrew Lang's edition of Perrault's *Contes* (1887) for a close comparison with other folktales and details of the careers of Gilles de Rais and Comorre.

BLUEBELL, a descriptive name for several unrelated plants, based on the bell-like shape of the flowers. The wild hyacinth (*Scilla nonscripta*) of England, and the harebell of Scotland, the United States and Canada commonly receive this designation. In the United States the Virginia cowslip (*Mertensia virginica*) and the bellflower (*Campanula rotundifolia*) are called bluebell; on the Pacific coast various species of *Phacelia* plants of the waterleaf family (Hydrophyllaceae) are known as the California bluebell. See CAMPANULA; GRAPE HYACINTH; HAREBELL; HYACINTH; VIRGINIA COWSLIP.

BLUEBERRY (*Vaccinium*), the name given in North America to certain shrubs of the heath family, Ericaceae (*q.v.*), prized for their sweet, edible fruits. The British species of the genus are called bilberries and bear their fruit singly, in contrast to the many-fruited clusters of the American blueberries.

The most important North American forms are: (1) two high-bush or swamp blueberries of the north (*V. australe* and *V. corymbosum*), 4 to 12 ft. high, native to moist soils from Maine, Quebec and Michigan south to southern Georgia, the fruit blue with a thick bloom; (2) the rabbit-eye high-bush blueberry of the south

ROCHE

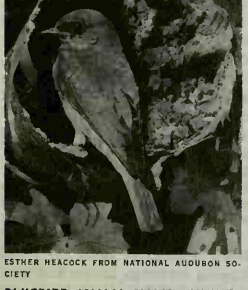
HIGH-BUSH OR SWAMP BLUEBERRY (VACCINIUM CORYMBOSUM)

(*V. ashei*), mostly 8 to 16 ft. high, found in swamps and pine barrens in southern Georgia and Alabama and northern Florida, the fruit black, rarely blue; (3) the low-bush blueberry (*V. lamarckii*), 1 to 2 ft. high, supplying the bulk of the canned blueberries, abundant on barrens, heaths and mountain lands from Newfoundland to Saskatchewan and south in the mountains to Virginia, the fruit blue usually with a bloom; (4) the Canadian blueberry (*V. myrtilloides*), similar in size and range to *V. lamarckii* but with more acid and later fruits; (5) two dry-land low-bush species (*V. pallidum* and *V. vacillans*), 1 to 3 ft. high, of sandy or rocky places from Maine to Wisconsin and south to Georgia and Kansas, the fruit blue with a heavy bloom (part and possibly most of the berries gathered are from tetraploid forms known as *V. altomontanum*); (6) the evergreen blueberry (*V. ovatum*), 6 to 20 ft. high, near the coast from central California to British Columbia, the fruit black or slightly blue, of value also for its long-keeping foliage, called evergreen huckleberry; and (7) the mountain blueberry or bilberry (*V. membranaceum*), 3 to 6 ft. high, in the Sierra and Cascade mountains, especially from northern Oregon to British Columbia, the fruit deep maroon to black, borne singly in the leaf axils, a very drought-resistant species. All the above species, and to a lesser extent other species, are gathered in large quantities in the wild.

Blueberries grow only in very acid (pH 4 to 5), well-drained but moist soils. About 20,000 ac. of the high-bush blueberry (*V. australe*) are cultivated in New Jersey, southwestern Michigan and eastern North Carolina and to a slight extent elsewhere. One selected native variety and many from breeding work are raised; the largest bear fruits about seven-eighths inch in diameter. Recommended varieties are, in order of season, Earliblue, Blueray, Bluecrop, Berkeley, Herbert and Coville for Maryland and north, and Angola, Wolcott, Croatan and Murphy in North Carolina. The most highly flavoured varieties are Blueray, Herbert and Coville. Propagation is by hardwood cuttings. Plantings are usually set five by eight feet in the fall or early spring. Superior varieties of the rabbit-eye are Callaway, Coastal, Homebell, Tifblue, Garden Blue and Menditoo. They are hardy from eastern North Carolina to southern Arkansas. Propagation is by softwood cuttings. Plantings are usually set 10 by 15 ft. during the winter. The fruit begins to ripen about a month later than the New Jersey type and ripens over a period of four to six weeks.

Blueberries are seriously damaged by the "stunt" virus disease, canker, leaf spots and a rust disease. A bud mite, stem borers and fruit worms are serious pests. *See* also BILBERRY; VACCINIUM.

See U.S. Department of Agriculture, *Farmers' Bulletin 1951* (rev. 1957). (G. M. D.)



ESTHER HEACOCK FROM NATIONAL AUDUBON SOCIETY

BLUEBIRD (SIALIA SIALIS) AT NEST IN HOLLOW STUMP

BLUEBIRD, a North American thrush of the genus *Sialia*, with much blue in the plumage of the male. There are three species, all about seven inches long and all living in thinly wooded areas. They feed on insects that they catch on the wing or drop down to the ground to seize, and on fruit in season; the female lays about five pale-blue eggs in a hole in a tree, in a crevice about a cliff or building, or in a nest box.

The eastern bluebird (*Sialia sialis*), which inhabits the eastern part of the North American continent, is migratory in the north. Its very early spring arrival, liquid notes, plaintive song, beautiful bright blue upperparts, reddish-brown breast and gentle appearance have endeared it to many persons. It often lives in orchards, and will nest in bird boxes with entrances 1½ inches in diameter.

The western bluebird (*S. mexicana occidentalis*) of the mountains from British Columbia to western Mexico is of a deeper blue, and has a reddish-brown breast and back. The mountain bluebird (*S. curroides*) of the western part of the continent has a pale-blue breast and upperparts and is a remarkably silent bird.

(A. L. RD.)

BLUEBONNET (*Lupinus subcarnosus*), a North American plant of the pea or pulse family (Leguminosae; *q.v.*), native to the plains of Texas. It grows about a foot high, has silky haired leaves composed of five leaflets and bears handsome clusters of purplish-blue flowers, marked in the centre with white or yellow. As early as March the plant in bloom covers immense areas in southern and western Texas with a blue carpet. The bluebonnet is one of the most popular wild flowers of the southwest and has been adopted as the state flower of Texas. In Scotland the name is given to the bluebottle (*Centaurea cyanus*) and also to the blue scabious or devil's-bit (*Succisa pratensis*). *See* LUPINE.

BLUEFIELD, a city of Mercer county, W.Va., U.S., in the Appalachian mountains is the southernmost city in West Virginia, and at an elevation of 2,558 ft. the highest city of the United States east of Denver, Colo. Bluefield, and its companion city, Bluefield, Va., were named for fields of blue flowers that grew there.

Bluefield, W.Va., was incorporated in 1889 when the Norfolk and Western railway established yards, shops and a division point there. The city adopted a council-manager form of government in 1921. The name of Graham, Va., a suburb of Bluefield in Tazewell county (founded in 1880), was changed to Bluefield in 1924. They make one continuous city. Bluefield is the outlet for the nearby coal fields. The annual Southern Appalachian Industrial exhibit or "coal show," held each spring in Bluefield, is the only display of its kind in the United States.

Bluefield State college, founded in 1895, enrolls about 500 students annually. Across the state line in Bluefield, Va., Bluefield college (Baptist), a junior college founded in 1920, enrolls about 300 students.

For comparative population figures *see* table in WEST VIRGINIA: *Population.* (K. K. McC.)

BLUEFISH (*Pomatomus saltatrix*), a relative of the sea basses (Serranidae), lives in the tropical or temperate oceanic waters away from the coasts. It is the only member of the family Pomatomidae. Bluefish congregate in large schools and consume or kill large numbers of small fish. They grow to about four feet in length; the larger individuals, which may weigh over 20 lb., are commonest in the Atlantic ocean off Africa. They are a prized game fish and are also caught commercially for food. Bluefish breed during the spring and summer. The young grow rapidly, attaining the length of about one foot when one year old.

(C. HU.)

BLUEGRASS, a common name applied to about 200 species of *Poa*, most of which are found in the temperate regions. The exact origin of the name bluegrass is unknown, but it could refer either to the fact that bluegrass fields have a bluish cast when in flower, or to the bluish leaf colour of Canada bluegrass (*Poa compressa*). Kentucky bluegrass (*Poa pratensis*), also called June grass and smooth-stalked meadow grass, a valuable lawn and pasture grass in North America and Europe, is the most widely known species. Kentucky bluegrass is native to Eurasia.

It is a long-lived perennial characterized by a spreading growth habit and soft leaves with boat-shaped tips. The plants tolerate moderate drought, but will not thrive in the shade. Kentucky bluegrass grows best on heavy, well-drained, nonacid soils of good fertility. Applications of nitrogen and phosphorus improve sod formation and colour. It becomes established slowly from seed and hence fall seeding is recommended where practical. The seeding rate for lawns is about 3 lb. per 1,000 square feet. An improved lawn variety, Merion, is resistant to the destructive purple spot disease. Kentucky bluegrass lawns should not be

mowed closer than one and one-half inches.

Other important bluegrasses are: Canada bluegrass which competes with Kentucky bluegrass as a pasture grass on poor dry soils; the shade-tolerant rough bluegrass (*Poa trivialis*); the valuable range species, big bluegrass (*Poa ampla*); mutton grass (*Poa fendleriana*); and Texas bluegrass (*Poa arachnifera*). *See* also LAWNS, CARE OF; GRASSES. (A. A. H.)

BLUE JAY: *see* JAY.

BLUE LAWS, in U.S. history, a term applied to a series of strict enactments ascribed to the New Haven Puritan government in the 17th century; some were enactments of other New England colonies, and some were pure invention. Among the 45 "blue laws" which the Rev. Samuel A. Peters listed in his *General History of Connecticut* (published in 1781) that were wholly or substantially true are the following: "The judges shall determine controversies without a jury"; "married persons must live together or be imprisoned"; "a wife shall be good evidence against her husband"; "no minister shall keep school"; "the selectmen, on finding children ignorant, may take them away from their parents and put them into better hands, at the expense of their parents." Among those in the same list which are wholly or in part spurious are: "No woman shall kiss her child on the Sabbath or fasting day," and "No one shall travel, cook victuals, make beds, sweep house, cut hair or shave on the Sabbath day." Examples of "blue laws" could be found in all the American colonies but they generally disappeared after the American Revolution.

BLUE MOUNTAINS, part of the eastern highlands of New South Wales, Austr., really a plateau falling from about 3,500 ft. in the west to about 1,200–1,800 ft. along the steep eastern scarp overlooking the Sydney lowland, about 40 mi. inland. Basically the plateau is formed of massively bedded Hawkesbury (Triassic) sandstones, interbedded with softer sandstones and shales, strikingly dissected by deep canyons. For 25 years it acted as a barrier to exploration inland, until in 1813 Gregory Blaxland penetrated it along the ridges. (*See* also AUSTRALIA, COMMONWEALTH OF: *History.*) (O. H. K. S.)

CITY OF BLUE MOUNTAINS, a local government area of New South Wales, comprises 22 townships. Pop. (1961) 28,119. The main tourist centres are Katoomba, Leura, Mount Victoria, Blackheath, Springwood, Wentworth falls and Hazelbrook, all of which lie on both the railway line and the Great Western highway between Sydney and Lithgow. The City of Blue Mountains, whose amenities include hotels, camping areas, scenic walks and golf courses, is visited by about 500,000 tourists annually. The highest point within the area is Mt. Boyce (3,576 ft.). (R. GA.)

BLUE MOUNTAINS, a range curving northeastward from central Oregon to southeastern Washington, U.S., with a length of 190 mi. and up to 68 mi. wide, comprises an uplifted, warped and dissected lava plateau, above which rise several higher mountain ridges, including Aldrich, Strawberry and Elkhorn. Elevations range from 1,000 to over 10,000 ft. At lower elevations basins or flats—the Grande Ronde, Baker valley and many others—are cultivated, some with irrigation. Lava flows cover much of the region but erosion has exposed older and harder rocks. Mining of gold, copper, chrome and other metals, formerly important, declined. Rainfall varies from 10 in. (in the west) to 40 in. (in the north), and the natural vegetation includes grass used for grazing, pine and Douglas fir for timber and brush land. Much of the forest is stunted and noncommercial. The region is drained by tributaries of the Columbia river, the Deschutes and the John Day in the west, and the Grande Ronde on the northeast. (S. N. D.)

BLUE NILE PROVINCE (MUDIRIYAT AN NIL AL AZRAQ), of the Republic of Sudan, borders Ethiopia, much of it between the Blue and the White Niles. Area (54,879 sq.mi.) is comprised mostly of black clay ("cotton soil") plains which are a quagmire in the rainy season and crack in the dry. The average altitude is 1,300 ft., sloping gently from the Blue to the White Nile. Outcrops of basement complex form isolated groups of hills stretching north-northwest from Kurmuk in the southeast. Most major streams rise outside the region because of the low rainfall, absorbent clays and the level topography. West of the White Nile and occasionally near its eastern bank are found *qoz* (mainly fixed sand dunes). Along the rivers and the stream beds are alluvial silts and sands. The unreliability of the rainfall, which comes from the southwest monsoon, is an agricultural hazard throughout the province. In the north the annual average is below 10 in., falling in three months (July–September); southward the season lengthens to eight months (April–November), and near the Ethiopian border the fall exceeds 40 in. This variation affects temperatures: in the north the coolest period is January (mean 75° F.) and the hottest May–June (93°); closer to the equator the coolest period is August (76°) and the warmest April (88°), with a subsidiary warm season during October–November and a short cool season in January because of the northerly winds.

Vegetation follows the rainfall distribution; there is acacia desert scrub in the north and acacia tall grass forest in the south. In the centre there are gum gardens (*Acacia senegal* and *Acacia seyal*). Along the Ethiopian border is bamboo forest, and "goat desert" is found around large settlements. Wild animal life was much reduced in the 20th century by the spread of settlements, but there is the Dinder game reserve. Crops are frequently damaged by birds and locusts.

The province was enlarged in 1939 by inclusion of the former Fung and White Nile provinces and its present boundaries were determined in 1951. Its population at the 1955–56 census was 2,069,646. Principal towns are Wad Medani (47,677) the provincial capital, Kosti (22,688), Ed Dueim (12,319), Sinjah, Rufa'a, Sennar, Tendalti, Suki, al Husayhisah, Ar Rusayris (a railway terminal) and Kurmuk, the administrative centre for the south. Nearly three-quarters of the inhabitants are Arabs and more than 85% speak Arabic as their first language. Non-Arabs include Nilotics in the south, and west Sudanese and west African tribes elsewhere. Of the total population 93% are settled and 7% truly nomadic. Settlements concentrate along rivers and around hillfoot water points. There is some seasonal migration to and away from the Niles.

The gainfully employed are engaged in farming (86%) and stockbreeding (10%). Crops are mainly subsistence; cash crops are of greater significance in the north and on irrigated land. The staple food crop is durra (*sorghum vulgare*), and on unirrigated land in the north precarious farming is based on this quick-maturing crop. Southward crops become more varied, with two durra harvests (quick and slow-maturing), sesame on clays and peanuts on sands. Large-scale mechanized agriculture has been started. Irrigation is mainly along the Niles, the largest scheme being served by gravity from the Sennar dam. There was expansion after 1946 of pump schemes for cotton, with durra and *lubia* (*Dolichos lablab*), a bean fodder, as subsidiary crops. Some government controlled schemes were financed out of compensation from Egypt for Sudanese affected by the Jebel Aulia dam, which stores water for Egyptian use. Small pumps, shadoofs and Persian wheels irrigate fruit and vegetables. Maize (corn), vegetables and watermelons grow on the *gerf* (land uncovered as the floods recede). The province provides about 85% of Sudan's long staple cotton exports and 17% of gum. Pastoralism is an important subsidiary occupation, with cattle, sheep and goats, and some camels; the largest owners are nomads. There is fishing on the river banks. Gold was formerly of importance along the Ethiopian border. Industries include cotton ginning, brickmaking and local crafts.

Sennar is a railway centre with connections to Khartoum, Nyala, Wau, Ar Rusayris and Port Sudan. Roads are closed during the rainy season. Regular steamer services on the White Nile are centred on Kosti; the Blue Nile is rarely used.

See also SUDAN, REPUBLIC OF THE; NILE; GEZIRA.

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BLUEPRINT, the popular name applied to both the blueprint and whiteprint methods for copying drawings, letters and similar material by exposing sensitized paper to light.

The blueprint method, used principally for copying house plans

and other drawings, employs paper sensitized with a mixture of ferric ammonium citrate and potassium ferricyanide and produces a blue-coloured print that actually is a negative since the darks and the whites of the original are reversed on the blueprint.

The whiteprint method uses paper sensitized with diazo compounds (*q.v.*) that form a dye when exposed to light. A diazo compound is a complex chemical whose identifying unit is a carbon atom attached to two nitrogen atoms. The whiteprint process, widely employed in the early 1960s in office copying machines, produces a positive print of the original, that is, the darks and whites of the original appear as darks and whites on the whiteprint.

Since they differ in the type of print produced and in other technical aspects, despite being based on the same photoprinting principles, the two methods are discussed separately below.

Blueprints.—The blueprint method was originated by Sir John Herschel in 1842. The method was used first for printing photographic negatives but later came to be used chiefly for making copies of drawings. Cheapness of materials, permanence of prints and simplicity of method are advantages of the blueprint process. In making blueprints, the drawing to be copied, which is made on translucent tracing cloth or paper, is placed in contact with the sensitized paper and exposed to light. After exposure the sensitized paper is removed and washed in clean water, producing a clear negative print with the dark lines of the drawing appearing as white lines on a background of prussian blue.

In the early days of blueprinting, prints were produced individually in frames by exposure to sunlight. Coating the paper and exposing and developing the print were all done by hand until a machine was developed that combined all these operations. In the machine, a continuous strip of sensitized paper (*see* fig. 1) passes around a rotating glass drum carrying the drawing on its surface and a light source in its interior. After exposure the print is separated from the drawing and then moved through a water bath, a developing bath of potassium dichromate (to improve contrast between white lines and blue background), another water bath and then over drying drums. The finished print is then trimmed off the continuous roll.

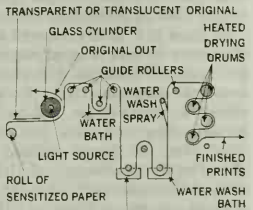

FIG. 1.—SCHEMATIC DIAGRAM OF PROCESS FOR MAKING BLUEPRINTS WITH A CONTINUOUS ROLL MACHINE

Whiteprints.—The whiteprint method, developed in 1917 by Gustav Kögel, employs either a dry or semimoist technique. In both, the print produced is an exact copy of the original and the chemistry is based on a diazo compound. In addition to a light-sensitive diazo compound, each technique uses a coupler that forms the colour, an acid that prevents coupling of the diazo and coupler before development, and an alkaline agent that combines the diazo compound and coupler to form the image. By changing the coupler, the colour of the print is changed. Materials used in both processes are fundamentally the same; the only differences are in the materials used for coating the paper and the method for developing the print.

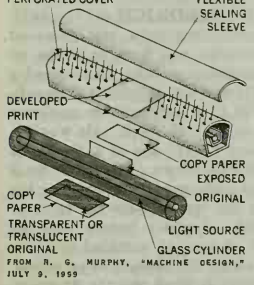

FIG. 2.—SCHEMATIC DIAGRAM OF DRY PROCESS OF WHITEPRINTING

In the dry (or ammonia) process (*see* fig. 2) the paper or other material used for printing is sensitized by a coating of diazo compound, coupler and acid. After exposure the print is developed in ammonia vapours; the ammonia neutralizes the acid and permits the diazo compound and coupler to unite and form the azo dye that produces the image. Prints are delivered dry immediately after development.

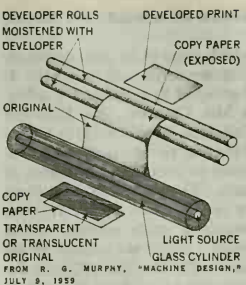

FIG. 3.—SCHEMATIC DIAGRAM OF SEMIMOIST PROCESS OF WHITEPRINTING

In the semimoist process (*see* fig. 3) the material used is sensitized with the diazo compound and acid. After exposure the print is developed by running it between two rollers that apply a thin film of developer, which consists of the coupler and alkaline agent. Wetting the exposed print with this solution causes the diazo compound and coupler to unite and form the azo dye that produces the image. After developing, the print passes over a drying drum.

In both the dry and semimoist processes, the print is exposed by placing the sensitized material in contact with the original as the latter moves around a glass drum containing the light source. After exposure, the original is separated from the print and removed. The exposed copy is then moved through the developer section, over a heated section and out either the front or back of the machine.

In the original whiteprint process, the print was exposed in one machine and developed in another. The two steps later were combined in one machine, and by the early 1960s the whiteprint process was more widely used than was blueprinting.

See DIAZO COMPOUNDS; IRON: *Carbides, Carbonates, Carbonyls, Cyanides;* PHOTOGRAPHY: *Nonsilver Printing Processes.*

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(F. E. Go.)

BLUE RIDGE, a range of mountains in southeastern U.S., the southwesternmost portion of the older Appalachian mountains (*q.v.*). The Blue Ridge is a relatively narrow ridge, 5 to 65 mi. wide and 615 mi. long., extending from Carlisle, Pa., through parts of Maryland, Virginia, North Carolina and South Carolina to Mt. Oglethorpe, Ga. Included in the Blue Ridge system are the Black mountains, with Mt. Mitchell (6,684 ft.), the highest peak east of the Mississippi river; the Great Smoky mountains; and the Unaka mountains. Geologically the Blue Ridge is composed principally of ancient Pre-Cambrian metamorphic rocks strongly folded, occasionally faulted, and containing igneous materials of more recent age. The whole region has been subjected to intricate dissection by numerous small streams. On the eastern front range, commonly referred to as the Blue Ridge, the altitude is between 2,000 and 4,000 ft. Several peaks are included in this section: Mt. Rogers (5,720 ft.), highest peak in Virginia; Sassafras mountain (3,560 ft.), highest peak in South Carolina; Brasstown Bald (4,784 ft.), highest peak in Georgia. Others are Stony Man (4,010 ft.) and Hawks Bill (4,049 ft.) in Virginia and Grandfather mountain (5,939 ft.) in North Carolina. Three major rivers have cut gaps through the ridge—the Roanoke, James and Potomac, all in Virginia. The Skyline Drive highway begins south of Front Royal, Va., and runs 97 mi. through the Shenandoah National park (*q.v.*). The drive connects with Blue Ridge parkway at Rockfish Gap in Virginia and runs south to the Great Smoky Mountains National park (*q.v.*). The famous Appalachian trail (for hikers) follows the crest of the Blue Ridge range from Mt. Oglethorpe, Ga., into Pennsylvania. Over 700 varieties of trees and plants have been catalogued, including azaleas, rhododendrons, mountain laurel and galax. Long noted for its isolation, the region in the 1960s still contained numerous small farms with picturesque log cabins. Intensive truck farming, tobacco production and cattle raising are important farm activities. The main nonfarm resource of the region is its hardwood forests; some minerals are available. (M. C. P.)

BLUE SKY LAW, a term popularly applied in the United States to statutes and regulations enacted in almost all the states

to protect purchasers of stocks and bonds from fraud. *See* SECURITIES REGULATION.

BLUESTOCKING, a word which came to be used derisively to describe a woman who affects literary or learned interests. It derives from the name given to the group of English literary ladies, including Mrs. Elizabeth Montagu, Mrs. Chapone, Mrs. Elizabeth Carter (*qq.v.*), Mrs. Vesey, Mrs. Ord, Mrs. Boscawen, Mrs. Crewe and Miss Mary Monckton, who, in the mid 18th-century, held *conversaziones* to which they invited men of letters and members of the aristocracy with literary interests. The sole purpose of these parties, according to Hannah More (*q.v.*), whose poem "The Bas Bleu, or Conversation" provides valuable inside evidence about them, was conversation, and they were a deliberate attempt to replace card playing by something more rational. The origin of the term bluestocking, or *bas bleu,* is probably to be found in an anecdote told by Mme d'Arblay (Fanny Burney; *q.v.*), perhaps the most famous "bluestocking." Mrs. Vesey had asked the learned Benjamin Stillingfleet to one of her parties, and he declined because he lacked appropriate dress for the evening. She persuaded him by telling him to come "in his blue stockings"—the ordinary worsted stockings he was wearing at the time. He did so, and Bluestocking (or *Bas bleu*) society became a nickname for the group, which was never a society in the formal sense.

According to Mme d'Arblay, the first party was given by Mrs. Vesey at Bath, but when she moved to London a rivalry developed with Mrs. Montagu, who became the leader. Among frequent attenders at the parties were Dr. Johnson, Garrick, the earl of Bath, Mrs. Delaney, Mrs. Thrale, Lord Lyttleton, Horace Walpole (who called them "petticoteries"), William Mason and Sir William and Sir Lucas Pepys.

See W. S. Scott, *The Bluestocking Ladies* (1947); and, for contemporary references, the bibliographies to the articles on the most notable members of the group.

BLUETHROAT, a bird, *Cyanosylvia svecica,* allied to the nightingale, but with a blue throat and a dark brown and chestnut tail. In habits it is shy and skulking; even its song, though musical, is weak. It haunts tangled hedges and thickets of birch and willow, especially when swampy, and nests close to the ground. Five to seven gray-green eggs, speckled with red-brown, are laid in early summer. The bird breeds in northern Europe and Asia, to the Arctic circle, migrating to Africa and India in winter. Two forms are common: the white-spotted bluethroat (*C. s. cyanecula*) of Scandinavian countries and the central European red-spotted bluethroat (*C. s. svecica*).

BLUETS (*Houstonia caerulea*), a popular North American wild flower of the madder family (Rubiaceae; *q.v.*), known also as innocence, eyebright and quaker-ladies. It is native to grassy places and wet rocks from Nova Scotia to Wisconsin and south to Georgia and Missouri. This early spring favourite, which grows perennially in matted tufts, with smooth stems three to seven inches high, is aptly described by Asa Gray as "a delicate little herb producing in spring a profusion of light blue flowers fading to white, with a yellowish eye." In the southern United States there are about 20 other species of *Houstonia,* some of which are known as bluets, as the thyme-leaved bluets (*H. serpyllifolia*), the least bluets (*H. minima*), the small bluets (*H. patens*) and the purple bluets or Venus-pride (*H. purpurea*) which grows 18 in. high. In Great Britain the bluebottle or cornflower (*q.v.; Centaurea cyanus*) is sometimes called bluet.

BLUM, LÉON (1872–1950), French politician, first Socialist premier of France, was born on April 9, 1872, at Paris, a member of an Alsatian Jewish family. Educated at the École Normale Supérieure, he proceeded to study law at the Sorbonne, graduating in 1894 with the highest honours, and thereafter he made his name as a brilliant literary and dramatic critic. The Dreyfus affair (*see* DREYFUS, ALFRED) brought him into active politics on the side of the republican Dreyfusards, and his close association with Jean Jaurès, whom he greatly admired, led to his joining the Socialist party in 1899.

Blum was first elected to the chamber of deputies in 1919. His first task was to reconstruct the Socialist party after the split of Dec. 1920, when the Communist section of it won a majority at the congress of Tours and so inherited the party machinery, funds and press. Blum ranks in history as the maker of the modern French Socialist party and of its chief journal, *Le Populaire.* He led the opposition to the governments of Alexandre Millerand and Raymond Poincaré and in 1924 supported Edouard Herriot's Cartel des Gauches (Radical coalition), though refusing to participate in the ministries of Herriot and Aristide Briand. In the elections of 1928 the Socialist party won 104 seats in the chamber, but Blum himself was defeated. A year later he was returned for Narbonne, which also returned him in 1932 and again in 1936.

After the riots in Paris in Feb. 1934 Blum worked for solidarity between Socialists, Radicals and all other opponents of fascism. These efforts contributed to the formation of the electoral alliance of the left known as the Front Populaire which, in the elections of April and May 1936, won a large majority in the chamber. Blum, its chief architect, became premier as leader of the Popular front government of June 1936. He was the first Socialist and the first Jew to become premier of France. His government introduced, against considerable opposition, the 40-hour week; it nationalized the chief war industries and the Bank of France, and carried out a program of social reforms. Its most intractable problem was national defense against the growing power of the Rome-Berlin axis, and its policy of "nonintervention" in the Spanish civil war was denounced as appeasement. His social reforms aroused bitter hostility among French industrialists and financiers, who refused to co-operate with his government, and it was at this time that sections of the right wing adopted the ominous slogan, "Better Hitler than Blum."

In June 1937 Blum resigned after the conservative majority in the senate refused to grant him emergency decree powers to tackle the country's financial difficulties. Modified Popular front governments were formed by Camille Chautemps, in which Blum served as vice-premier, and by Blum again in March 1938. He refused office under his successor, Edouard Daladier. In Oct. 1940, after the French collapse in World War II, Blum was indicted by the government of Vichy on charges of war guilt, and in Feb. 1942 was brought to trial at the court of Riom. The powerful defense put up by Blum and the others accused so greatly discomfited the men of Vichy and so irritated the Germans that in April the hearings were suspended indefinitely, and Blum was returned to prison. He was freed by U.S. forces from a German concentration camp in May 1945.

After the liberation of France he emerged as one of France's leading veteran statesmen, and in the spring of 1946 he negotiated a U.S. credit to France of $1,370,000,000. In Dec. 1946 he formed a "caretaker government," the first all-Socialist French ministry, pending the election of the first president of the new fourth republic. Though the ministry lasted little more than a month, its vigorous policy left a deep impression on France. Blum retired from public life in Jan. 1947, but served as vice-premier in André Marie's ministry of Aug. 1948. He died on March 30, 1950.

Blum's many writings include *La Réforme gouvernementale* (1936); *Souvenirs sur l'Affaire* (1935); *A l'échelle humaine* (1945), Eng. trans. by W. Pickles, *For All Mankind* (1946).

See *L'Oeuvre de Léon Blum,* 2 vol. (1954–55); G. Fraser and T. Natanson, *Léon Blum, Man and Statesman* (1937; 1938). (D. TN.)

BLUMENBACH, JOHANN FRIEDRICH (1752–1840), German physiologist and comparative anatomist who proposed one of the earliest racial classifications, was born at Gotha on May 11, 1752. After studying medicine at Jena, he received a medical degree at Göttingen in 1775 and was appointed extraordinary professor of medicine there in 1776 and ordinary professor in 1778. He died at Göttingen on Jan. 22, 1840. He was the author of *Institutiones Physiologicae* (1787) and of a *Handbuch der vergleichenden Anatomie und Physiologie* (1824), but he is best known for his work in physical anthropology, of which he has been called the founder. He was the first to show the value of comparative anatomy in the study of man's history, and his craniometrical research led to his division of mankind into five great families—the Caucasian or white, the Mongolian or yellow, the Malayan or brown, the Ethiopian or black and the American or red. His most important anthropological work was his collec-

tion of 60 human crania of various physical types, described in his *Collectionis suae craniorum diversarum gentium illustratae decades* (1790–1828).

A selection of Blumenbach's writings is given in Earl W. Count (ed.), *This Is Race* (1950).

BLUNT, WILFRID SCAWEN (1840–1922), English poet whose impulsive, generous nature found expression also in anti-imperialism based on sympathy for small or oppressed nations. Born on Aug. 17, 1840, at Petworth house, Sussex, he was educated at Stonyhurst and Oscott, and entered the diplomatic service in 1858, serving successively at Athens, Madrid, Paris and Lisbon, and in South America. He retired on his marriage with Lady Anne Noel, daughter of the earl of Lovelace and a granddaughter of Byron. In 1872 he succeeded to the estate of Crabbet park, Sussex, where he established a famous stud for the breeding of Arab horses. With his wife he traveled frequently in northern Africa, Asia Minor and Arabia, two of their expeditions being described in Lady Anne's *Bedouin Tribes of the Euphrates* (2 vol., 1879) and *A Pilgrimage to Nejd* (2 vol., 1881).

Blunt became known as an ardent sympathizer with Muslim aspirations, and in *The Future of Islam* (1882) he directed attention to the forces which produced the movements of Pan-Islamism and Mahdism. He was a violent opponent of British policy in the Sudan, and in *The Wind and the Whirlwind* (in verse, 1883) prophesied its downfall. He supported the national party in Egypt, and took a prominent part in the defense of Arabi Pasha. *Ideas About India* (1885) was the result of two visits to that country, which, by rousing his sympathy for the poverty of the people, confirmed his distrust of colonialism as "exploitation." In 1885 and 1886 he stood unsuccessfully for parliament as a Home Ruler; and in 1887 he was arrested in Ireland while presiding over a political meeting in connection with the agitation on Lord Clanricarde's estate, and was imprisoned for two months in Kilmainham. His best-known volume of verse, *Love Sonnets of Proteus* (1880), reveals his real merits as an emotional poet. *The Poetry of Wilfrid Blunt* (1888), selected and edited by W. E. Henley and George Wyndham, includes these sonnets together with "Worth Forest, a Pastoral," "Griselda" (described as a "society novel in rhymed verse"), translations from the Arabic and poems which had appeared in other volumes. Blunt published a complete edition of his poetical works in 1914 and two volumes of *My Diaries* (1919 and 1920). He died at Newbuildings, Sussex, on Sept. 12, 1922.

See Edith Finch, *Wilfrid Scawen Blunt, 1840–1922* (1938); Lord Lytton, *W. S. Blunt* (1961).

BLUNTSCHLI, JOHANN KASPAR (1808–1881), Swiss writer on the laws of war, was born at Zürich, March 7, 1808. He studied law at Zürich, Berlin and Bonn (under Friedrich Karl von Savigny), became a professor at Zürich university and a member of the Great Council of Zürich (1837–45). In 1848 he was appointed professor of German private and public law in Munich and in 1861 in Heidelberg.

His outstanding contribution, the *Lehre vom modernen Statt* (3 vol. 1875–76), was translated into French and English. Bluntschli is probably best remembered for his contributions to international law. *Das moderne Kriegsrecht* (1866), based on Francis Lieber's code, contributed to the eventual codification of the laws of war (*see* HAGUE CONFERENCES), and *Das moderne Völkerrecht* (1868), presented, in the form of a code, a deceptively complete system. Bluntschli, equally interested in codification and progressive development of international law to satisfy the growing needs of mankind, filled gaps in positive law without drawing a line between existing law and what the law ought to be. Immediately an outstanding success, this book, translated into many languages, became a reference work for diplomats. Bluntschli was cofounder of the Institute of International Law (1873) which has made substantial contributions to the development of international law. He died on Oct. 21, 1881, at Karlsruhe.

Of Bluntschli's numerous publications the following may be mentioned: *Allgemeines Staatsrecht* (1851–52); *Über die Communisten in der Schweiz* (1844); *Deutsches Staatswörterbuch* (co-editor; 11 vol. 1857–70); *Das Beuterecht im Krieg* (1878); *Privatrechtliches Gesetzbuch für den Kanton Zürich* (4 vol., 1854–56); *Deutsches Privatrecht*, 2 vol. (1853–54).

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BLY, NELLIE (pen name of ELIZABETH COCHRANE) (1867–1922), U.S. newspaper writer, whose around-the-world race against a theoretical record made the name one of the most celebrated of the era, and a synonym for the feminine star reporter. She was born at Cochran's Mills, Pa., on May 5, 1867, but after her father's death moved to Pittsburgh, where she obtained a job at the age of 18 as feature writer on the *Dispatch*. There she did a series of articles on such subjects as divorce, slum life and conditions in Mexico. She was employed by the *New York World* in 1887. Feigning insanity to get into the asylum on Blackwell's Island, she wrote an exposé which brought about needed reforms. Later she exposed tenement conditions, "mashers' " methods, the Albany lobby, and the like. On Nov. 14, 1889, she sailed from New York to beat the record of Phileas Fogg, hero of Jules Verne's romance, *Around the World in Eighty Days*. The *World* built up the story by daily articles and a guessing contest in which whoever came nearest to naming Nellie's time in circling the globe would get a trip to Europe. There were nearly 1,000,000 entries in the contest. Nellie rode on ships and trains, in jinrickishas and sampans, on horses and burros. On the final lap of her journey the *World* brought her from San Francisco to New York by special train; she was greeted everywhere by brass bands, fireworks, etc. Her time was 72 days, 6 hours, 11 minutes and 14 seconds. Miss Cochrane married millionaire Robert Seaman in 1895; but after his death and financial reverses she returned to newspaper work on the *New York Journal* in 1920. She died in New York city on Jan. 27, 1922.

See Mignon Rittenhouse, *The Amazing Nellie Bly* (1956). (F. L. MT.)

BLYTH, a municipal borough (1922) and seaport in the Blyth parliamentary division of Northumberland, England, at the mouth of the Blyth, 17 mi. N.N.E. of Newcastle by road. Pop. (1961) 35,933. The area around this short river that runs past tree-covered banks to a sandy shore has been occupied at least from Saxon times. The flourishing salt pans on the coast were gradually displaced by sea trade in coal from the hinterland. About 6,000,000 tons of coal are shipped yearly from the harbour which has ample quays, five dry docks and shipbuilding yards. Timber is largely imported; industries include ropemaking, electroplating and textiles. Blyth has also become a seaside resort along the grassy dunes south of the harbour. To the southwest is Seaton Delaval hall, designed by Sir John Vanbrugh in 1718.

B'NAI B'RITH ("Sons of the Covenant") is the oldest and largest Jewish service organization in the world, with men's lodges, women's chapters and youth chapters in countries all over the world.

Founded in New York city in 1843, B'nai B'rith defends human rights; promotes intercultural relations; provides for the religious and cultural needs of Jewish college students; sponsors Jewish education among adults and youth groups; supports hospitals and philanthropic institutions; provides vocational guidance; sponsors welfare projects in Israel; assists victims of natural disasters; and carries on a broad program of community service and welfare, civil defense and service to veterans. It confers with government leaders on such issues as civil rights, immigration, abuses of freedom by totalitarian states, the position of Israel and problems affecting Jews throughout the world. B'nai B'rith is represented at the United Nations through its membership in the Coordinating Board of Jewish Organizations.

The order is headed by a president elected at triennial meetings of the supreme lodge (made up of representatives of district grand lodges), a board of governors and an administrative committee. (ME. B.)

BNEI BRAK (BNEI BRAQ), the modern Israeli name of the biblical Beneberak, a town allotted to the Israelite tribe of Dan (Josh. xix, 45). The ancient site has been identified as Arabic Al

Kheiriyeh (Ibn Ibraq), 5 mi. E. of Tel Aviv-Jaffa (Yafo), and the present town is north of the ancient site. Bnei-Brak appears among the captured cities of the Assyrian monarch Sennacherib who defeated Sidqia, king of Ascalon (Ashkelon) and suzerain of Banai-Barqa (*i.e.*, Bnei Brak), in his third campaign, 701 B.C. The name, which means "sons of lightning," is similar to an attested Canaanite (Ugaritic) personal name *Bn brq*. The Mishnah records a famous Passover seder at Bnei Brak wherein five rabbis expounded all night on the story of the exodus from Egypt. A modern village was established in 1924 by Polish immigrants, which quickly became an industrial centre of some importance. Pop. (1956 est.) 30,000. (J. S. I.)

BOA, the popular name of snakes of the subfamily Boinae of the family Boidae. All boas kill their prey by constriction, have no poison fangs, give birth to live young, have a vestigial pelvis and hind limbs that can be seen externally as small spurs on either side of the vent, have no teeth in the premaxillary bones and lack supraorbital bones. They range in length from 8 in. to 30 ft. The only larger snakes are the pythons of the related subfamily Pythoninae. A python (*q.v.*) closely resembles a boa, differing only by laying eggs and possessing supraorbital bones. The boas and pythons, since both have vestigial hind limbs, are believed to be the most primitive of living snakes.

ISABELLE H. CONANT

EMERALD GREEN BOA (BOA CANINA)

Most boas are either terrestrial or arboreal and feed upon birds and mammals, killing them by constriction; the smaller species may hold their prey with the teeth and without constriction until it is swallowed. In colour, most boas show patterns of browns, tans and yellows arranged in rhombuses, diamonds, blotches and other disruptive figures that blend into the natural coloration of the habitat.

There are about 35 living species of boas, 32 of which occur in tropical America, nearby temperate regions and the West Indies. The largest new world boa is the anaconda (*q.v.*), which reaches a length of about 30 ft. The second largest is *Constrictor constrictor,* whose technical name once was Boa constrictor, a term now used popularly to describe any large constrictor snake; *C. constrictor* averages 11 ft. in length and ranges from near the U.S. border in Mexico to central Argentina and the West Indies. The rubber boa (*Charina bottae*), reaching 18 in., is found in the western U.S. and extreme southwestern Canada, and two species of *Lichanura* occur in southern California and Arizona and northwest Mexico. The last genus includes the California boa, which reaches 24 in. Other new world species include the rainbow boa (*Epicrates cenchris*), found from Costa Rica to Argentina; the Cuban ground boa *Tropidophis semicinctus;* the emerald green boa (*Boa canina*); and members of the dwarf genera *Ungaliophis* and *Trachyboa.*

Boas of the old world include the sand boas (*Eryx*) of the dry regions of central Asia, southeast Europe and northeast Africa; the Pacific boas (*Enygrus*), found from the Celebes through New Guinea to the Society Islands; and two genera in Madagascar.

See also SNAKE: *Boidae.* (A. Sc.)

BOABDIL (ABU 'ABD ALLAH MOHAMMED XI) (d. 1527) ruled over Granada (*q.v.*) as the last Nasrid sultan during 1482–92. The son of Mulay Hasan, his succession was endangered by the rivalry between his mother, the sultana Aisha and the sultan's favourite Zoraida, a Christian captive. Proclaimed sultan by popular insurrection in 1482 in place of his father, he was taken prisoner by the Castilians at Lucena in 1483 and was released after secretly consenting to surrender Granada city upon demand to the Catholic sovereigns of Aragon and Castile, Ferdinand and Isabella. The next few years were spent in civil war with his father and his uncle, al-Zagal ("the valiant"), who had usurped the sultanate in Boabdil's absence. The Castilians profited from these diversions to capture the chief strongholds of their kingdom.

In 1491 Boabdil was summoned to fulfill his promise to the Catholic sovereigns, and on his refusal Granada was subjected to the celebrated siege. It fell on Jan. 2, 1492, and Boabdil left for lands he was allowed to hold in the Alpujarras district of southern Spain. He crossed to Africa in 1493 and is reported to have been killed in 1527 fighting for his kinsman, the Marinid ruler of Fez.

A romantic figure, Boabdil has survived in many local folk tales, such as those collected by Washington Irving in his *The Alhambra* (1832). The hill from which he looked for the last time on the palaces and pleasure-gardens of Granada is known as "the last sigh of the Moor." There his mother Aisha is said to have taunted his tears with the words "You do well to weep like a woman for what you could not defend like a man."

See W. H. Prescott, *A History of the Reign of Ferdinand and Isabella,* 8th ed. (1887). (K. GA.)

BOACO, a department in Nicaragua extending from the northern end of Lake Nicaragua eastward across the central highlands; and a town, capital of the department. Pop. (1963) 71,905; area, 2,085 sq.mi. The population is concentrated in highland valleys in the western third of the department. Despite rather rugged relief, the department is important agriculturally, producing especially cattle, swine, hides and skins, dairy products, corn, beans, other vegetables and fruits. The town of Boaco, a very old settlement, is connected by a new road 38 mi. long with the Inter-American highway at San Benito, which is only 23 mi. from Managua. (C. F. J.)

BOADICEA (properly BOUDICCA), a British queen who in A.D. 60 led a revolt against Roman rule. Her husband, Prasutagus, ruled the Iceni (in what is now Norfolk) as a client king under Roman suzerainty. On his death in A.D. 60 without male heir, he had left his private wealth to his two daughters and the emperor Nero, trusting so to win imperial protection for his family. Instead, his kingdom was annexed, his family humiliated and the chief tribesmen plundered. While the provincial governor Suetonius Paulinus was absent in north Wales and Anglesey in 60, Boudicca and her people rose, and with them the rest of East Anglia. They burned Colchester, Verulam, the mart of London, and several military posts, massacred (according to Tacitus) 70,000 Romans and friendly Britons and cut to pieces the 9th legion marching from Lincoln to the rescue. Paulinus, concentrating his army, met the Britons at a point thought to be near Fenny Stratford on Watling street. In a desperate battle Rome regained the province. Boudicca took poison or died of shock; thousands of Britons fell in the battle or were hunted down in the ensuing warfare.

In the end Rome adopted a milder policy, and Britain became peaceful. But the retarded development and modest character of Romano-British remains in Norfolk suggest the severity with which the Iceni were crushed. (I. A. RD.)

BOAR, generally speaking, the name given to the male of the domestic pig (*q.v.*) and to the males and females of some wild species of the family Suidae. The European wild boar refers to *Sus scrofa,* the largest of the wild pigs, distributed over Europe, northern Africa and central and northern Asia. Long extinct in the British Isles, it is still found in marshy woodland districts in Spain, Austria, the U.S.S.R. and Germany.

BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

EUROPEAN WILD BOAR (SUS SCROFA)

From the earliest times, because of its great strength, speed and ferocity when at bay, the boar has been one of the favourite beasts of the chase. In some parts of Europe and India the wild boar is still hunted with dogs, but the spear, except when used in emergencies and for giving the *coup de grâce,* has been replaced by the gun. The wild boar of India (*S. cristatus*) is slightly taller than *S. scrofa,* standing about 30 to 40 in. at the shoulder. It is found throughout India, Ceylon and Burma. There the horse and spear are used for hunting it (*see* PIGSTICKING).

The boar is one of the four heraldic beasts of the chase, and was the distinguishing mark of Richard III, king of England. As an article of food the boar's head was long considered a special delicacy.

BOARD GAMES are games of skill and chance played by two or more players with "men," or pieces, on a restricted field, or board. Man has been playing board games for thousands of years; the first "boards" no doubt consisted of lines drawn on the ground, the first pieces, stones, bones or shells. Ancient game boards have been found in Egyptian tombs and at Ur; a diagram for Nine Men's Morris (*q.v.*) was engraved on the steps of an ancient Cretan temple. An ivory and ebony veneer board with ivory pieces for an Egyptian game, "Hounds and Jackals," dates from the reign of Amenemhet III (*c.* 1842–1797 B.C.) in the 12th dynasty. The origins of the oldest games, such as backgammon and chess, are in doubt; all may have descended from a common, earlier ancestor. Primitive man may have evolved games from playing with materials at hand, or repeated magical rites, funeral games or military lessons. Board games imitate, symbolically, the activities of men—the battle, siege, hunt, race or territorial conquest. They undergo evolutionary development and the invention of variants, especially when rules are transmitted orally. The Japanese game of Go, for example, is quite different from its Chinese parent, wei-ch'i, and there are many variants of checkers (*q.v.*).

COURTESY OF THE METROPOLITAN MUSEUM OF ART, NEW YORK CITY, CARNARVON COLLECTION, GIFT OF EDWARD S. HARKNESS, 1926

EGYPTIAN BOARD GAME "HOUNDS AND JACKALS," WITH IVORY AND EBONY VENEER BOARD AND IVORY PLAYING PIECES, 12TH DYNASTY

In the earliest board games moves were controlled by instruments of chance such as staves (sticks or straws), cowrie shells, knucklebones or early forms of dice; modern games use dice, cards or spinners. Proprietary board games have been known since the 18th century. Many modern proprietary games are built around popular television, literary or comic characters; favourite themes have been detecting, news reporting, treasure-hunting, quiz contests and travel. Two modern innovations in skill games have been Monopoly, a buying and selling game, and Scrabble, a combination of crossword puzzles and anagrams.

See also articles on individual board games, as BACKGAMMON; BINGO; CHESS; GO; etc. (P. FR.)

BOARDING-OUT SYSTEM, the placing of destitute children in families where they would be treated as members, evolved from the apprenticeship provisions of the early English and American poor laws into foster home programs for children in need of care outside their own homes. *See* CHILD WELFARE: *Children Away From Home: Foster Care.*

BOARD OF GUARDIANS: *see* POOR LAW.

BOARD OF TRADE, in Great Britain a department of the government (*see* GOVERNMENT DEPARTMENTS) and in the United States a term occasionally, and especially in earlier times, used as a synonym for chamber of commerce (*see* TRADE ORGANIZATION). The typical chamber of commerce consists of business and professional men of a city, state, country or other locality who have an interest in industrial development, legislation affecting business and the like, and are also concerned with charitable causes and general civic improvement. Board of Trade has another important meaning as the corporate name of an organized market for grain in the city of Chicago. Incorporated by an act of the legislature of Illinois in 1850, it is a self-governing exchange on which grain, grain futures and certain other commodities are traded.

See also COMMODITY MARKET. (FK. L. K.)

BOARD OF TRADE UNIT, the unit of energy adopted by the British Board of Trade. It is equal, in electrical units, to one kilowatt-hour. *See* PHYSICAL UNITS.

BOAS, FRANZ (1858–1942), one of the most influential of U.S. anthropologists, was a specialist in the cultures and languages of American Indians. Born July 9, 1858, at Minden, Westphalia, he studied physics and geography at Heidelberg and Bonn before receiving his Ph.D. from the University of Kiel (1881). His interest in primitive culture was aroused by observations of the Eskimos made during a scientific expedition to Baffin Island (1883–84). In 1886 he made the first of many trips to the north Pacific coast to study the Kwakiutl and other tribes of British Columbia, on which he later specialized. In 1887, having become a permanent resident of the United States, he joined the staff of *Science* as editor. He began his academic career as instructor at Clark university, Worcester, Mass., in the following year. In 1896 he became instructor, and in 1899 professor of anthropology at Columbia university. During his long tenure at Columbia, where he remained for the rest of his life, Boas built up one of the foremost departments of anthropology in the United States and trained or influenced many notable ethnologists and linguists. He was largely responsible for encouraging women to enter the field of anthropology.

From 1901 to 1905 he was also curator of anthropology at the American Museum of Natural History; in that capacity he directed and edited the reports of the Jesup North Pacific expedition, the purpose of which was to investigate relationships between the aborigines of Siberia and North America.

Boas was an indefatigable field worker, collecting voluminous data on the languages, religion and material culture of North American tribes. His work was criticized for lacking integration, but his emphasis on facts rather than interpretation reflected a widespread reaction against the sweeping theories on cultural evolution in vogue during the 19th century. Boas also made important contributions to physical anthropology. After extensive metrical studies made on immigrants and their descendants, he demonstrated that head form is an adaptive trait, subject to environmental influences—a conclusion significant for racial studies, and substantiated by later investigators.

Boas established the *International Journal of American Linguistics,* was one of the founders of the American Anthropological association, president (in 1931) of the American Association for the Advancement of Science, and a member of many other scientific societies in the U.S. and abroad. He died in New York city on Dec. 21, 1942.

Boas was a prolific though not always lucid writer. Among his more important books were *Race Language and Culture* (1940), a collection of writings including *Changes in Bodily Form of Descendants of Immigrants; The Mind of Primitive Man* (1938), a series of lectures on culture and race; *Primitive Art* (1928); and *Anthropology and Modern Life* (1929).

For an evaluation of his work and a complete bibliography *see* "Franz Boas, 1858–1942," *American Anthropological Association Memoir* no. 61 (July–Sept. 1943); Melville Herskovits, *Franz Boas* (1953), which includes a selected bibliography.

BOAT, a generic term for small craft propelled by paddles, oars, sail or motor, open or partially decked, and usually less than 45 ft. in length. A vessel larger than this customarily is classed as a ship (*q.v.*), although the word boat is often applied to certain working vessels; *e.g.,* tugboats, that may be of considerable size. This article deals principally with ancient and primitive boats and modern working boats of various types; the equipage of some of these craft is described in RIGGING and SAILS. For a description of modern pleasure boats, *see* the article BOATING. The highly specialized boats and landing craft used in military and naval operations are described in TRANSPORT, MILITARY. (*See* also FISHING VESSELS; LIFEBOAT AND LIFESAVING; YACHT.)

EVOLUTION OF THE BOAT

It is customary to assume that the boat developed from a floating log to a raft to a dugout canoe. Actually, the early forms of the boat were many, and their design and structure depended upon available material. Where suitable timber was at hand, the raft and later the dugout canoe developed. Where suitable timber was not available, reed rafts, skin-covered canoes and skin floats made by inflating the hides of small animals could be found. In some timbered areas bark canoes were used. It may be assumed

that the boat developed from the canoe forms; it is evident that boats did not appear until long after various forms of canoes came into being.

During the evolution of the dugout canoe the sides were raised by means of plank and this led to gradual reduction in size of the dugout portion until it became a mere keel piece, with the rest of the hull built of plank. However, there is reason to doubt that the development of the plank boat was confined to areas where dugout canoes were used. The bark canoe and the skin boat were employed in some timbered areas, and the rigid framing of the skin boat may have been adapted naturally to plank construction once the primitive builder found a way to produce planking. This possibility is supported by the fact that the longitudinal and transverse framing of most planked boats is basically the same as that employed in skin boats.

The development of primitive water craft of each of the basic forms was more rapid in some areas than in others because of varying needs for water transportation. A great many types of primitive craft survived into modern times and some are still in use. Many were of relatively large size and of excellent design for the tasks they had to perform.

Rafts and Dugouts.—The raft, made of timbers lashed or pegged together, was in some cases a mere float, heavy and awkward to propel. However, in a few instances, the raft was developed into an efficient sailing craft with a raised platform that enabled cargo to be carried and protected from water. Rafts made of bundles of reeds lashed together, given a somewhat pointed bow and rudimentary sides, were also used.

Dugouts range from simple, trough-shaped hulls to beautifully formed boats with the sides spread, after shaping, by warping with hot water. In another form, the dugout consists of a number of shaped logs fastened together to form a hull. A more common design employs a main dugout hull with the sides raised by means of plank secured by pegs or by "sewing," done by passing lashings through holes along the seams of the planking. It is but a short step from the dugout with plank sides to a boat built solely of plank, using sewed fastenings. Sewed construction was extensively used in the South Pacific canoes. The ancient Egyptians built boats of short pieces of plank, laid up like bricks in a wall, but used edge-fastenings instead of sewing the seams.

Bark and Skin Craft.—Bark canoes developed in a few areas, ranging in design from craft having only the most elementary framing to the highly developed birch bark canoes of the North American Indians. The birch bark canoes had a thin plank lining held against the inside of the bark cover by an extensive framing of ribs forced under the gunwale. So efficient were the Indian canoes that the white man copied them for wilderness travel.

Skin craft range from inflated skins, used singly or joined together in a raft, to framed hulls of good form and construction. In the latter there is a rigid frame composed of longitudinals and ribs secured by lashings or pegs, and the skins are stretched over the completed framework.

Plank Construction.—The lapstrake type of planking, in which each plank or strake overlaps slightly the one below it, can be seen in an elementary form in some dugouts with plank sides. In the primitive form the lap is sewed its full length. The lapstrake planking method appears to have reached its final form in northern Europe, where iron fastenings were used. As seen in the remains of ancient European craft, the seams were nailed at the laps but the planking was lashed to the ribs or frames. The use of metal fastenings throughout the hull did not become common, apparently, until about the 9th century in northern Europe.

Caravel planking has smooth seams, with the planks placed edge to edge and fastened only to the frames. This originated in the Mediterranean basin; possibly it evolved from the older edge-fastened plank construction of the Egyptians. However, it took its name from a class of ships built in Spain and Italy in the 14th and 15 centuries. Plank construction did not become common in Europe until metal fastenings were procurable, although pegged construction was probably used in an early stage of evolution.

The basic framework of planked boats of the conventional lapstrake or caravel forms is the same: a keel and transverse frames or ribs more or less evenly spaced along the length of the boat. At the gunwale or top edges of the planking there are longitudinals, and sometimes a little below the gunwale there are additional longitudinals to support the rowing seats or thwarts. In the early boats the frames were cut from "knees" or crooked timber, but early in the 19th century steam-bent frames came into use. One marked difference between lapstrake- and caravel-planked boats is that the former usually had ribs put in after the planking was complete whereas the caravel boat was commonly planked over the ribs. Lapstrake boats do not have the seams caulked except along the keel. Moss was used to caulk the viking boats, while animal hair and textile materials were used in ancient Mediterranean boats. Tar was placed over the caulking to fill the seams. The lapstrake and caravel planking, combined with the basic framework, have been retained as conventional methods of boatbuilding.

Greek and Roman Boats.—Little is known of the boats of Rome and Greece, though more is known about the ships of these eras. No identified remains of Greek or Roman boats have been recovered, and the fragments of contemporary literature and art produce little more than some type names and the impression that some small boats were built with speed particularly in view. It is mere speculation to attempt to describe the individual types; apparently, many types first built as small boats became large, fast, rowing ships in a normal process of evolution. The mode of construction used by the Greeks and Romans appears to have been caravel plank and sawed or hewed frame construction of some kind, but the speed with which boats and ships were reportedly built suggests that some were flat-bottomed and developed from raft forms.

Modern Methods and Materials.—Canvas-covered hulls follow the general plan of birch bark canoe construction in that they have a plank lining supported by ribs. However, canvas boats have rigid framing systems. Canvas or other fabric over battens, following the basic arctic skin-boat construction, is used in small folding boats and in kayaks, which were inspired in design and construction by the Eskimo skin kayak or hunting boat.

Paper boats, made by cementing layers of paper over a hull-mold, have been built successfully, and at one time this construction was popular for small boats and canoes in America. These boats had simple framing and, being made with water-resistant adhesives, were strong and durable.

The use of veneer and plywood to build small craft developed very rapidly after 1920 in the United States. However, the use of plywood panels instead of planking not only required a complete framework but also limited the practical hull forms to V-bottom and flat-bottom types. Molded plywood, in which veneer sheets were laid up over a mold with adhesive between two or more plies or skins, was the next development. This type of construction proved strong and lasting, although the use of a mold and the need for pressure-setting of the adhesives limited the types of molded plywood boat to those that could be mass-produced.

A great many small craft are built wholly or in part of thermosetting plastics. A mold is required and there is usually a special textile employed to give strength to the hull skin. The usual method is to use layers of plastic over textile plies. Both hand-applied and mechanically-applied plastics are widely used, but the latter require a very expensive mold and manufacturing equipment. Metal or wooden stiffeners sometimes are used with the plastic shell, although all-plastic hulls are now quite common. Both molded plywood and plastic construction methods are best suited to mass-production building and therefore to small boats of the open or half-decked types.

EXISTING BOAT TYPES

Primitive Boats.—A number of ancient and primitive boat types have survived into the present century. The rafts still in use include the Brazilian jangada and the catamaran of Ceylon. The Brazilian and other sailing rafts have dagger boards or centreboards fitted between the two centre logs to allow windward sailing; they are fast sailers.

A large number of dugout canoe types have remained in use.

Some of these are merely trough-shaped hulls suitable only for protected waters, but others are well-developed craft. Until late in the 19th century the large single-log dugout canoes of the Northwest Coast Indians of North America were the best developed canoes of that type in existence. Multiple log canoes were used as sailing craft on Chesapeake bay in North America and large craft of a similar form and rig later developed under the type name bugeye. Large dugouts with built-up sides exist in the South Pacific and once were very numerous. The Pacific island canoes are commonly narrow and require double hulls or outrigged floats on one or both sides for stability. One of the most notable of the single-outriggers is the flying proa, one of the fastest sailing boats in the world, first described by Capt. James Cook. The double-hulled craft are made of two canoes of equal size, placed side by side but at a short distance apart. These usually are used as sailing canoes and have come to be known as catamarans. The idea has been adapted by yachtsmen in the sailing catamaran or double-huller, ranked among the fastest sailing types known.

Skin boats have survived in the American arctic in various tribal forms of the kayak or hunting boat and in the larger and open umiak or "woman's boat." Other skin-covered craft, such as the English coracle for river fishing and the Irish curragh for sea fishing and transport, have continued in use for hundreds of years, although the modern versions have outer covers of canvas and tar instead of the original skins and tallow.

The birch bark canoe of the North American Indians could still be found in use into the early 20th century, but in most areas canvas had gradually taken the place of bark long before 1900. Primitive bark canoes are still used by aborigines in South America and Australia, however.

Sewed plank construction in the 20th century was mostly confined to some islands in the South Pacific, where basic dugouts were heightened by means of plank sides, and to some very limited areas where all-plank boats were built by this method. The basic advantages of sewed plank construction were utilized in a patented process, using copper or bronze wire, that was employed in England early in the 20th century for building high-speed motor boats.

National Boat Types.—The need for craft of the boat class in fisheries, pilotage, salvage and transport resulted in almost innumerable models, each designed for superior performance in a specific task and to meet geographic and economic needs.

Far East.—In the China seas the sampan is the commonest boat type, although the hull form, rig and fittings vary widely. Some sampans have sharp bows; nearly all have large transom sterns, and the after portion of the gunwale is higher than the forward portion. Sampans are often rigged for sailing with a single battened Chinese lugsail. Usually the boats have only one mast, but there are local types, notably in Hong Kong, equipped with two. The sampan is sculled with a large sweep balanced on the transom stern. It is usually open or partially decked and has a shelter or cabin aft for passengers or freight. In Japanese waters another form of sampan once was common, rigged with a rather primitive lugsail and with a peculiar form: the stem was straight and raking in profile and the forebody long and rather sharp, while the midsection was flat-bottomed. This model later developed into a motor boat and came to be used not only in Japan but in Hawaii and Formosa.

In Malayan waters the proa is the basic boat type. It is a fast, sharp-ended, rowing and sailing boat once popular with the Malay pirates. The proa is open, long and rather narrow, with a "clipper" bow and a sharp stern. The boats are usually rigged with one or two lugsails somewhat like the Chinese lugsail. In early days the type was built more than 60 ft. in length and decked. The name proa is often applied both to this type and to the single-outrigger flying proa mentioned earlier. However, the proa of the Pacific and the Malay boats are entirely different types.

In Indian waters there are a number of boat types, including dugouts with raised plank sides, sometimes fitted with outriggers, and plank boats with a long, straight, raking stem in profile, a transom stern and a short keel. The latter are usually rigged with one mast and a settee sail: a lateen sail with the fore corner or tack cut off to form a short luff or fore edge. These boats vary locally in form and rig; one type has greater depth at the bow than at the stern and the keel profile is a hollow curve. This is the pattamar, rigged with two or three masts and considered a fast sailer.

Near East and Mediterranean.—In the Persian gulf and southward along the east African coast the best known boats are usually classed by Europeans as dhows. The two types so named are the bagala and sambuk. These have one or two settee sails, short keels, long and very raking curved stems, square sterns, and a well-formed hull for fast sailing.

The boats of the Mediterranean basin are numerous in type and rig. One is the handsome Turkish *caïque,* a long, narrow rowing boat with graceful ends, designed for speed. These boats sometimes are rigged for sailing with a small spritsail or lugsail and in modern versions are often fitted with an outboard motor in a well at the stern. Small double-ended boats are also used by the Turks; these are called sandals and are often rigged with a single lugsail. A square-stern sailing skiff of distinctive appearance is found on the Turkish Black sea coast; it resembles a coaster of larger size known as the *taka.* A distinctive double-ended beach boat, known as the *cekterme,* is also found on the Turkish coast, although this type name came to be more commonly applied to a large auxiliary coaster.

On the Nile may be found the dahabeah, a sailing lighter and houseboat. This boat developed from the Nile gaiassa, a lighter and river freighter with a shallow hull like that of a canal boat, a high, sheer bow and a huge outboard rudder. These boats usually have a large lateen sail forward and a small one aft, although some are fitted with only a single large sail. Another variation is the naggar, a sailing river lighter rigged with a single lugsail, with the boom along its foot parallel with its head.

The best known of Italian boats is the gondola of Venice, a double-ended craft, with ornamental posts at bow and stern, propelled by an oarsman using a single oar or sweep. A now obsolete Venetian boat was the topo, a double-ended, flat-bottomed craft with a single mast carrying a lugsail; it was the forerunner of the Venetian sandal, which is still in use.

The boomed standing lugsail was for a long time most common in the Adriatic, usually in a two-masted rig, while the lateen sail predominated in boats built in southern Italy, on the French Mediterranean coast and in Spain and Portugal. Among small craft of the Mediterranean, combination rowing and sailing boats were once typical, rather than boats built to sail only, but in modern times engines have almost completely replaced sail.

Many local types in the Mediterranean are loosely classed as feluccas, a term originally applied to two-masted lateen sail craft fitted to row and built for speed; later the name came to be applied also to three-masted craft of the galley type that had once been called xebecs.

Northern Europe and Great Britain.—The coast of Northern France was the home of a number of types of square-sterned and sharp-sterned lug-rigged boats, usually two-masters. These boats were commonly of lapstrake construction and were good sailers, many carrying large areas of sail. The three-masted lugger or *chasse-marée* of France and a similar type built in England were fast enough to become the traditional craft of Channel smugglers.

England and Scotland produced many distinctive small boats; the coble, a square-sterned beach boat with deep forefoot, still survives as a motor fishing boat, as does the caravel-built Thames bawley. An extinct beach boat is the Yarmouth beach yawl, a long, narrow, lapstrake double-ender with sharp ends, built for salvage work and rigged with two or three lugsails and a jib.

Another noted English type was the Deal galley punt, a square-sterned, lapstrake open boat rigged with a single dipping lugsail and once used for salvage and rescue work off the beach. The cat was a larger lugger of two or three masts used at Deal; both types were very seaworthy and were fast sailers. Scotland produced many fine skiffs, the class name for a number of open or partly decked, lapstrake, one-masted, lug-rigged boats. The Lock Fyne skiff, the Fifie skiff, and the Scaffie and Zulu skiffs were fine examples of sailing and rowing fishing boats. The Shetland sexern was particularly fast and seaworthy; this type

was rigged with a single lugsail and its hull was low-sided and sharp-ended.

In the Netherlands and Belgium small boats fitted to sail had distinctive wing-shaped leeboards pivoted on each side at about amidships, to reduce leeway when sailing to windward. The boats were usually shallow in body and strongly built, with full, buoyant ends. Danish boats generally have sharper lines and deeper draft, and the smaller ones, commonly lapstrake built, sail and row well. The praam, a lapstrake boat with square stern and a small transom bow, is a popular Danish type; formerly a sailing and rowing boat, it came to be used extensively as a motor boat. The praam can also be found on the Norwegian coast.

The predominance of the double-ended, lapstrake hull in Scandinavia is very marked and some modern boats strongly resemble those of the vikings. Scandinavian small boats are usually fast rowing and sailing craft with bow and stern sharp and curved in profile.

North America.—Many small boat types developed in North America during the 19th century. In eastern Canada the Labrador whaler, a lapstrake, double-ended rowing and sailing boat used in the Labrador fisheries, became popular, and its design appears to have inspired the design of the Tancook whaler, a schooner-rigged centreboard fishing boat notable for its excellent handling qualities. Another boat developed in the maritime provinces was the Cape Island sloop, a deep draft keel sloop once popular in the shore fisheries. On the Great Lakes the Canadians produced a two-masted, half-decked, square-sterned fishing skiff, the Collingwood skiff, as well as a similar type in double-ended form. Perhaps the best known Canadian types are the lumberman's drive-boat or bateau, a double-ended, flat-bottomed rowing and poling boat used in the lumber drives when timber is floated downstream to the mills; and the York boat, a double-ended sailing and rowing boat used in the fur trade. The large birch bark *maitre canot* of the fur trade, an oversized version of the Indian canoe, used by the fur trade "brigade" or freighting party, also was once of economic importance.

The United States and Canada both produce the dory, the flat-bottomed skiff of the New England and maritime provinces fisheries. Some dories are fitted with centreboards for sailing. Others were equipped with engines, and this led to the design of special types in which rounded side frames replaced the straight frames of the regular fishing dory, producing a hull with an almost round bottom and a wide plank keel. This form of hull was carried to its highest degree of evolution in the New Jersey Seabright skiff or beach skiff, in which the bottom is very narrow and the sides very round. Formerly a rowing and sailing beach boat, the Seabright skiff developed into a high speed, seaworthy motorboat once favoured by liquor smugglers and later used for sport fishing.

There have been more than 200 distinct types of small American sail and rowing boats under 40 ft. in length. Some of the more notable of these are the Hampton boat of New England, first a lapstrake sail and rowing boat like the Labrador whaler but later a square-sterned, two-masted, half-decked boat equipped with a centreboard. This design was found suitable for the installation of engines and was gradually modified into a fishing launch. The Block Island boat and No Man's Land boat were two-masted, double-ended beach boats notable for their seaworthiness. The New Haven sharpie was a large, two-masted, flat-bottomed boat, and its use spread southward to the Carolina sounds following the development of the oyster fisheries. Of a number of small sailing scows that also were employed in the U.S. fisheries, the New Jersey garvey is one of the better known. This type of sailing scow had one leeboard held to the side by a rack or iron bar-and-staple device and was usually rigged with one or two spritsails. It was used in the oyster and other inshore fisheries and in modern versions has been modified into a low-cost but efficient launch.

Another boat that has been adapted for use with engines is the New Orleans lugger. Originally a single-masted, square-sterned boat with a centreboard, the only lugger-rigged boat in the American fisheries, it was a fast sailer, and its good handling qualities made it ideal for use as a power boat. The San Francisco felucca, a single-masted, lateen-rigged fishing boat, also developed into a double-ended power craft now known as the Monterey boat.

The term pirogue is the old West Indies name for a dugout and was later applied to scow ferries having leeboards and to a round-bottomed boat with a sharply raked foremast forward and a mainmast aft. These boats are obsolete, and the name is applied to a dugout or similar crude, shallow-draft boat used for negotiating swamplands and shallow inlets in Louisiana.

Ships' Boats.—The boats carried on shipboard for harbour transportation, rescue work, etc., constitute a special class. Usually they are open boats fitted to row, although some are sailboats and many modern types have engines.

The largest boat on shipboard is the launch or longboat, originally a burdensome sailing and rowing boat capable of carrying such heavy loads as anchors and cannon. When steam engines became available the launch became a self-propelled boat and, in the present century, a motor boat. The cutter was a long, narrow boat especially designed for speed under either sail or oars; it usually was carried only by naval or revenue vessels. Another naval type was the gig, similar to the cutter but sharper in its lines, and usually reserved for the personal transport of high-ranking officers. Both the gig and cutter were designed with narrow transom sterns and some rocker or curvature in the keels.

The yawl or dinghy, sometimes called a stern-boat when it was slung from davits at the stern of the ship, was a short, square-sterned rowing boat, either lapstrake- or caravel-planked, and sometimes fitted to sail. Modern yawls are powered, and the yawls carried aboard skipjacks, the V-bottomed sloops popular in Chesapeake bay waters, are known as push-boats because they are used to push the mother ship in a calm.

The whaleboat is a light, swift, rowing and sailing boat fitted with a centreboard; usually it is caravel-built, although lapstrake whaleboats predominated at one time. Developed for use by whaling crews, its superior handling characteristics made it popular as a general purpose ship's boat, and it often serves as a cutter or gig.

The lifeboat is a double-ended rowing boat carried aboard ship for rescue purposes. Originally of wooden lapstrake construction, these boats now are almost universally made of steel, and some are equipped with diesel or gasoline engines. They often are built with special air chambers to make them unsinkable, and many are designed to be self-bailing and self-righting in heavy seas. The size and fitting of lifeboats is established by law, as is the number a ship must carry. *See* also Index references under "Boat" in the Index volume.

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BOATING for pleasure has been enjoyed for several centuries, but the sport has increased tremendously in popularity in the 20th century, particularly in North America, western Europe and Australasia. This article deals with the growth of this form of recreation and also with the various kinds of power boats, sailboats and rowboats. Boating is most often carried on as a pleasure for its own sake, but it is also enjoyed as a competitive sport, or in connection with such sports as fishing, hunting (shooting) or water skiing. (For the history of sailboat racing and cruising *see* YACHTING.)

Growth of Boating.—The growth of boating as a sport increased markedly after World War I and even more rapidly after World War II. Among the factors contributing to this growth was the progressive development of more reliable, lighter and more powerful outboard motors to power speedboats and hydroplanes, utility boats for fishing, camping trips and water skiing, cruisers and houseboats and for use as auxiliaries on sailboats. The development of outboard motors was paralleled by the development of inboard motors, both gasoline and diesel, and by the successful introduction of new materials in boatbuilding, especially plywood, glass fibre and aluminum. The widespread marketing of do-it-yourself plans and instructions and of boat kits consisting of par-

tially precut or prefabricated parts for building boats made it possible for more people to own their own boats. At the same time, the development of lightweight, maneuverable automobile trailers, equipped with small winches for launching and loading boats, enabled more and more people to take small boats along on vacation trips and weekend outings for fishing, water skiing or simply boating on lakes and streams. The spreading network of highways and the establishment of the type of boat harbours known as marinas, boat-launching ramps and docking facilities made more and more waters accessible to boaters. Added to all these factors was the increasing availability of leisure time together with what some psychologists and sociologists identified as a widespread urge to escape urbanization and get, even if momentarily, back to nature, impelling people to seek recreation on the water.

In the early 1960s the marine industry estimated there were 7,800,000 pleasure boats in use on United States waters. It grouped them as follows: 3,940,000 outboards, *i.e.*, boats under 16 ft. in length with transoms designed to accommodate outboard motors; 2,500,000 rowboats, dinghies, prams and other miscellaneous craft (sometimes used with outboard power but not considered speedboats); 541,000 motorboats numbered by the U.S. coast guard for use on navigable waters (having a navigable outlet to the sea), this group including all inboard boats, outboards 16 ft. or more in length and some 44,500 auxiliary-powered sailboats; 496,000 sailboats without inboard power; 319,000 unnumbered inboard motorboats in use on waters not under federal jurisdiction; and 4,000 of the largest inboard cruisers and auxiliary-powered sailboats documented by the U.S. bureau of customs. In Great Britain trade estimates for the early 1960s showed that there were approximately 100,000 pleasure boats in use, of which 1,000 were the larger type of cruiser, big enough to be registered with the registrar of shipping, although many of these were probably in the Mediterranean. In the U.S., a federal boat-numbering system which came into force in April 1960 was based on horsepower rather than size of the boat. It required that every motorboat of more than 10 h.p. be numbered (registered), either by the state in which it operated or, in the few states that failed to set up their own numbering systems, by the federal government. Most states went beyond the federal code, originally drawn in 1958, and adopted laws requiring all motorboats, regardless of horsepower, to be registered. One effect of the new law was a rapid continuation of the trend toward larger outboard speedboats. Under the old law, outboard speedboats frequently were built just under 16 ft. to escape the inconvenience of registration. (C. R. McC.; S. N. C.)

POWER BOATING

Speedboats.—One of the most popular types of pleasure craft is the speedboat, a small, usually open motorboat, designed for swiftness and mobility in calm water.

The outboard speedboat, which lends itself to mass production, led the so-called boating boom after World War II. The development of more powerful motors broadened the function of the speedboat so that a family runabout with an 80 h.p. motor could go more than 40 m.p.h. or, sacrificing speed for pulling power, tow six water skiers. Water skiing began to rival fishing as a reason for buying a speedboat, either outboard or inboard. In addition, speedboats were used for day cruises, as yacht club launches and, in many cases, for simply "running about" on the water.

Powered either by inboard or outboard motors, speedboats range approximately from 12 to 25 ft. in length; the average outboard speedboat measures just under 15 ft., the average inboard somewhat longer. Passenger capacity ranges from one in the smaller racing craft to half a dozen or so in the conventional pleasure speedboat. Freeboard (distance from top of side to water line) is fairly low. Most speedboats are decked over at the bow and have wrap-around or straight windshields. Some are equipped with removable or fixed coverings that protect part of the cockpit. Speedboat types include: runabouts, utilities, water-ski boats, bass boats and racing motorboats. While speeds of 40 m.p.h. or more are not uncommon for recreational speedboats and one firm has offered a written guarantee of 60 m.p.h. with its 20- and 24-ft. inboard runabouts, racing outboards have exceeded 100 m.p.h. and racing inboards have bettered 200 m.p.h. (*See* also MOTORBOAT.)

Hull Design.—The primary goal in designing a fast boat is to reduce friction and resistance between hull and water. Speedboats are fast largely because the shape of their hulls succeeds in cutting this resistance. Virtually all speedboats have planing hulls; *i.e.*, hulls which, when properly matched with motor and propeller, rise partially out of the water and skim, or "plane," across the surface. The bottom, normally round or V-shaped near the front, is somewhat flat or shallow near the stern. The stern is cut off square so that displaced water, attempting to flow inward there, breaks abruptly away from the hull. Water flowing faster and faster under the boat exerts a dynamic force that lifts the hull to the surface. In contrast, as the slower displacement hull gains speed, it tries to draw in the water pushed aside by the bow and sides—water which, at slow speeds, flows inward of its own accord and comes together at the tapered stern. This creates suction and prevents such a craft from exceeding its relatively slow "hull speed," although only comparatively low power is required to maintain that speed. The ultimate in planing design is the three-point racing hydroplane, which at planing speed rides only on its propeller and two sponsons. The three-point principle, in which the boat is supported by three planing surfaces arranged in a triangle with the apex near the stern, was advanced originally by William Froude in England in the 1870s. Hydrofoils go one step further. First explored before the turn of the 20th century by Alexander Graham Bell, they were developed mainly by the Germans and Italians before and during World War II. The thin foils extending into the water on either side and below the boat lift the hull entirely out of the water, in the same manner as wings lift an airplane.

Motors.—Outboard motors vary from 1- or 2-h.p. midgets to powerful units that weigh more than 200 lb. and generate 100 h.p. They operate on a mixture of gasoline and marine oil. The outboard is steered either by a handle on the motor or by remote controls. In the latter system the throttle, gearshift and electric-starter controls are located near an automobile-type steering wheel in the front of the cockpit. The wheel is connected to the motor either by rope-and-pulley or by steel cables. These turn the motor to right or left. The underwater unit of the motor itself forms the boat's rudder.

The inboard speedboat, with engine or engines inside the hull connected by a shaft to the propeller, normally is somewhat larger and more powerful than its outboard counterpart. Some inboards have engines generating more than 500 h.p.

Inboard-outboard power assemblies, first developed largely in Sweden and introduced commercially in the late 1950s, consist of an inboard engine driving an outboard propeller unit by a shaft through a hole in the transom.

A major development in inboard pleasure boats occurred in 1960 with the introduction of a 16-ft. craft using a jet-propulsion unit developed by C. W. F. Hamilton of New Zealand. The jet unit, powered by a marine engine, included a screened water intake flush with the keel amidships; a three-stage axial-flow turbine pump (equivalent roughly to a series of three propellers in a row, each boosting the next); a nozzle at the stern through which water is ejected into the air at a rate of 2,250 gal. per minute; and hydraulically operated deflectors or "gates" on either side of the transom opening to control the steering. The force of the water stream propels the craft according to the equal-and-opposite-reaction law of physics. In reverse, the stream is deflected forward under the hull. Because it has neither a propeller nor a rudder, the jet is capable of running in as little as four inches of water. It is able to make extremely sharp turns, even at full throttle. Another kind of jet, which pushes against water instead of into the air, was developed in Italy for use in outboard motors. The stream ejected into the air gives considerably more thrust, with consequently higher speeds.

Materials.—Most speedboats are built of wood (smooth planking or overlapping, clinker, or "lapstrake"), aluminum or reinforced plastics such as those made of glass fibres. In the late 1950s, the latter became the most popular material, with aluminum falling somewhat behind. The design and construction of plastic small

craft started in 1876 when George Waters of Troy, N.Y., made the first laminated paper rowing shells, bonded in layers with shellac. The modern glass fibre craft is built on the same principle, the hull consisting of alternate layers of glass fibre cloth and mat, each saturated with liquid polyester resin as it is "laid up" into the wooden mold, which represents the desired hull shape. When the resin sets, the mold is removed, leaving a glass fibre hull with an impact strength greater than wood. The material also is impervious to dry rot, can be molded into any shape that does not have sharp corners and provides a one-piece hull that does not require caulking. Since glass fibre is heavier than water and would sink, boats of this material need built-in flotation tanks. Another molded hull employs a five-ply plastic construction built around a cellular or honeycombed centre. It has great impact strength and will not sink.

Materials greatly influence the design of a speedboat. A round-bottom hull is better suited to glass fibre or molded plywood. Sheet plywood or conventional wood planking go better with V-bottom craft.

Racing.—The major divisions in motorboat competition are stock inboard, stock outboard, inboard hydroplane and outboard hydroplane. Each division has a number of classes, depending mostly on engine displacement. Some of the smaller craft are barely big enough to hold the driver; the biggest, the unlimited hydroplanes, weigh close to four tons. Many hundreds of races and regattas are held each year in the United States under the sanction of the American Power Boat association, governing body for the sport in that country. Most races are held over closed courses. Some, like the Mississippi River marathon, are long-distance endurance events. A separate division was established for pleasure boats, which compete in marathons of from 50 to more than 250 mi. Major trophies for unlimited hydroplanes include the Harmsworth trophy, international, donated in 1903 by Sir Alfred Harmsworth of England, later to become Lord Northcliffe; the American Gold cup, donated in 1904 to the American Power Boat association by the Columbia Yacht club, N.Y.; and the President's cup, first contested in 1926. (*See* also MOTORBOAT.)

Cabin Cruisers.—A cabin cruiser is a motorboat with an enclosed cabin designed primarily for comfort and shelter and containing most, or all, of the minimum essentials of living. The category covers a variety of craft with a wide range in size, speed, accommodations, function and cost. Cruisers range in length from about 17 to 60 ft. or more and in speed from under 10 to more than 40 m.p.h. Unlike the sailing auxiliary or motor sailer, the cabin cruiser is wholly dependent upon its engine or engines for power. A typical cruiser would have, in its cabin or cabins: sleeping berths for four or more persons, stove, sink, icebox or refrigerator, toilet, storage lockers and water tank. Many large cruisers also are equipped with electronic aids to navigation such as radar and an automatic piloting device; most carry ship-to-shore radio and depth finder, or echo sounder. The more luxuriously appointed craft often have wall-to-wall carpeting, frozen food storage, showers, garbage-disposal unit and air conditioner. A cabin cruiser can be many things: a means of vacation, weekend or overnight travel and for practising seamanship and navigation on inland lakes and streams or coastal waters; a pleasant base for entertaining, picnicking, exploring, swimming, fishing or sunning; a regatta committee boat, towboat or ferryboat; or a pretentious, seldom used status symbol. After World War II, the preference in cruisers appeared to have swung toward smaller craft, while the demand in outboard and inboard runabouts was for larger boats. Cruisers of more than 60 ft. or so are becoming scarce. Those over that length generally are listed as "motor yachts."

Types.—Outboard cruisers seldom are less than 17 ft. or more than 26 ft. long; however, with more powerful outboard motors they may be more than 30 ft. These craft are powered by either one or two outboard motors attached to the transom. A motor of 35 h.p. is regarded as the minimum requirement; a twin installation will deliver up to 160 h.p. About half the length of the small cruiser is devoted to the cabin, the rest to an open or partly covered cockpit in the rear part of the boat. Some outboard cruisers carry only a few of the living essentials. They may have a chemical toilet, portable stove and limited sleeping quarters. Such boats are called day cruisers. The outboard cruiser has gained in popularity because of its low initial cost compared to inboards, its maneuverability on the water, where its shallow draft and absence of underwater gear increase mobility, and its light weight, which makes transportation by trailer easy.

The inboard cruiser, in most cases, is larger than its outboard counterpart. It is powered by one or two engines, either gasoline or diesel, located inside the boat. Power, in a twin-screw cruiser, can go to 600 h.p. or more. A diesel engine costs more to install than a gasoline engine, but since it burns nonexplosive fuel oil, the fire hazard is greatly lessened. A diesel also is considered more economical to operate. Despite a trend toward the use of plastics in the construction of smaller boats, including many outboard cruisers, wood is still the preferred material for inboard cruisers. Mahogany and teak, in particular, are thought to provide the sleek look desired in such craft. Many cruisers are designed to the specifications of individual yachtsmen and are custom-built by private boat yards.

Design.—Cabin cruisers, particularly the larger ones, are capable of venturing into the open ocean. But they are not so well suited for long ocean voyages as the sailing yacht or the motor sailer, which are not restricted in cruising range by the amount of fuel that can be carried. The cabin cruiser, with its relatively shallow draft and round or V-shaped bottom, is at its best in protected or semiprotected waters—inland rivers and lakes or coastal waters. For stability, the cabin cruiser relies mostly on its ample beam (width); in heavy seas, it will pitch and roll more than the sailing yacht or motor sailer whose keel, mast and sails act as a steadying force. One of the few types specifically designed for offshore work is the sport fisherman (see *Utility Boats,* below). Another seaworthy type is the inboard-powered sea skiff, of sturdy lapstrake (overlapping) construction, open or having a shelter-cabin and with a high freeboard. A popular form of cruiser in British waters follows the shape of the fishing craft in use round the coast. Since speed is not the main concern, most cruisers have displacement hulls rather than the planing or semi-planing hulls found on speedboats. V-bottom hard-chine hulls with straight planking are easier to construct and provide more cabin room because of their depth. They also tend to be faster and drier than round-bottom hulls, since the sharp angles between the bottom and sides of the boat throw bow waves out and away. But the round-bottom hull, usually built with steam-bent ribs, is considered stronger than the V-bottom, and more stable. It also is thought to give a better appearance to the boat. Many power cruisers have a V or round shape forward, tapering out to an almost flat stern.

(S. N. C.)

Utility.—A utility boat is a special kind of all-around craft. It is usually an open boat with perhaps a canvas shelter top, from 14 to 30 ft. in length, light and fast. It earns its name by its ability to perform many useful functions. Its spacious cockpit enables it to carry several people or a quantity of camping or other gear and makes it an admirable fishing boat. A utility boat may be powered with an inboard or an outboard motor; when intended primarily for fishing on inland waters a relatively small motor often is used. For water skiing or exploring, a more powerful motor is preferred. The ocean-going sport fisherman, or sport-fishing cruiser, sometimes classed as a utility boat, is seaworthy in construction, hull form and power plant and may have outriggers, fish boxes and other fishing equipment as well as adequate cruising accommodations. Other utility boats may be specially designed for shallow draft fishing over shoals, for transporting sportsmen to camps or cabins accessible only by water, or for other purposes.

Houseboats.—The houseboat is found all over the world. Houseboats, as the name implies, provide first of all a home that floats. Houseboats may be equipped with engines or even powered by sail, but essentially they are broad-beamed flat-bottomed craft that provide a maximum of living space gained at great sacrifice or elimination of seaworthiness, speed and maneuverability. Houseboat types range from the canal and sailing barges of England and continental Europe to the square-ended junks of far east-

ern rivers. At its crudest a houseboat is simply a shanty built on a log raft. Moving is accomplished by tow or drift. At its most refined, a houseboat is a cruiser of broader beam and with more extensive living quarters than a cruiser hull of comparable dimensions would accommodate. Such boats as these can safely cruise sheltered waters under their own power.

A post-World War II innovation was the outboard-powered houseboat cruiser. These employ lightweight construction and space-saving interiors to give commodious living quarters. Some designs are equipped with wheels that permit them to be towed down a highway like a land trailer; the wheels retract into special wells when the boats are launched. *See* also HOUSEBOAT.

(C. R. McC.)

SAILING

The sport of sailing has grown with that of power boating. Sailing as a sport in Europe almost certainly started in Holland in about the 16th century and was introduced into England by King Charles II. Yachting was once associated with seagoing vessels. Indeed the early yachts were evolved either from the smaller naval craft or from fishing or other working boats; *e.g.*, "America" was built on the lines of a New York pilot boat. All boats designed primarily for pleasure, including such craft as the 15½-ft. International Snipe and 10½-ft. International Cadet, are yachts; the sport of racing and cruising is dealt with under YACHTING (for the smaller boats *see* especially the section *United States: Smaller and One-Design Classes*). Various types of racing and cruising craft are identified below.

GEORGE O'DAY ASSOC.

FIG. 1.—A PLANING SAILBOAT, INTERNATIONAL 505 WITH FIREFLY SAIL, ON A BROAD REACH

Easy leaders in style and glamour are racing sailboats. The sole purpose of their design is speed. Fastest of all are the catamarans. These are twin-hulled boats, descendants of the outrigger canoes of the south seas. Next in line for speed are the planing sailboats, and here the brilliant British naval architect, Uffa Fox, led the way. Racing boats conceived on his drawing board were designed to rise to the surface and skim on the water at full speed. He achieved great success in the 1930s in the 14-ft. International and International 10 square metre canoe classes and, with Tom Thornycroft and Morgan Giles, he did much to perfect the type of dinghy designed to plane, which has become the popular form of British racing dinghy.

An older design, but equally tricky and for years the fastest water-sailing boats (sailing iceboats are much faster than any water-borne sailing craft) are the so-called inland scows. These are long, extremely flat craft, light for their sail area, with two bilge boards (instead of a centreboard) and double rudders. These, too, are planing boats, the principles of their hull dynamics being essentially the same as those applying to speedboats (see *Power Boating: Speedboats: Hull Design,* above).

But the heart of the racing class lies in one-design craft. All boats in a one-design class are built to rigid specifications. The boats in the many one-design classes range from 8 ft. prams to the famous 12-meter yachts. The majority are in the 12 to 22 ft. range and are almost always Bermuda, or Marconi, rigged and carry a jib. Most classes have international, national and regional races in which the best boats compete annually.

Ocean racers, larger craft, 40 to 80 ft. in length, annually compete in a variety of races, more often made up of boats from a localized area, but sometimes, as in the Bermuda race or Fastnet, boats from all over the world race internationally. A complicated handicap formula makes these races possible, for the boats are dissimilar as to length, rig, displacement, water line length and other factors are all figured to give each boat a relative standing against a norm or "scratch" boat. The boat that does best in relation to this scratch boat wins.

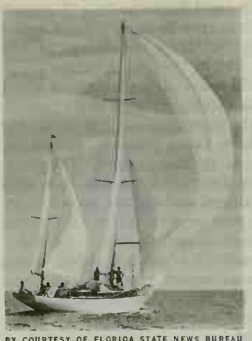
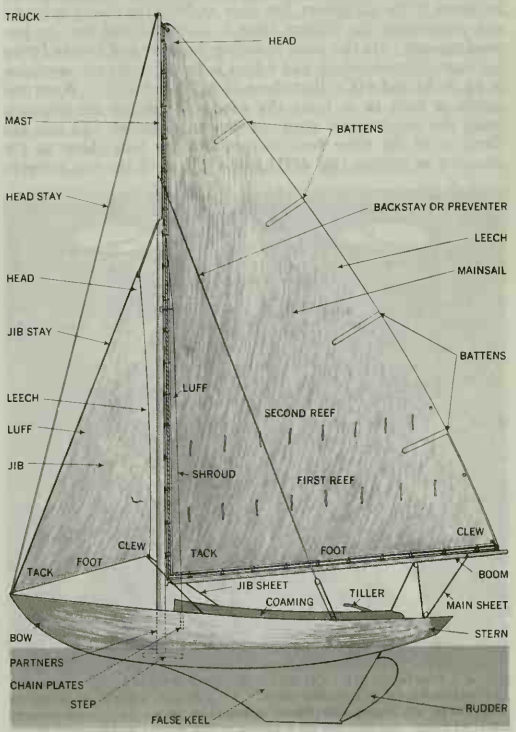

BY COURTESY OF FLORIDA STATE NEWS BUREAU

FIG. 2.—OCEAN RACING MARCONI-RIGGED YAWL, WITH SMALL STAYSAIL AND LARGE SPINNAKER

Day sailers take many forms. These boats are not classed, and they are not raced. They are roomy, steady, practical and wholly enjoyable boats on which to spend a morning or afternoon sailing with family or friends. Generally the term applies to any sailboat not a racing boat that lacks accommodations for overnight living aboard.

Probably no type of sailboat is better known than the cruising sailboat which, although small enough to be handled by a crew of one or two, or perhaps half a dozen, is capable of making long ocean voyages and even of circling the globe. Instead of the tall masts of the racer, the masts of the cruising sailboat are lower and stronger, sail area is less, to put less strain on hull and rigging. Hard-to-handle spinnakers and flying jibs are nonexistent. Ports and cockpit are small; canvas, rigging and construction is heavier. The boat is built to weather storms and withstand the weight of crushing waves breaking over it. Rigs are "balanced" so, with the wheel lashed, the boat can sail itself hour after hour while the crew sleeps, eats or mends. Most renowned of the



FROM H. A. CALAHAN, "YACHTSMAN'S OMNIBUS," THE MACMILLAN COMPANY; 1951

FIG. 3.—PARTS OF A MARCONI-RIGGED DEEP-KEEL BOAT

modern cruising sailors has been Irving Johnson and his "Yankee," a 97-ft. brigantine. With students as crew he has circumnavigated the earth a half-dozen times or more. Most famous of the solitary cruisers was Joshua Slocum who in 1895–98 sailed his sloop, the "Spray," alone around the world and wrote a classic book about it, *Sailing Alone Around the World* (1900).

The motor-sailer is just what the name implies: a sailboat that has a motor larger than an auxiliary (used primarily for getting in and out of harbour) and can be sailed under power. The variations are endless. Generally, the description applies to a type of boat that is bluff of the ends, rugged and slightly slower under sail than a cruising sailboat, yet with smooth design that allows it to maintain a steady eight to ten knots under power. (Z. T.)

How a Boat Is Sailed.—The sails of a boat are airfoils which by their angle of incidence to the air stream (the wind) generate the drive that propels the boat. The trim of the sails is governed mainly by the angle of the desired course to the wind. When sailing to windward (fig. 4[F] and 4[G]) the boat's course is at the smallest practicable angle to the wind. The sails are then trimmed to an angle with the wind that produces their greatest driving force—an angle that is usually about 10° and varies with the efficiency of the sails. The resultant force produced by the sails may be further resolved into a component in the direction of the desired course (drive) and another normal to it (leeway force). Under the conditions of fig. 4(F) and 4(G), the drive force will be about one-third of that producing leeway. The latter has to be resisted by the boat, whose ability in this respect is one determinant of the smallest practicable angle of the course to the wind. Very efficient racing craft may sail at about 40° to the wind; undistinguished performers may not be able to sail closer than 55° without suffering from excessive drift to leeward. When the course lies at right angles to the wind (fig. 4[A] and 4[C]) the sails are still trimmed at approximately the same angle of incidence to the air stream, but their angle to the course is bigger and accordingly the driving force is increased and that to leeward reduced. On this point of sailing the drive and leeway forces are approximately equal, and a boat is faster under the condition in fig. 4(A) and 4(C), than those of 4(F) and 4(G). When the course is such as to bring the wind still further aft the sails reach the aerodynamic condition known as stalled, and also the direction of the drive force swings with the sails closer to the direction of motion (fig. 4[H] and 4[J]) until the two coincide when the wind is astern 4(B). When the direction of the wind is abaft the beam and it is no longer possible to trim the sails to a uniform angle of incidence of about 10°, the most efficient sails are those with a full curvature—such as the spinnaker (fig. 4[B])—which deflects the maximum volume of wind through the biggest possible angle. It will be evident that under the conditions of fig. 4(F) and 4(G), when a boat is said to be "close-hauled" or on a tack, it is necessary to follow a zigzag course (4[D] and 4[E]) in order to reach a point dead to windward. When the bow of a boat is steered through the eye of the wind she is said to be tacking (fig. 4[I]); when the same evolution, of bringing the wind from one side to the other, is performed by steering so that the wind passes round the stern, she is said to be jibing, or gybing (J). *See* also NAVIGATION; OLYMPIC GAMES; RIGGING; SAILS.

(D. H. C. P.-B.; A. F. Lo.)

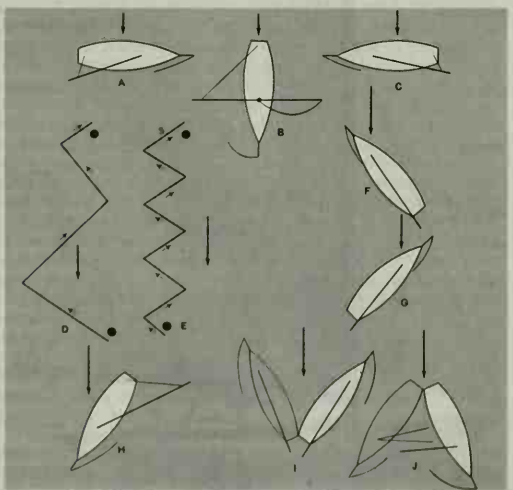


FIG. 4.—POINTS OF SAIL: (A) REACHING ON PORT TACK; (B) RUNNING; (C) REACHING ON STARBOARD TACK; (D) AND (E) COURSE TACKING TO WINDWARD; (F) CLOSE-HAULED ON STARBOARD TACK; (G) CLOSE-HAULED ON PORT TACK; (H) SAILING ON A BROAD REACH WITH A QUARTERING WIND; (I) TACKING; (J) JIBING. ARROWS INDICATE DIRECTION OF THE WIND

Sailing and Yacht Clubs.—With few exceptions, sailboat racing and all organized boating activity is conducted under the auspices of a vast network of chartered yacht clubs found clustered around boating centres all over the world. The oldest is the Royal Cork Yacht club established in Ireland in 1720 as the Cork Water club. Most of these clubs are affiliated with their own national or regional authority; *e.g.*, the Royal Yachting association, for Great Britain, the North American Yacht Racing union, for North America. While the primary purpose of most clubs is social, these clubs make an important contribution to boating as a whole by establishing competitive standards, promoting competitive events and attending to the endless details of executing these. In addition, most of the larger one-design classes such as Lightnings, Stars, Dragons, Snipes, etc., have their own class associations that supervise and foster the class and sponsor national and, in some cases, international racing events in the class. These are held at yacht clubs, the club varying usually from year to year. Thus the Star international championship may be decided one year in Naples, Italy; the next in Rye, N.Y. Organizations may be worldwide, such as the International Flying Dutchman Class organization, or purely national, such as the British Dragon association. Most yacht clubs supervise a series of races for their own members and host regional races or qualifying races for national and international events. While most small boat races are held on weekends, important regattas may encompass several days with morning and afternoon races. For the more important of these events and for the history of yacht clubs *see* YACHTING.

Some clubs may have specialized objects such as the Cruising Club of America or its British counterpart, the Royal Ocean Racing club, both organizing offshore racing events and regulating the handicapping of ocean racers. There are also many clubs which cater exclusively for the owners of power boats.

The most highly organized boating force in the world is the U.S. Power squadron, consisting of more than 200 units in 25 districts of the United States. This group, of some 35,000 members, was organized in 1914 as something of a small boat naval reserve. A notable feature is the provision of instructional classes covering all aspects of boating, including pilotage and navigation. There are many clubs in Britain which offer instruction, notably the Little Ship club and the Cruising association, of London, and the Clyde Cruising club with headquarters in Glasgow, although none of these confines its membership to either power boat or sailing men. There are also motorboat racing clubs and water-ski clubs, the former organizing motorboat racing and the latter concerned with the regulation of the comparatively young sport of water skiing.

Many yacht clubs organize competitive power boat events. Called predicted log races, navigational skill rather than speed is the basis for scoring. In these, the skipper of a boat predicts the exact time he will pass specified points around a predetermined course. Not allowed a watch, he must adjust the speed of his boat to such variables as wind, tide and current so that the time requirement is met. The skipper coming closest to his prediction wins.

In addition to races for sailboats and predicted log races for power boats most yacht clubs hold regattas in which events are not limited to boats built for racing and many conduct overnight, or longer, cruises. (Z. T.)

OTHER PLEASURE BOATS

Canoes.—The canoe of the general type known as the Canadian canoe among sportsmen and in Olympic games events was developed by the North American Indians as a utilitarian carrier. A versatile craft, it has retained its popularity for fishing, for racing and aquatic events at summer camps, as well as for more formal racing events, and for short and long camping trips and expeditions, both in the wilderness country of the north woods of North America and along the well traveled rivers and canals of the British Isles and continental Europe. The kayak type canoe, evolved from the Eskimo craft, has been especially popular in Great Britain and also is represented in Olympic events. White-water canoeing, negotiating swift rapids, appeals to some enthusiasts. Either the open Canadian canoe or the kayak may be equipped for cruising with mast and sails, leeboards and a paddle or rudder for steering. The sailing canoe for racing is decked and has watertight compartments, uses a centreboard, a rudder for steering, and a sliding outrigger seat for balance. (*See* also CANOE.)

Rowboats.—Any boat that relies on oars alone for propulsion falls in the rather loose category of rowboats, or "pulling" boats as fishermen may call them. Although they are fast disappearing as workboats, as motors replace oars in every corner of the globe, they are still probably the most numerous of any type found around most water fronts and at most fishing camps and docks on inland waters. Prams and dinghies propelled by oars still ferry many a yachtsman ashore. Both are small light boats capable of being towed behind or taken aboard a yacht.

A true rowboat, or sculling boat, has an easy motion through the water, and, most important, "glides" between power strokes. Thus the boat's forward motion never ceases; each unhurried stroke of the oar keeps the boat under way and a steady tempo of strokes can be maintained hour after hour. A boat that does not glide requires the force of inertia be broken at each pull of the oars, an effort that will quickly tire the strongest man. Boats are rowed in one of two ways: either the rower sits facing the stern and pulls with his legs and back, or he faces ahead, letting his weight fall forward on the oars. Sometimes the boat is "sculled" by one oar over the stern. A few outstanding types still survive. The fishing dory of the Grand Banks is a famous example. The chase boats of the whale ships were rowed and sailed and are the prototype of the modern lifeboat.

Mention must be made of the single-, double- and eight-oared racing shell, since it represents the apogee of speed attained by oars. These boats are long, frail craft, specially equipped with seats which enable the rower or rowers to put the maximum power into each sweep of the long scull or oar. These are used solely in competitive racing (*see* ROWING).

Punts.—The punt is an interesting flat-bottomed square-ended craft designed to be poled rather than rowed. Long popular in England, especially on the Thames, its use is confined to sheltered shallow waters. A specialized form of punt is the duck punt used for duck shooting, mainly in the eastern part of England. This has evolved over the years as a form of flat bottomed canoe, propelled by oars, paddles or poles, mounting a large bore shotgun, which is used for stalking ducks and geese in the shallow estuaries. An extremely fast form of sailing boat, peculiar to Norfolk, has been evolved from these boats.

Miscellaneous.—Easily portable rubber life rafts, sometimes propelled by outboard motors, have been adapted to pleasure boating uses, as tenders for small yachts, for negotiating very shallow or weedy waters, or as pontoons decked with various materials serving essentially as floating platforms from which to fish or swim.

(C. R. McC.; J. H. M. S.)

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BOATSWAIN (BOSUN). Before the Royal Navy was established the boatswain was the expert seaman in an English merchant vessel. Each ship had a master, who was proficient in navigation, and a boatswain, who was second in command. The boatswain was responsible for the care of the masts, yards, sails, rigging, anchors, boats and cordage; his shrill boatswain's pipe or whistle, which could be heard above the roar of the sea or noise of battle, gave all signals to the crew; he was assisted by boatswain's mates, who were petty officers. When the king hired a ship he issued a warrant to her owner, and another warrant for the services of the boatswain, thus originating the name warrant officer.

From the beginnings of both the Royal Navy and the U.S. navy boatswains have been warrant officers. In modern vessels the boatswain has charge of anchors and anchor gear, cargo-handling gear, rigging, boats and the instruction of the crew in practical seamanship, such as boat handling. (J. B. HN.)

BOBADILLA, FRANCISCO DE (d. 1502), of Aragonese origin, became the confidential agent of Ferdinand and Isabella of Spain and as such imprisoned Columbus in Santo Domingo and returned him to Spain in irons. As knight commander of Calatrava, Bobadilla took part in the reconquest of Spanish territory from the Moors, and upon Moorish evacuation of borderlands he was made military governor of Jaén (Córdoba) and subsequently participated in the siege of Granada (1492). When Columbus asked the Catholic kings for an agent and judge to investigate the claims against him by rebels in his ranks they sent out Bobadilla with complete powers to investigate and make recommendations. Reaching Santo Domingo on Aug. 23, 1500, when Columbus was in great difficulties, Bobadilla decided to send Columbus and his brother Diego to Spain in irons as prisoners of the crown. He was considered to have exceeded his instructions but was himself recalled in Sept. 1501, to be succeeded as governor by Nicolás de Ovando. The ship which carried Bobadilla and his papers was lost in the hurricane that struck the returning fleet in June 1502. *See* COLUMBUS, CHRISTOPHER.

See Samuel Eliot Morison, *Admiral of the Ocean Sea, a Life of Christopher Columbus* (1942). (U. S. L.)

BOBBIO, a town in Piacenza province in the Emilia-Romagna region, Italy, 45 km. (28 mi.) S.W. of Piacenza city, and the see of a bishopric. Pop. (1957 est.) 6,279 (commune). It is an ancient town (Bobium), with narrow streets and wide squares, in a valley dominated by Monte Penice and watered by the Trebbia river. It contains the monastery and abbey of S. Colombano (11th and 13th centuries, restored in 1600), with the tomb of the saint, whose relics are preserved in the museum. The cathedral, romanesque and baroque, contains the tomb of S. Gianelli. There are also the medieval Ponte Vecchio ("Old Bridge") over the Trebbia, a small palazzo, the Casa di Teodolinda (15th century), the Castello Malaspina (14th century), and the sanctuary of Madonna dell'Aiuto (17th century). The town acquired fame from St. Colombano, an Irish monk (d. 615), and was ruled by the Lombard kings and Frankish emperors. The bishopric was created in 1014. In 1176 the town fought against the emperor Barbarossa at Legnano, and in 1748 it became part of Savoy. (MU. T.)

BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

BOBCAT OR NORTH AMERICAN BAY LYNX (LYNX RUFUS)

BOBCAT, the North American bay lynx (*q.v.; Lynx rufus*), found in eastern North America from Canada into Mexico. Other races, or perhaps species, are found in western North America. The name refers to its short stumpy tail. The colour is reddish brown or gray, spotted and streaked with black. Bobcats,

larger than the true wildcat (*Felis sylvestris*) and smaller than the leopard (*q.v.*), vary greatly in size, adults weighing 12 to 39 lb. Two to four young are born in spring, remaining with the mother until autumn.

Larger bobcats prey on deer, in addition to rabbits, small rodents and birds. This species differs from the Canada lynx in having shorter pelage, poorly developed ear tufts and black bands on the tail above the black tip. *See* also CARNIVORE.

(J. E. HL.; X.)

BOBOLINK (RICEBIRD), *Dolichonyx oryzivorus*, a North American bird allied to the American orioles, grackles and meadow larks and placed with them in the large family Icteridae. It is remarkable for its buntinglike bill and its rippling song (the name bobolink is derived from its call), which the bird generally sings while fluttering across a meadow. The bobolink is a migrant, breeding in the northern United States and southern Canada in summer and wintering in South America, which it reaches by a route through the West Indies. In the southern part of the United States this bird feeds upon rice and grain and is consequently unpopular with the farmer. Farther north, however, it is an insect eater, and the young, as is nearly always the case with small birds, are fed almost exclusively upon insects. Five mottled eggs are laid in a nest of grasses on the ground. The male in spring is black, with yellow hindneck and pale gray rump, but in fall it becomes a dull, streaked buff and blackish-brown like the female and young.

BOBRUISK (BOBRUYSK), a town of Mogilev *oblast* (province) of the Belorussian Soviet Socialist Republic, U.S.S.R., stands on the right bank of the Berezina river. Pop. (1959) 97,000. First mentioned in 16th-century sources, the town has a much troubled history. It was held by Lithuania, Poland and Russia at various times, was bombarded by Napoleon and was the scene of a major battle during the German retreat in 1944. The fortress of 1769 survives.

Its industries include engineering (pumps and saw-milling machinery), timber working (saw-milling, veneer and furniture), chemicals, food preparation and clothing and shoe manufacture. The main Minsk-Gomel railway crosses the Berezina there and there is a branch line to Oktyabrski. The town is the focus of five highways. The Berezina is navigable for small craft, for which there are repair facilities at Bobruisk. (R. A. F.)

BOBRZYNSKI, MICHAL (1849–1935), Polish historian whose writings inaugurated a reappraisal of his country's past and who also played some part in its political affairs during the final years of Austrian rule. Born in Cracow on Sept. 30, 1849, he studied at the university there, graduating as doctor of law in 1872 and becoming its professor of the history of law in 1877. His most fruitful work was done in the years 1873–85, on the social history of medieval Poland. His most important book, *Dzieje Polski* ("History of Poland"), first published in 1879, was written in some measure as the foundation of a program for the so-called "Stanczycy," a political group which at first represented the liberal *bourgeoisie* but later allied itself with the conservative country squires of Austrian Poland. Bobrzynski regarded the weakening of the central government as having been the main cause of the 18th-century partitions of Poland and therefore criticized the structure of the "nobility's republic" severely. He thus became the chief exponent of the "pessimistic" (or Cracow) school of Polish historiography.

Entering active politics in 1885, Bobrzynski was a leader of the Conservative group both in the Galician diet and in the Vienna *Reichsrat*. From April 1908 to May 1913 he was viceroy of Galicia. In Oct. 1917 he served for a short time in Vienna as minister for Galicia but resigned when he saw no hope for an "Austro-Polish" solution of the Polish question. After 1918 he retired from political life, but published *Wskrzeszenie panstwa polskiego* ("The Restoration of the Polish State"), two volumes (1920–25). The fourth edition of his *Dzieje Polski* (1927–31) included a third volume covering the most recent period. Bobrzynski died at Poznan on July 3, 1935. (A. Gr.)

BOBSLEDDING, the sport of sliding down an ice-covered natural or artificial incline on a four-runner sled carrying two or four persons. Bobsledding originated in Switzerland around 1890, and is attributed to two U.S. vacationers who endeavoured to increase the thrills of tobogganing by adding runners to increase the toboggan's speed. The sport grew in popularity and in 1898 the first organized competition was held on the Cresta run at St. Moritz, Switz., which had been constructed 13 years earlier for one-man toboggans. The bobsled traveled much faster on the icy run and with improvements in sled construction during the next few years the Cresta, built for slower speeds, became too dangerous for bobsledding.

In 1904 a separate bobrun was built at St. Moritz having a gentler slope and high banked turns. In 1923 bobsledding became an internationally recognized sport with the organization of the Federation Internationale de Bobsleigh et Tobogganing and it was included in the first Winter Olympic games at Chamonix, France, in 1924. In 1931 the first bobrun in the United States was built on Mt. Van Hoevenberg near Lake Placid, N.Y., for the 1932 Olympics.

Runs.—The bobrun used in international competition must be at least 1,500 metres long and have an average slope between 8% and 15%. There are generally from 15 to 20 turns ranging in size up to huge hairpins of more than 180°. Most bobruns have permanent foundations of concrete or stone set into the earth. The foundation is covered with several inches of wet snow which is then saturated with water and allowed to freeze. The straightaways have sidewalls of reinforced ice about 18 in. high. The large turns are banked very steeply and are built up as high as 20 ft. to prevent the fast traveling bobsleds from flying out of the turn.

European bobruns are quite narrow, only four to five feet wide, leaving less than a foot of clearance on each side of the sled. The American bobrun at Lake Placid, on the other hand, is six to eight feet wide and has about a half inch of snow frozen to the ice, giving the runners a better grip for steering. The major turns have an overhanging lip of ice to prevent the sleds from going over the top.

Sleds.—Early bobsleds were built mostly of wood. Steel runners were adopted within a few years and by the second half of the 20th century steel and aluminum were used throughout. The four runners are generally mounted in pairs on two axles, allowing them to rock freely. Steering is accomplished by turning the front axle either with ropes or by a wheel linked to the axle by cables. The brake is a toothed bar which is pressed against the ice between the rear runners. Racing bobsleds have a streamlined cowling in front of the driver to reduce wind resistance. The principal manufacturer of bobsleds for many years was the Feierabend family of Engelberg, Switz. The Italian Podar bobsled was introduced during the mid-1950s and soon proved its superiority by winning most of the major races. In addition, many sleds are built and raced by individuals.

Two types of bobsled are used: two-man boblets, as they are called in Europe, and four-man bobsleighs. Rules limit the maximum weights to 363 lb. and 507 lb., the maximum length to 106 in. and 149 in. and the minimum runner thickness to .320 in. and .400 in. respectively for the two types of sleds. Furthermore, the runner surfaces must be half round and separated by $26\frac{3}{8}$ in. The crew is limited in weight to an average of 220 lb. per man.

Racing.—A racing team originally consisted of five persons (four men and a woman). The team of five, which lay prone on the bobsled, was last used in the 1928 Olympics, after which it was reduced to four men. The team must now sit upright. The two-man event was begun in 1929. Since 1931 both two-man and four-man international competition has been held each year except for a seven-year interruption during World War II.

A race consists of four descents by each team, the total time for the four heats determining the winner. Electrical timing equipment measures elapsed time to $\frac{1}{100}$ of a second. A running start is used from a fixed position a few feet behind the start line. The heavier four-man sleds attain speeds approaching 100 m.p.h. while the smaller and lighter two-man sleds are only a little slower.

The technique which a racing team must master involves pushing the sled at the start to attain maximum starting velocity and balancing their weight to prevent the sled from skidding. Many

early teams had a technique of bobbing their bodies back and forth with a sudden snap (hence the name) which was presumed to increase the speed of the sled. It is doubtful whether bobbing accomplished this result. In any event it was discontinued as higher speeds were attained through improvements in sled design. The driver, who is the captain and most critical team member, must learn to sense the stability of the sled and to react quickly to prevent skids and to maneuver properly on the turns.

See also TOBOGGANING; WINTER SPORTS; OLYMPIC GAMES.

(A. W. Tr.)

BOBWHITE, one of the best-known North American game birds, *Colinus virginianus*, of the subfamily Odontophorinae (new world quail) is about ten inches long, mottled, reddish-brown above, with white on the breast. Common to the region east of the Rocky mountains, north to Minnesota and Ontario and south to the Gulf of Mexico, it has been successfully introduced into Idaho and Oregon.

The bobwhite resembles the (resident or nonmigratory) partridge and (migrant) quail of Europe, and is known by both these names, but is best named from the ringing call, "bobwhite!" which resounds through the fields in the evening twilight when the family group is assembling for the night. These families, or coveys, keep together until the spring following the hatching of the young birds; they trot confidently through the stubble picking up seeds and insects—altogether too confidently, for in many states they were brought close to extinction by the hunter, but are again increasing under protection. Since 15 or 20 eggs are laid, they would increase rapidly if permitted. Heavy snow and ice are severe on these nonmigratory birds; they will come readily to feeding stations in winter.

A few of the subspecies found in the United States are: the smaller, darker *C. v. floridianus* of Florida; *C. v. texanus*, grayer above, of Texas; and *C. v. ridgwayi* (the masked bobwhite) of southwestern Arizona. Other subspecies and species extend through eastern and southern Mexico to the borders of northern Brazil, including 14 subspecies of *C. virginianus* ranging to Cuba and Guatemala, and various races of the black-throated bobwhite (*C. nigrogularis*), white-faced bobwhite (*C. leucopogon*) and crested bobwhite (*C. cristatus*). *See* also QUAIL. (G. F. Ss.)

H. ARMSTRONG ROBERTS

BOBWHITE (COLINUS VIRGINIANUS) FEMALE (LEFT) AND MALE (RIGHT)

BOCAGE, MANUEL MARIA BARBOSA DU (1765–1805), the most notable Portuguese lyrical poet of the 18th century, was born in Setúbal, the son of a lawyer. He entered the army at the age of 14, transferring to the navy at 16. At the royal naval academy in Lisbon, however, he spent his time in love affairs, writing and declaiming poetry and leading a Bohemian existence. In 1786 he was sent to serve in India where he was promoted lieutenant but deserted and fled to Macao, returning to Lisbon in 1790. He then joined the literary society known as the New Arcadia but was expelled for attacks on his fellow members. In 1797 he was imprisoned, accused of propagating republicanism and atheism. During his imprisonment he undertook translations of Virgil and Ovid. Translation work provided him with a livelihood after his release, by which time he had abandoned his revolutionary and antiecclesiastical sentiments. Bocage employed various verse forms: satires, epistles, idylls, but he is at his best in the sonnet. Despite the neoclassical framework of his poetry, Bocage's intensely personal accent, frequent violence of expression and obsession with fate and death anticipate the Romantic verse of the 19th century.

Bocage's works were published as follows: *Rimas*, vol. i (1791), vol. ii (1799), vol. iii (1804). His complete works were edited by Inocêncio da Silva (1853) and T. Braga (1876).

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BOCAGE, a term of widespread application in western districts of France, indicating their well-timbered character in contradistinction to the *campagnes*, hedgeless tracts of arable land characteristic of the old-established areas of open-field agriculture in northeastern France. The bocage country consists of a patchwork of small, irregular, hedge-enclosed fields, with numerous trees. The term is especially applied to districts in western Normandy and Vendée. (AR. E. S.)

BOCAS DEL TORO, a province in northwestern Panamá; also a bay, group of islands and a small town on the island of Colón. Area of the province is 3,332 sq.mi. Population of the province (32,110 in 1960) is concentrated largely in the low plains northwest of Almirante bay. The plantations of the province supplied most of the bananas exported from Panamá between 1900 and the late 1930s, but the banana trees were gradually destroyed by the Panamá disease (*Fusarium cubense*), and cacao, abacá (manila hemp) and rubber were planted on abandoned banana lands. These, the chief products, are exported through the port of Almirante, 140 nautical miles west of Colón, Panamá. (C. F. J.)

BOCCACCIO, GIOVANNI (1313–1375), Italian writer and humanist, one of the greatest figures in European literature, was born in Paris in 1313. His father, Boccaccio di Chellino, called Boccaccino, was a merchant whose family belonged originally to Certaldo in Tuscany. Boccaccino's brother Giovanni, however, had moved to Florence not later than 1297 and Boccaccino had followed him thither. (Boccaccio could thus regularly describe himself as a citizen of Certaldo or of Florence, despite the accident of his Parisian birth.) Boccaccio's mother was probably French, but his contradictory statements about her in his *Filocolo* and in his *Ameto*—that she was a young girl of royal birth and that she was a widowed gentlewoman—may both be discounted as examples of a sort of autobiographical embellishment to which he was much inclined (particularly when writing of his early years) in conformity with recognized literary patterns of the time. The year of his birth is specified by Petrarch (*Senili*, viii, 1), and Boccaccio's own statement that he was born in Paris of a French mother is supported by documents showing that his father was in Paris in 1310, 1313 and 1314 for business transactions in which the great banking house of the Bardi was engaged.

Youth in Naples.—Boccaccio passed his early childhood rather unhappily in Florence. His father had no sympathy for Boccaccio's literary inclinations and sent him (not later than 1328) to Naples to learn business, probably in an office of the Bardi. Boccaccio claims to have spent six years in this situation and seems also to have spent an equal period studying canon law—likewise on his father's insistence (because of the prospect of emoluments) and against his own inclination. His claim to have been determined on a literary career from birth is probably to be regarded partly as another autobiographical embellishment of his past.

The Bardi, of whose business Boccaccino had become an associate, dominated the court of Naples by means of their loans. Moreover, the king, Robert of Anjou, took pleasure in surrounding himself with men of letters. All doors, then, were open to Boccaccio in Naples, and the years that he spent there were decisive for his education and his tastes. His commercial activity brought him into contact with everyday life in its varied aspects, and his ex-

perience of the aristocracy of the business world was to give his writing the special quality which recommended it to that milieu above all. Contact with the court, on the other hand, showed him all that survived of the splendours of chivalry and feudalism and aroused in him a taste for high and decorous endeavour and for the old nobility's courage, self-control and courtesy, which he was to pass on to his own world, that of the rising *bourgeoisie*. He mixed with the learned men of the court (above all Paolo da Perugia, Andalò del Negro and perhaps Barlaam) and the friends and admirers of Petrarch (Barbato da Sulmona, Giovanni Barrilli and Dionigi da Borgo San Sepolcro), through whom he came to know the work of Petrarch himself. Petrarch and Boccaccio together were to mark out the paths along which the humanism of the Renaissance was to develop.

These years in Naples, moreover, were the years of Boccaccio's love for Fiammetta, whose person dominates all his literary activity up to the *Decameron* (in which there also appears a Fiammetta whose character somewhat resembles that of the Fiammetta of his earlier works). Boccaccio's accounts of the love affair are certainly romanticized and contradict one another occasionally: in the earliest works Fiammetta is unfaithful, whereas in the *Elegia di Madonna Fiammetta* it is she who is betrayed; and in *Filocolo* she is a king's daughter, whereas in *Ameto* and in *Fiammetta* she is only the daughter of a noblewoman married to a rich bourgeois and courted by the king. Attempts to use passages from Boccaccio's writings in order to identify Fiammetta with a supposedly historical Maria, natural daughter of King Robert and wife of a count of Aquino, are therefore untrustworthy—the more so since there is no documentary proof that this Maria ever existed.

It was probably in 1340 that Boccaccio was recalled to Florence by his father, involved in the bankruptcy of the Bardi. The sheltered period of his life thus came to an end: thenceforward there were to be only difficulties and occasional periods of poverty. From Naples, however, the young Boccaccio brought with him a store of literary work already completed. The *Caccia di Diana*, his earliest work, is a short poem, in terza rima of no great merit, in which a number of beautiful women of Naples are reviewed within the loose framework of a fable. Much more important are two works with themes derived from the medieval romances: *Filocolo* (*c.* 1336), a prose work in five books on the loves and adventures of Florio and Biancofiore (Flore and Blanchefleur); and *Filostrato* (*c.* 1338), a short poem in ottava rima, telling the story of Troilus and the faithless Criseida. The *Teseida* (probably begun in Naples and finished in Florence, 1340–41), is an ambitious epic of 12 cantos in ottava rima, in which the wars of Theseus serve as a background for the love of two friends, Arcita and Palemone, for the same woman, Emilia: Arcita finally wins her in a tournament, but dies immediately.

While all these themes of chivalry and love had long been familiar in courtly circles and were already in favour also with the bourgeois and even with the lower classes, Boccaccio not only enriched them with the fruits of his own acute observation of real life and insight into the human heart but also sought to present them nobly and illustriously by a display of learning and rhetorical ornament, so as to make his Italian worthy of comparison with the monuments of Latin literature. It was Boccaccio who raised ottava rima, the metre of the popular minstrels, to literary dignity and launched it on its way to becoming the characteristic vehicle for Italian verse. Moreover, these early works had immediate effect outside Italy: Chaucer drew inspiration from *Filostrato* for his *Troilus and Criseyde* (as Shakespeare was later to do for *Troilus and Cressida*) and from *Teseida* for his "Knight's Tale."

The Return to Florence.—The 10 or 12 years following Boccaccio's return to Florence about 1340 are the period of his full maturity, culminating in the writing of the *Decameron*. From 1341 to 1342 he was working on the *Ninfale d'Ameto*, in prose and terza rima, which describes how a rude shepherd is raised to spiritual refinement and worldly honour through love. Next came *L'Amorosa Visione* (1342–43), a mediocre allegorical poem of 50 short cantos in terza rima, in obvious imitation of Dante but revealing also some affinity with Petrarch's *Trionfi*, so that some critics have argued that Petrarch's poem was in fact inspired by Boccaccio's. The *Elegia di Madonna Fiammetta* (1343–44), in prose, shows remarkable psychological penetration, though the style and narrative method are heavy.

The slightly later *Ninfale fiesolano* (perhaps 1344–45), in ottava rima, on the love of the shepherd Africo for the nymph Mensola, is written with a graceful and studied simplicity foreshadowing 15th-century poetry. To complete the survey of Boccaccio's Italian writings before the *Decameron*, mention must be made of the *Rime*, begun in his youth but continued throughout his life, for the most part in the style established for the love lyric by the Sicilian school, by the exponents of the *dolce stil novo* or by Petrarch.

Boccaccio meanwhile was trying continually to put his financial affairs in order, though he never succeeded in doing so. Little is known, however, of the detail of his life in the period following his return to Florence. He was at Ravenna with Ostasio da Polenta between 1345 and 1346; at Forlì in the service of Francesco degli Ordelaffi in 1347; in Florence during the ravages of the Black Death in 1348; and in Florence again in 1349. The Florentines appointed him ambassador to the lords of Romagna in 1350, municipal councilor and also ambassador to Louis, duke of Bavaria, in the Tirol in 1351, ambassador to Pope Innocent VI in 1354 and a member of the Ufficio della Condotta in 1355.

Petrarch and the Classics.—Of far more lasting importance than official honours was Boccaccio's first meeting with Petrarch, in Florence in 1350, which began a friendship doing honour to both. Boccaccio, who had already written a life of Petrarch in Latin (*De vita et moribus Francisci Petrarchae*) revered the older man as his master (though respect did not preclude frank criticism); Petrarch proved himself a serene and ready counselor and a reliable helper. Together, through the exchange of books, news and ideas and through the stimulus that they afforded one another, they laid the foundations of the humanist reconquest of classical antiquity.

His meeting with Petrarch, which occurred when he was already working on the *Decameron*, helped to bring about a decisive change in Boccaccio's literary activity. After the *Decameron*, of which Petrarch remained in ignorance until the very last years of his life, Boccaccio wrote nothing in Italian except *Corbaccio*, the late Dantesque writings (*see* below) and perhaps an occasional lyric. Turning instead to Latin, he now devoted himself to humanist scholarship rather than to imaginative or poetic creation. His encyclopaedic *Genealogia deorum gentilium*, medieval in structure but humanist in spirit, was probably begun in the very year of his meeting with Petrarch but was continuously corrected and revised until his death. His *Bucolicum carmen* (1351–66), a series of allegorical eclogues on contemporary events, follows classical models on lines already indicated by Dante and Petrarch. His *De claris mulieribus* (1360–74), a collection of biographies of famous women, is the complement of Petrarch's *De viris illustribus*, just as his *De casibus virorum illustrium* (1355–74), on the inevitable catastrophe awaiting all who are too fortunate, reflects Petrarch's *De remediis utriusque fortunae*. Finally, there is his compilation of classical geographic names, *De montibus, silvis, fontibus, lacubus, fluminibus, stagnis seu paludibus, et de nominibus maris* (1355–74).

The meeting with Petrarch, however, was not the only cause of the change in Boccaccio's writing. A premature weakening of his physical powers and disappointments in love may also have contributed to it. Some such occurrence would explain how Boccaccio, having previously written always in praise of women and love, came suddenly to write the bitterly misogynistic *Corbaccio* and then turned his genius elsewhere. Furthermore, there are signs that he may have begun to feel religious scruples. Petrarch describes how the saintly Carthusian monk Pietro Petrone, on his deathbed in 1362, sent another Carthusian, Gioacchino Ciani, to exhort Boccaccio to renounce his worldly studies; and it was Petrarch who then dissuaded Boccaccio from burning his own works and selling his library. As early as 1360, moreover, Boccaccio's way of life had been regarded as austere enough to justify his being entrusted with a cure of souls in a cathedral (he had taken minor orders many years earlier, perhaps at first only in the hope of being given benefices).

Boccaccio's circle in Florence was of vital importance as a nucleus of early humanism. Leonzio Pilato, whom Boccaccio housed from 1360 to 1362 and whose nomination as reader in Greek at the Studio he procured, made the rough Latin translation through which Petrarch and Boccaccio became acquainted with Homer's poems—the starting-point of Greek studies by the humanists. The recovery of Latin classical texts (Varro, Martial, Apuleius, Seneca, Ovid and, above all, Tacitus) likewise occupied Boccaccio's admiring attention. Even so, he did not neglect Italian poetry, his enthusiasm for his immediate predecessors, especially Dante, being one of the characteristics that distinguish him from Petrarch. His *Vita* or *Trattatello in laude di Dante* and the two abridged editions of it that he made show his devotion to Dante's memory.

Last Years.—All these studies were pursued in poverty, sometimes almost in destitution, and Boccaccio had to earn most of his income by transcribing his own works or those of others. In 1362, on the invitation of Niccolò Acciaiuoli, he went to Naples in some hope, but was disappointed and returned at once to Florence. Then, in 1363, he retired to Certaldo. He was twice sent as ambassador to Pope Urban V, at Avignon in 1365 and in Rome in 1367. In 1370–71, on the invitation of Niccolò di Montefalcone, he paid another visit to Naples, with no better success. In Oct. 1373, he began public readings of Dante's *Divina Commedia* in the church of S. Stefano di Badia in Florence. A revised text of the commentary that he gave with these readings is still extant, but breaks off in the 17th canto of the *Inferno*, at the point that he had reached when, early in 1374, ill-health and the criticisms of those who disapproved of his explaining Dante to the multitude made him lose heart. Petrarch's death (July 1374) was another grief to him, and he retired again to Certaldo.

There Boccaccio died, on Dec. 21, 1375, and was buried in the church of SS. Michele e Jacopo (his bones seem to have been scattered in 1783). Franco Sacchetti expressed the general dismay of men of letters at the death within 18 months of the two great writers when he said that all poetry was now extinct (*mancata ogni poesia*).

The Decameron.—In the form in which it is read today, the *Decameron* was probably composed in the years 1349–51.

The *Decameron* begins with the flight of ten young people (seven women and three men) from plague-stricken Florence in 1348. They retire to a rich, well-watered countryside, where, in the course of a fortnight, each member of the party has a turn as king or queen over the others, deciding in detail how their day shall be spent and directing their leisurely walks, their outdoor conversations, their dances and songs and, above all, their alternate storytelling. This storytelling occupies ten days of the fortnight (the rest being set aside for personal adornment or for religious devotions); hence the title of the book itself, *Decameron* or "Ten Days' Work." The stories thus amount to 100 in all. Each of the days, moreover, ends with a *canzone* for dancing sung by one of the storytellers, and these *canzoni* include some of Boccaccio's finest lyric poetry.

In choosing a framework of this sort for his stories Boccaccio was following a tradition familiar in oriental and medieval literature. To this tradition, however, he brought a new element. In addition to the 100 stories, he has a master theme, namely the way of life of the refined *bourgeoisie,* who combined respect for conventions with an openminded attitude to personal behaviour.

The sombre tones of the opening passages of the book, where the plague and the moral and social chaos that accompanies it are described in the grand manner, are in sharp contrast to the scintillating liveliness of Day I, which is spent almost entirely in witty disputation, and to the playful atmosphere of intrigue that characterizes the tales of adventure or deception related on Days II and III. With Day IV and its stories of unhappy love the gloomy note returns, but Day V brings some relief, though it does not entirely dissipate the echo of solemnity, by giving happy endings to stories of love that does not at first run smoothly. Day VI reintroduces the gaiety of Day I and constitutes the overture to the great comic score, Days VII, VIII and IX, which are given over to laughter, trickery and licence. Finally, in Day X, all the themes of the preceding days are brought to their most exalted pitch, the impure made pure and the common made heroic. Even if it is not always artistically convincing, this conclusion forms a noble testament, ending with the glorification of fidelity, constancy and womanly obedience in the story of Griselda.

The prefaces to the days and to the individual stories and certain passages of especial magnificence based on classical models (on Livy at his most florid or on Apuleius at his richest rather than on Cicero), with their select vocabulary and their elaborate periods, have long held the attention of critics. But there is also another Boccaccio, the master of the spoken word and of the swift, vivid, tense narrative free from the proliferation of ornament. These two aspects of the *Decameron* make it the fountainhead of Italian literary prose for the succeeding centuries.

The romantic view of the *Decameron,* propounded by Francesco De Sanctis, who regarded it as a "Human Comedy" in succession to Dante's *Divine Comedy* and Boccaccio as the pioneer of a new moral order superseding that of the middle ages, is no longer tenable, since the middle ages can no longer be presented as having been wholly ascetic or wholly turned toward God in contrast with a virtually pagan Renaissance concerned only with the human. Medieval literature in general does not ignore man and the flesh and even has passages that exalt the individual; and the men of the Renaissance, far from ignoring God, strove in many ways to reconcile religious truth and Christian doctrine with both ancient philosophy and the new science. Also, in particular, the whole corpus of Boccaccio's work is perforce medieval in subject matter, form and taste, at least in its point of departure. It is the spirit in which Boccaccio treats his subjects and his forms that is new. Boccaccio in the *Decameron* for the first time deliberately shows man striving with fortune and learning to overcome it and even, when possible, to exploit it. This marked dualism of virtue and fortune lies at the root of the feeling and thought of the Renaissance. The *Decameron* exalts essentially what Machiavelli was to call the virtue of man: his intelligence, his eagerness, his sense of proportion, his tireless self-control and his power to bend events to his own designs. To be truly noble, according to the *Decameron,* man must accept life as it is, without bitterness; must accept, above all, the consequences of his own action, however contrary to his expectation or even tragic they may be. To realize his own earthly happiness he must confine his desire to what is humanly possible and renounce the absolute without regret. Thus Boccaccio insists both on man's powers and on their inescapable limitations. A sense of spiritual realities and an affirmation of moral values underlying the frivolity even in the most licentious passages of the *Decameron* are features of Boccaccio's work which modern criticism has brought to light and which make it no longer possible to regard him only as an obscene mocker or sensual cynic.

Boccaccio and the Renaissance.—Boccaccio was also a man of the Renaissance in other senses. His humanism comprised not only classical studies and the attempt to rediscover and reinterpret ancient texts, but also the "humanism of the vernacular" (*umanesimo volgare*), which he and Petrarch consciously initiated. This meant the raising of literature in the modern languages to the level of the classical by setting standards for it and then conforming to those standards. Such an undertaking, however, requires the writer to master his own caprices and impulses, to submit to the restraints of an illustrious and unalterable tradition, to tame his passions by the exercise of his intellect in the interests of formal perfection: poetic originality is to be sought only within the confines of tradition. In the second half of the 15th century and in the 16th century humanism did produce a vernacular literature in conformity with these requirements: indeed the humanist principle that the classical ideal should permeate the whole of modern life had as its natural consequence that the language and literature in which modern life was expressed should receive the stamp of classicism. Boccaccio advanced farther than Petrarch in this direction not only because he sought to dignify prose as well as poetry but also because, in his *Ninfale fiesolano,* in his *Elegia di Madonna Fiammetta* and in the *Decameron,* he ennobled everyday experience, tragic and comic alike. While his *Teseida* and his *Ninfale d'Ameto* invite comparison with classical genres (as do Petrarch's *Trionfi*), his *Filocolo* and his *Filostrato*

raise to the level of learned art the literature of chivalry and love that had fallen to the level of the populace. The same attention to popular and medieval themes characterized Italian culture in the second half of the 15th century. Without Boccaccio, the culmination of the Renaissance would be historically incomprehensible. For a portrait of Boccaccio *see* ITALIAN LITERATURE.

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On the development and history of criticism *see* G. Petronio, "Giovanni Boccaccio," in *I Classici italiani nella storia della critica,* ed. by W. Binni (1954). (U. B.)

BOCCALINI, TRAIANO (1556–1613), an anti-Spanish Italian theorist of the *ragione di stato* ("reason of state") and an extremely effective satirist, was born at Loreto, the son of an architect. He was educated for the law and passed many years in the papal service (1584–1612). In 1612 he left Rome for Venice where, in contact with the papal nuncio, he was probably engaged in diplomatic activity. Boccalini's most considered work was the *Commentari sopra Cornelio Tacito,* published posthumously with the *Lettere politiche ed historiche* (of doubtful authenticity) under the title *La bilancia politica* ("The Political Scales"), 3 vol. (1678). A slighter though more popular work was his *Ragguagli di Parnaso* (1st "Centuria," 1612; 2nd "Centuria," 1613; critical ed. by G. Rua and L. Firpo, 3 vol., 1910–48), a sequence of 201 ironical newsletters in which the wise men of all centuries discuss politics, literature and art, under the guidance of Apollo. Another series of 31 *ragguagli,* the *Pietra del paragone politico* (1615), contains Boccalini's most vigorous denunciation of the Spanish domination in Europe. It was widely translated, the first English version, by Henry, earl of Monmouth, being called *Advertisements from Parnassus in two centuries with the Politicke Touchstone* (1656). *Religione e Ragione di Stato* (first pub., 1933) is a dialogue concerned with the attitude of Charles V toward the German Protestants.

Boccalini died in Venice, Nov. 29, 1613.

See G. Silingardi, *La vita, i tempi, e le opere di Traiano Boccalini* (1883); F. Meinecke, *Machiavellism,* Eng. trans. by D. Scott (1957). (D. M. We.)

BOCCHERINI, LUIGI (1743–1805), an Italian composer and cellist best known for his chamber music. Born at Lucca, Feb. 19, 1743, he studied under his father and at Rome, and after establishing a local reputation soon made an international one when a concert tour culminated in his appearance at the famous Paris Concert Spirituel in 1768. He was promised a favourable reception at the Spanish court, and on visiting Madrid was appointed chamber music composer to the Infante Don Luis. After Don Luis' death in 1785 Boccherini probably took up a post in Berlin under Friedrich Wilhelm II, but returned to Madrid on the latter's death in 1797 and, despite patronage from Lucien Bonaparte and some old acquaintances, died there in extreme poverty on May 28, 1805.

The types of post Boccherini held determined that he was to be primarily a composer of chamber music, and it certainly seems that his own inclinations and gifts lay in that direction. He produced more than 100 each of quintets and quartets, more than 50 trios and more than 50 chamber works in other forms. His output also includes some sacred music, symphonies and concertos, the last mainly for his own instrument, the cello (though it is notable that a Boccherini violin concerto provided the model for Mozart's Violin Concerto in D, K. 218). The Cello Concerto in B flat, Boccherini's best-known complete work, is to some extent spurious, being arranged from two Boccherini concertos by the 19th-century composer and cellist Friedrich Grützmacher. His well-known Minuet is from his String Quintet in E major, Op. 13 (or 11), no. 5.

Boccherini has often been compared to Haydn, usually to his disadvantage. A contemporary, Giovanni Puppo, characterized him as "Haydn's wife," but it hardly does Boccherini justice to regard him as no more than an emasculated Haydn: their qualities are of different kinds. It is true that his music often lacks Haydn's characteristic forward-drive and virility, qualities which derive from a keen sense of form and symphonic development. Thus whereas Haydn's first movements usually centre upon the closely reasoned argument of their development sections, Boccherini's depend on their thematic material and the way in which it is presented and re-presented, and his development sections often lack a firm sense of direction and purpose. Closely related to this difference between the two composers are their divergent attitudes toward texture. *Concertante* writing has little place in Haydn's schemes but is of fundamental importance to Boccherini's, and he obtains a wide variety of tone-colours by writing high viola or cello parts (he was clearly influenced here by his own instrumental facility). His varied treatment of instrumental texture is one of the most characteristic features of his music. While Haydn, with his emphasis on the dramatic nature of sonata form, is in the mainstream of musical development, Boccherini can be said to represent a backwater. His concern was the production of smooth, elegant music: his favourite expression marks were *soave, con grazia* and *dolcissimo,* and his favourite dynamic mark was *pianissimo.* Especially toward the end of his life his music displayed certain stylistic mannerisms in general mood, phrasing and melodic shapes (the last two possibly because of Spanish influence). But it is in his gentle warmth and superlative elegance—often with a hint of melancholy just below the surface—that we find Boccherini's most characteristic contribution.

See A. Bonaventura, *Boccherini* (1931). (S. J. Sa.)

BOCCHUS, the name of two kings of Mauretania in the 2nd and 1st centuries B.C.

Bocchus (2nd–1st century B.C.), king of Mauretania from *c.* 118 B.C. to 91 B.C. In 106 B.C. he gave half-hearted assistance to his son-in-law Jugurtha, king of Numidia, against the Romans, with whom he had unsuccessfully tried to make a treaty. After suffering some losses he was persuaded in 105 B.C. by L. Cornelius Sulla, a lieutenant of the Roman commander Gaius Marius, to change sides and betray Jugurtha. He was rewarded with some Numidian territory and became a loyal dependent of Rome. Later, he supported Sulla with gifts and money during the latter's political career at Rome.

Bocchus (1st century B.C.), probably a descendant of the former, in 49 B.C. king of Mauretania east of the Mulucha river (Moulouya in northeastern Morocco), his brother Bogud ruling the area to the west. Both supported Julius Caesar against the supporters of Gnaeus Pompeius in Africa (49–46 B.C.), and Bocchus' rule was extended to much of Numidia after Caesar's victory of Thapsus (46 B.C.). After Caesar's death (44 B.C.) Bogud supported Mark Antony while Bocchus supported Octavian. Bocchus seized Bogud's territory when the latter was campaigning in Spain, and forced him to flee to Antony in the east. Bocchus then ruled over all Mauretania until his death in 33 B.C.

See S. Gsell, *Histoire ancienne de l'Afrique du Nord,* vol. vii and viii (1928). (B. H. Wa.)

BOCCIE, the chief Italian bowling game, controlled by the Unione Federazioni Italiane Bocce, is especially popular in Piedmont (where the first organization was formed in Turin, 1898) and Liguria. The game is also played in Italian communities throughout the United States and Australia and has a large following in South America. The first world championships were held in Genoa, Italy, in 1951.

The playing area, or alley, is 75 × 8 ft., with a surface of sand or soil, and is enclosed with boarded ends and sides 18 in. and 12 in. high, respectively. Each player (four to a side) in turn rolls or throws a wooden unbiased ball to a smaller wooden ball, or "jack," the object being, as in the game of bowls (*q.v.*), to bring the ball to rest closer to the jack than any ball of the other side, to protect a well-placed ball or to knock aside an opponent's ball. Rebounds from the side walls are allowed. (H. L. Eh.)

BOCCIONI, UMBERTO (1882–1916), Italian painter and sculptor and a pioneer of the Futurist movement, was born at Reggio di Calabria on Oct. 19, 1882. He worked in Rome from 1898 to 1902 under the avant-garde painter Giacomo Balla, then a follower of Georges Seurat. In 1902 he went to Paris, then for some months to Russia and back from 1904–06 to Padua and Venice. He then met F. T. Marinetti, founder of the new Futurist literary movement. Boccioni, with Balla, G. Severini, L. Russolo and C. Carrà formed an artists' branch of the movement and issued in 1910 two manifestos which, though extravagant, are important documents of modern art. Urging the overthrow of the cult of the past, they exult in speed, violence and pure sensation, praising the subject matter of a mechanized age. Their program is hinted at in the manifesto of Feb. 11, 1910: "Forms in movement are multiplied, deformed, follow one another like vibrations in the space through which they pass."

Boccioni's Futurist work, crowded into the years between 1911 and his death at war on Aug. 16, 1916, takes as its main theme the "development in space" of figures and common objects which are excavated, opened out, rotated and multiplied to give the illusion of dynamic movement. Some of the finest are in the Museum of Modern Art, New York.

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BOCHART, SAMUEL (1599–1667), an erudite orientalist and pastor of the French Reformed Church, was born at Rouen on May 30, 1599. After studying theology and oriental languages in France, England and Holland he settled at Caen, where he died on May 16, 1667. He achieved fame by his debate, printed in 1630, with the former Jesuit François Véron, the government-appointed polemicist for the conversion of the Huguenots. Bochart's works, still quoted, are *Geographia sacra seu Phaleg et Chanaan* (1646), dealing with the table of nations in Genesis ix and with the Phoenicians, and *Hierozoicon . . . de animalibus sacrae scripturae* (1663), a learned collection of material from classical and oriental sources. Unfortunately an uncritical predilection for Phoenician led him to produce many fanciful etymologies. His complete works were published in 1675 (4th. ed., 1712).

See W. R. Whittingham, *Essay on . . . Samuel Bochart* (1829). (W. D. McH.)

BOCHOLT, a town of Germany which after partition of the nation following World War II was located in the *Land* (state) of North Rhine-Westphalia, Federal Republic of Germany. It lies on the Aa, a stream near the Dutch frontier, 12 mi. N. of Wesel. Pop. (1961) 45,675. The church of St. George (1415–86) is in Gothic style, while the Rathaus (1618–21, restored 1928–34) is in Dutch Renaissance style. Nearby are the castles of Anholt and Gemen. The town is a centre of the cotton industry and there are also iron foundries and machine manufactures.

BOCHUM, an industrial city of West Germany in the *Land* (state) of North Rhine-Westphalia, Federal Republic of Germany, lies 9 mi. (14 km.) E of Essen and 12½ mi. (20 km.) W of Dortmund. Pop. (1961) 361,382. Situated in the heart of the Ruhr district, it serves as a commercial and cultural centre for a densely populated area. The town was heavily bombed during World War II, and the Propsteikirche or priory church (1599) is the only ancient monument still intact. Since 1946 Bochum has been rebuilt, with modern housing estates, more of which are planned or under construction on the outskirts of the town. There are many sports facilities, a zoological garden, a planetarium (opened in 1964), and an astronomical observatory which also tracks earth satellites. The theatre, rebuilt in 1953, shows classical and modern plays and organizes an annual Shakespeare festival; Bochum also has a town orchestra and a youth choir. During 1946–59, 35 new schools were built; adult and vocational education is provided by a college giving courses in administration, industry, and foreign trade, and by a miners' college. Construction of the Ruhr University at Bochum was started in 1962. The Ruhrschnellweg Road joins Bochum to Essen and Dortmund; the railway station is a well-designed modern building opened in 1957. The southern part of the town is the civic centre and residential quarter, and the town hall (1926–31) has a carillon of bells cast in Bochum. The suburbs take in the castle of Blankenstein, and a church (11th century) at Bochum-Stiepel with medieval wall paintings.

Bochum was chartered in 1298 and 1321, but remained a small agricultural town until the development of its iron, coal, and steel industries in the mid-19th century. Until the late 1950s mining was the chief occupation of the inhabitants, and its importance is shown in the town's geological museum and the unique mining museum, which illustrates the history of mining equipment and techniques. Bochum has the headquarters of the miners' trade union, insurance, and co-operative organizations, and a mining research institute. However the closure of eight mines between 1958 and 1964 marked a change in the pattern of Bochum's industry, and in 1962 only 15% of the town's workers was employed in the mines. New manufacturing industries grew up, notably two car factories which opened in the early 1960s. Metallurgy and allied industries occupied, in 1962, 29% of the town's workers; other industries included chemicals, textiles, brewing, and the manufacture of electrical goods.

BÖCKLIN, ARNOLD (1827–1901), Swiss painter, whose influence on German painting, especially on the Munich school, was very great, was born at Basel, Oct. 16, 1827. He studied at Düsseldorf, Antwerp, Brussels and Paris, but found his real inspiration in Italy, where he returned from time to time, and where the last years of his life were spent. Böcklin first won a reputation by his "Great Pan," exhibited at Munich in 1856, and bought for the Pinakothek. From 1858 to 1861, he taught at the Weimar academy, but the nostalgia for the Italian landscape pursued him, and after an interval during which he completed his mythological frescoes for the decoration of the gallery at Basel, he returned to

Italy. At Basel, and in almost all the great German galleries, there are many examples of his art. However, he was first and foremost a landscape painter. In his numerous mythological subjects he sought to express the soul of the landscape in the figures to which it gave birth. His "Isle of the Dead" inspired Sergei Rachmaninoff's symphonic poem of the same name. He died at San Domenico, near Florence, Jan. 16, 1901.

BOCSKAY, ISTVÁN (Stephen) (1557–1606), prince of Transylvania and a national leader of the Hungarians, was born at Kolozsvár (Cluj) in Transylvania. Brought up at the court of the Báthorys, he won the confidence of Sigismund Báthory (*q.v.*), prince of Transylvania, whom he advised to form an alliance with the Holy Roman emperor, who was also the Habsburg king of Hungary, instead of with the Ottoman sultan. When in 1599 Báthory's successors deprived Bocskay of his estates, he fled to Vienna to seek protection and redress. He was alienated, however, by the emperor Rudolf II's attempts to deprive royal Hungary of its constitution and the Hungarian Protestants of their religious liberties. Bocskay, a devout Protestant, therefore sought Turkish aid and helped the Turkish armies in driving the Habsburg forces out of Transylvania. As a reward the Hungarian diet elected him prince of Transylvania in 1605, and he was recognized as such by the sultan Ahmed I, who sent him a magnificent jeweled crown made in Persia. Although Bocskay refused to assume the title of king, he made skilful use of the Turkish alliance. Rudolf, faced with the possible loss of Hungary and strongly urged by his brother the archduke Matthias, entered into negotiations with Bocskay and ultimately made peace with him by the treaty of Vienna (June 23, 1606). This treaty restored and guaranteed all constitutional and religious rights and privileges of the Hungarians in Transylvania and in royal Hungary. Bocskay was recognized as the prince of Transylvania, and the right of the Transylvanians to elect their own princes was affirmed. Bocskay received the fortress of Tokaj and the counties of Bereg, Szatmár and Ugocsa. Soon afterward he concluded a treaty with the Turks at Zsitvatorok, which confirmed the provisions of the treaty of Vienna. Bocskay's sudden death on Dec. 29, 1606, was attributed to poison given him by his chancellor, Mihály Kátay, who was killed in the market place of Kassa (Kosice in Slovakia) by the enraged followers of Bocskay. (T. K.)

BODE, JOHANN ELERT (1747–1826), German astronomer, best known for his statement of "Bode's Law." He was born at Hamburg on Jan. 19, 1747. He founded in 1774 the well-known *Astronomisches Jahrbuch*, 51 yearly volumes of which he compiled and issued. He became director of the Berlin observatory in 1786, withdrew from official life in 1825, and died at Berlin on Nov. 23, 1826. Among his other publications was *Uranographia* (1801) a collection of 20 star maps accompanied by a catalogue of 17,240 stars and nebulae. He propounded, in 1776, a theory of the solar constitution similar to that developed in 1795 by Sir William Herschel. He gave currency to the empirical rule known as "Bode's Law," which was actually announced by Johann Daniel Titius of Wittenberg in 1766. This law expresses the proportionate distances of the several planets from the sun. For a statement of the law *see* Planets: *Distances of the Planets*. The law was an important factor in the discovery of the minor planets, most of which are located between Mars and Jupiter. *See* Asteroids.

BODE, WILHELM VON (1845–1929), German art critic and museum director, whose opinion was especially valued in the field of Dutch and Flemish paintings and Italian sculpture, was born at Kalvörde, Brunswick, on Dec. 10, 1845. At first Bode entered the legal profession but he turned to the study of art and became assistant in the Berlin museum in 1872. Toward the end of a most distinguished career he was made general director of all the royal museums in Prussia (1906). He resigned in 1920. Under his management the status of the Berlin museums rose to world-wide importance. Bode's knowledge extended over a wide field, and he wrote innumerable essays and books on Italian Renaissance sculpture, painting and furniture, oriental rugs, German sculpture and Dutch and Flemish painting of the 17th century, especially on Rembrandt. Bode died on March 1, 1929. His memoirs, *Mein Leben*, were published in 1930. (Hs. H.)

BODEL, JEHAN (*c.* 1167–1210), French lyric and epic poet, dramatist and (probably) author of *fabliaux*, was born at Arras and probably held some public office there. He planned to go on the fourth crusade, but was stricken with leprosy and admitted to a lazar house near Arras in 1202, dying there early in 1210. He wrote five *pastourelles* (one apparently in 1199), probably nine *fabliaux* (*c.* 1190–1200), the *Jeu de Saint Nicolas* (*c.* 1200), the *Chanson des Saxons* (before 1202) and the *Congés* (1202).

The *Jeu de Saint Nicolas* shows marked dramatic qualities and crusading fervour. It treats a theme first presented at the abbey of Fleury-sur-Loire (Orleans manuscript 201) and then by Hilarius in his Latin *Ludus super iconium Sancti Nicolai*, giving it new form and dimensions by relating it to the crusades. In Bodel's version the image of the saint, to which the sole survivor of a defeated Christian host is found praying, is made the source of a miracle. This image, placed upon the Saracen king's treasure, does not prevent its removal by thieves, who interrupt their drinking, dicing and brawling (presented in tavern scenes in which the everyday life of the people of Arras provides strong local colour) to carry it off, but the saint in person forces them to return it and the king and his people are converted.

The *Chanson des Saxons*, belonging to the period of decadence of the epic, adds *roman d'aventures* episodes to the story of Charlemagne's Saxon wars. The *Congés* are Bodel's poignant, but courageous, farewell to his fellow citizens and his plea for admission to a lazar house.

F. J. Warne's edition of *Le Jeu de Saint Nicolas* (1951) contains a bibliography. Editions of other works are: *Chanson des Saxons* by F. Menzel and E. Stengel (1906, 1909) and *Congés* by G. Raynaud in *Romania IX*, pp. 226–27 (1880).

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BODENSTEDT, FRIEDRICH MARTIN VON (1819–1892), German writer, whose poetry enjoyed great popularity during his lifetime, was born at Peine, Hanover, on April 22, 1819. As a young man he traveled extensively and obtained an appointment as head of a school in Tiflis, where he made a study of Persian literature. In 1851 he published *Die Lieder des Mirza Schafy* (Eng. trans. *The Songs of Mirza Schafy*, 1880), a collection of poems written in an oriental style, which was instantly successful. In 1854 he became professor of Slavonic languages at Munich. At this period he made numerous translations from Russian authors, notably Pushkin, Turgenev and Lermontov, and also composed an epic on a Circassian theme. He relinquished his post in 1858 in order to take up a professorship in early English literature, and from that time devoted his attention primarily to the Shakespearean drama. He collaborated with Paul Heyse and others in a new translation of Shakespeare's works (1866–72), and himself translated the sonnets. From 1866 onward Bodenstedt was director of the court theatre at Meiningen. Among his other works are *Tausendundein Tage im Orient* (1850), *Shakespeares Zeitgenossen und ihre Werke* (1858–60) and translations from Hafiz and Omar Khayyam. He died at Wiesbaden on April 18, 1892.

Bibliography.—Bodenstedt's collected works were published in 12 vol. (1866–69); *Erzählungen und Romane* (1871–72). *See* also Bodenstedt's *Erinnerung aus meinem Leben* (1888–90); G. Schenk, *Friedrich von Bodenstedt. Ein Dichterleben in seinen Briefen* (1893).

BODHISATTVA (literally, "enlightenment-being") is one on the way to enlightenment; *i.e.*, a Buddha-to-be. In the sutras of primitive Buddhism, Buddha often speaks of himself, "while I was yet an unenlightened Bodhisattva." In the sutras of Mahayana Buddhism, however, Bodhisattvas were elevated to a more dignified status and sent on specified missions; *e.g.*, Avalokitesvara (Kuan-yin or Kwannon) in the Saddharma Pundarika Sutra, Sudhanasresthi-daraka in the Avatamsaka Sutra, and Maitreya, the future Buddha. The repeated passage was: "Upward to seek the Bodhi, downward to cultivate the people." Naturally, these Bodhisattvas made much of cultivating and sav-

ing the people, this being a new focus of Buddhist faith in Mahayana Buddhism. *See* also BUDDHISM. (F. MA.)

BODHIVAMSA (MAHABODHIVAMSA): *see* PALI LITERATURE.

BODICHON, BARBARA LEIGH SMITH (1827–1891), English leader in the movement for the education and political rights of women, was born at Watlington, Norfolk, on April 8, 1827. In 1857 she married an eminent French physician, Eugène Bodichon, continuing, however, to lead the movements she had initiated on behalf of English women. In 1869 she published her *Brief Summary of Laws of England Concerning Women,* which had a useful effect in helping forward the passage of the Married Women's Property act. In 1866, co-operating with Emily Davies, she proposed a scheme for the extension of university education to women, and the first small experiment, a college at Hitchin, developed into Girton college, Cambridge, to which Mme Bodichon gave liberally of her time and money. She studied under the English artist William Henry Hunt, and her water colours showed originality and talent. She died at Robertsbridge, Sussex, on June 11, 1891.

BODIN, JEAN (1529 or 1530–1596), French political philosopher whose exposition of the principles of stable government was widely influential in Europe when medieval systems were giving place to centralized states, was born at Angers, the son of a master tailor. At the age of 15 or 16 he was professed in the Carmelite house at Angers, and three years later he was sent to the house of his order in Paris to complete his education. In 1551, however, he was dispensed from his vows—the circumstances are a matter of conjecture—and went to the University of Toulouse to study civil law. There he remained, as student or teacher, until 1561. That year he abandoned the teaching of law for its practice and returned to Paris as *avocat du roi,* just as the civil wars between Catholics and Huguenots were starting. In 1571 he entered the household of the king's brother, François, duke of Alençon, as master of requests and councilor and was there brought into contact with persons in the inner circle of the administration and diplomatic service. He himself only appeared once on the public scene, and that was as deputy of the third estate for Vermandois at the estates-general of Blois in 1576. His disinterested conduct on that occasion lost him royal favour. He opposed the projected resumption of war on the Huguenots in favour of negotiation with them; he also opposed the suggested alienation of royal domains as damaging to the monarchy; and he defended the right of the third estate to dissent from the recommendations of the two privileged orders. When, therefore, the duc d'Alençon died in 1583, Bodin retired to Laon as *procurateur* to the presidial court. He remained there until 1596 when he died of the plague.

Bodin's fame as a writer on law and politics had already spread abroad. The outcome of his academic years was the publication in 1566 of the *Methodus ad facilem historiarum cognitionem,* a scheme for the determination of the universal principles of law by a critical examination of the whole known field of history. But the bitter experience of civil war and its attendant anarchy turned his attention to the problem of authority. Anarchy, he came to think, is the supreme human catastrophe, order the supreme human need, and in the *Six livres de la République* of 1576 he examined the conditions under which order may be secured. He thought the secret lay in the recognition of the sovereignty of the state. His conception was Roman in origin, but removed from its particular historical setting and generalized. Supreme power is the distinctive mark of the state. It is unique, absolute in that no limits of time or competence can be placed upon it, and self-subsisting in that it does not depend for its validity on the consent of the subject. Governments command by divine right because government is instituted by Providence for the well-being of men. It is essentially a power to command, expressed in the making of laws in which are included all such other functions as the authorization of all appointments to office and the conduct of foreign relations. In the well-ordered state, this power is exercised subject to the principles of divine and natural law; in other words, the commands of the decalogue are enforced, and certain fundamental rights, liberty and property, are secured to the subject. But should these conditions be violated, the sovereign still commands with authority as well as power since he may not be resisted. The whole duty of the subject is obedience. He has no right of resistance to the sovereign power that he had no part in instituting, or to the law that he had no part in making, however tyrannical either might be.

There are only three types of commonwealth—monarchy, aristocracy and democracy—according to whether sovereign power lies in the one, in a minority, or in the majority. But each may have a government whose form exhibits the characteristics of one of the other types. In his search for order, the combination that Bodin preferred as the most stable was a monarchy functioning through democratic machinery. Such combined the strength that comes from unity with the strength that comes from popularity, since estates or parliaments are means whereby the king can keep in touch with the grievances and aspirations of his people.

These analyses, to the 16th century so original and so illuminating, won Bodin immediate fame. His book went through ten editions in his own lifetime, and he himself published a Latin version in 1586. It was also translated into Italian, Spanish, German and English. Its influence was marked well into the 17th century—on Thomas Hobbes and the English royalist writers, for instance. But Bodin himself devoted more than half the book to the urgent practical problem of order and examined exhaustively the causes of disruption in the various types of commonwealth and the means to their several preservation. One of his most original themes was the importance of climate. Laws must conform to the temperament of the people, and that is the product of environment—of which the essential constituents are temperature, humidity and configuration; environment determines not only physique but moral and intellectual aptitudes. Laws and institutions therefore are to be judged by relative, not absolute, standards of suitability. Such speculations did not appeal to a century that was essentially doctrinaire, and they attracted little notice. In retirement at Laon he turned his attention away from politics to religion, and composed the *Heptaplomeres,* a colloquy between a Catholic, a Calvinist, a Lutheran, a Muslim, a Jew, a theist and an Epicurean, with the object of finding a universally agreed religion. It is discovered in the decalogue. All else is demonstrated to be a matter of individual predilection. The detachment with which the argument was developed was so remarkable that it had to wait for publication until 1841, though the book circulated in manuscript soon after Bodin's death. Among his other works are *Responsio ad Paradoxa Malestretti* (1588), explaining the 16th-century revolution in prices, and a cosmological work, *Universale Theatrum Naturae* (1594).

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BODLEY, SIR THOMAS (1545–1613), English diplomat and man of letters, founder of the library of Oxford university called, after him, the Bodleian, was born at Exeter, March 2, 1545. His father had gone abroad to avoid persecution as a Protestant during Mary's reign, and Thomas was educated in Geneva. The family returned to England on Elizabeth I's accession and he entered Magdalen college, Oxford. In 1563 he became a fellow of Merton college and in 1569 was elected university proctor. He also held office as deputy orator. He had shown considerable aptitude for languages, and in 1576 he went abroad for four years to enlarge his experience, with the expressed intention of devoting the rest of his life to the service of the state.

In 1584 Bodley entered parliament for Portsmouth, and in the following year was sent to Denmark and Germany, in an attempt to form a league to help Henry of Navarre. In 1588 he went on a secret mission to France and soon after his return was made resident minister at The Hague. The difficulties of his position there were complicated by the intrigues of the queen's ministers at home, and he repeatedly asked to be recalled. He was finally allowed to return in 1596, and, although proposals for his becoming secre-

tary of state continued to be made until 1605, he insisted on retiring from public life.

In retirement Bodley's mind turned to Oxford. Being equipped with wealth, learning and leisure, he determined to refound the university library, established in 1327, enlarged by Humphrey, duke of Gloucester, but almost destroyed by the commissioners appointed under Edward VI to inculcate university reform. His offer was accepted in 1598, and the library was opened on Nov. 8, 1602, with 2,000 books. Not surprisingly Bodley was eager to acquire Protestant theology, but all fields of learning then recognized were represented. He solicited help from wealthy and learned friends in England and abroad and in 1610 made an agreement with the Stationers' company for the presentation of a copy of every work registered by them. This hastened the library's rapid growth, and the first extension was begun in the same year.

Bodley had married a rich widow in 1587, but had no children. He was knighted in 1604 and died in London, Jan. 28, 1613, being buried in Merton college chapel. In his will, which left most of his fortune to the library, he made provision for its enlargement (*see* also LIBRARY: *History: Middle Ages and Renaissance*).

Sir Thomas wrote his own life to 1609, which was published with the first draft of the statutes drawn up for the library, along with his letters to the librarian, Thomas James, in T. Hearne's *Reliquiae Bodleianae* (1703). His *Letters . . . to Thomas James* (1926) and *Letters . . . to the University of Oxford* (1927) were edited by G. W. Wheeler.

See also *Trecentale Bodleianum,* published for the Bodleian library (1913). (X.; G. M. B.)

BODMER, JOHANN JAKOB (1698–1783), Swiss-German critical writer, who contributed greatly to the development of an original German literature in Switzerland, was born at Greifensee near Zürich on July 19, 1698. He was professor of Helvetian history in Zürich from 1725 until 1775 and from 1737 a member of the *Grosser Rat.*

He published (1721–23), in conjunction with J. J. Breitinger (1701–76) and several others, *Die Diskurse der Mahlern,* a weekly journal after the model of the *Spectator.* Through his prose translation of Milton's *Paradise Lost* (1732) and his successful endeavours to make a knowledge of English literature accessible to Germany, he aroused the hostile criticism of J. C. Gottsched (*q.v.*) and his school, and a controversy arose which ended in the complete discomfiture of the latter.

Bodmer's most important writings are the treatises *Von dem Einfluss und Gebrauche der Einbildungskraft* (1727); *Von dem Wunderbaren in der Poesie* (1740); and *Kritische Betrachtungen über die poetischen Gemälde der Dichter* (1741), in which he pleaded for the freedom of the imagination from the restriction imposed upon it by French pseudo-classicism and for descriptive poetry in general. He was also engaged in studies of Shakespeare, Tasso, Dante and Cervantes, translated Homer (in hexameters), rediscovered the importance of medieval German poetry (*Minnesang, Nibelungenlied, Parzival*), espoused the causes of Montesquieu and Rousseau and thus played a part in European literature as a precursor of J. G. von Herder. In his own country he was an influential national educator, J. K. Lavater, H. Fuseli and J. H. Pestalozzi being among his pupils. As a poet he was unsuccessful.

Bodmer died at his farm near Zürich on Jan. 2, 1783.

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BODMIN, a municipal borough and county town in the Bodmin parliamentary division of Cornwall, Eng., 32 mi. W.N.W. of Plymouth by road. Pop. (1961) 6,214. Built of local stone and granite, it lies at the southwestern end of Bodmin moor, a granite mass covered by peaty moorland. The site, on the main Land's End road, is near what seems to have been a transpeninsular route between the Fowey and Camel estuaries. There are traces of Roman mining settlements of the 1st–2nd century A.D.; in the vicinity there are many archaeological remains. Bodmin's history begins with the arrival in the 6th century of St. Petroc, whose 12th-century ivory reliquary is preserved in the church. The rich and powerful Augustinian priory dedicated to him, of which only a few stones remain, held the manor at the time of Domesday Book. The Perpendicular church of St. Petroc, rebuilt in 1469–72 and greatly restored in the 19th century, is the largest in Cornwall. The town, recorded as a borough in 1190, was finally incorporated in 1553. It was a market for tin and wool in the reign of Edward II and a "coinage" town for taxing tin bars.

Three Cornish risings centred in Bodmin: in 1497 Cornish tax rebels were led by two Bodmin men and defeated at Blackheath; Perkin Warbeck had himself crowned Richard IV at Bodmin; and in 1549 a revolt against the new Prayer Book was stamped out there.

Many of the county institutions are at Bodmin, which is the assize and quarter sessions town, while Truro has the county offices and the cathedral. There are no significant industries, but Bodmin is the centre of an agricultural area. The largest employer of labour is St. Lawrence's hospital.

BODO (BÅRÅ), a race of tribes in Assam, India, divided roughly into two groups, the western consisting of the Chutiya, Plains Kachari, Rabha, Garo, Mech, Koch, Dhimal and Haijong tribes, the eastern of the Dimasa or Hill Kachari, Hojai, Lalung, Tippera and Moran tribes. The Bodo race were formerly dominant in Assam, where a Chutiya kingdom was destroyed by Shan invaders (*see* SHAN) who set up the Ahom kingdom in its place in the 13th century.

The Chutiyas practised human sacrifice, but the general features of Bodo customs may be inferred from the accounts of Kacharis (*q.v.*), Garos and Tipperas. Most of the Bodo tribes have now become superficially Hinduized, and it has been suggested that the Tantrik beliefs, for which the Hinduism of Assam is conspicuous, are based on Bodo belief and custom which has permeated and coloured the superimposed religion. The languages belong to the Tibeto-Burmese family.

BODONI, GIAMBATTISTA (1740–1813), Italian printer and type face designer, father of the "modern" style of type introduced into the U.S. in about 1912 and popular in the early 1960s in newspapers and books. Bodoni, the son of a printer, was born Feb. 26, 1740, at Saluzzo in Piedmont. He became a compositor for the press of the Propaganda and later was placed in charge of the printing house of the duke of Parma. Under Bodoni, the Parma printing house became well known throughout Europe.

The intrinsic value of his editions is seldom equal to their outward splendour. His Homer, however, is a truly magnificent work; and his Greek letters are faultless imitations of the best Greek manuscript. His editions of the Greek, Latin, Italian and French classics are all highly prized for their typographical elegance, and some of them are not less remarkable for their accuracy. Bodoni died at Padua on Nov. 30, 1813.

In 1818 a magnificent work appeared in two volumes quarto, entitled *Manuale Tipografico,* containing specimens of the vast collection of types that had belonged to him. The style of type named after Bodoni is classified as "modern" although Bodoni designed it about 1798. The classification refers to the design features, rather than to the age of the type. As shown in the following specimen

This is set in 10 point Bodoni bold

the thick main strokes and thin secondary strokes provide extreme contrast in Bodoni. Other identifying characteristics are the thin, straight serifs and the lengthy ascenders and descenders.

See De Lama, *Vita del Cavaliere Giambattista Bodoni* (1816); Bertieri, *L'Arte di Giambattista Bodoni* (1913).

BODY AND MIND. To human beings reflecting on their own nature, it seems clear that each man has two distinguishable aspects. Certain of his qualities and activities belong to him as a physical body and are observable by others and in an obvious sense spatially localized, but there are also processes within him which are known to himself alone and not obviously connected with any physical organ; *e.g.,* unspoken thoughts, wishes and feelings. Since these processes are not publicly observable and not

easily localized, they are thought of as nonphysical and it is a short step to refer them to some nonphysical entity, which is their subject, as the body is the subject of physical activity. This is called the mind (*nous*) or soul (*psyche*). Anaxagoras (*q.v.*) seems to have been the first in western philosophy to make this dualism of body and mind explicit, although it is doubtless implicit in earlier thinking. Plato states it clearly, especially in the *Phaedo*. Mind-body dualism has always been attractive as leaving open the possibility of human survival of death. The body obviously perishes, but the mind or soul may be immortal.

Natural and attractive though it is, dualism presents logical difficulties because of the close and inescapable connection between mental and purely bodily functions. Aristotle was aware of these difficulties and, in his *De Anima*, put forward a theory of the soul as the form (*q.v.*) of the body. This seems to be a sort of behaviourism, according to which the soul is inseparable from the body. An exception is made, however, in favour of the intellect (*nous*), which Aristotle regards as separable from the body.

This somewhat unsatisfactory compromise was in general adopted in the middle ages as being in accordance both with the facts of biology and with the demands of religion. The problem became acute in the 17th century, which first saw the hope of presenting physical nature as a closed system; it is revealed in its sharpest form in the works of Descartes (*see* especially *Meditations* ii and vi). Descartes found himself maintaining three propositions which, taken together, are incompatible: (1) that physical nature is a closed system, or, in other words, that all physical events are completely explicable in terms of physical laws; (2) that the mind is a substance of a different nature and separable from anything physical; and (3) that every mind is in intimate causal connection with some physical body.

Subsequent discussions have been largely determined by a desire to escape from this impasse. Interactionists reject the first proposition; the second is denied, although in different ways, by epiphenomenalists and by behaviourists; and the third is abandoned by parallelists.

Interactionism.—This theory commends itself to unsophisticated common sense and is also the presupposition of much religious thinking. It does not logically require the theory of a mind-substance. All that is logically presupposed is that mental events are distinguishable from physical events; but in order to complete his theory the interactionist must indicate the relation holding between mental events when they belong to the same mind or person. The essential thesis is that mental events can be both caused by, and causative of, physical events; *e.g.*, that in sensation the physical causes the mental and in volition the mental causes the physical event. There is, however, an ambiguity in the word "cause." Many philosophers since Hume have maintained that the word as used in science can mean no more than "invariable antecedent." There is no intelligible or necessary connection between cause and effect. Empirical investigation is the only way to find out causal relations, and, conversely, the empirical evidence of invariable precedence or concomitance is sufficient to establish a causal relation. (*See* CAUSALITY.) On this view it seems clear that interactionism is correct, since the evidence for invariable connection between mental and physical in both directions is extremely good. Attacks on interactionism have been made (1) by philosophers using a stronger notion of causation and (2) in the interests of a specific scientific theory.

An example of the first type of objection is to be found in the reasons which led the occasionalists and Spinoza to reject Descartes's theory of interaction. They demanded intelligibility in the causal relation and held that the condition of intelligibility was likeness between cause and effect. Since Descartes had denied any properties in common between mental and physical, it seemed that no causal connection was possible. This consideration led to the parallelism of Spinoza (*see* below) and to occasionalism (*q.v.*).

The second type of objection appeals to some recognized principle of physical science (*e.g.*, the conservation of energy) that is held to be logically incompatible with the proposition that mental events produce physical changes. Such objections have great force when the principle in question is of high generality and is well supported. They are not, however, logically conclusive. It may be pointed out that these principles are not logically necessary truths but rather scientific postulates or conventions and therefore modifiable under sufficient pressure from empirical facts. Alternatively it may be argued that, with a suitable understanding of the terms involved, the principle is not incompatible with interaction; *e.g.*, that mental-physical causation does not involve the transference of energy and so is compatible with the principle of conservation of energy.

Epiphenomenalism.—Epiphenomenalism (*q.v.*) involves the following propositions: (1) that physical nature is a closed system and all physical changes, including those taking place in human and animal bodies, are explicable in terms of physical laws alone; and (2) that the notion of causation involves that of explanatory force, so that only physical processes can properly be regarded as causes of physical changes, and mental events, being superfluous from the explanatory point of view, cannot be accepted as causes of change in the human body. Perhaps the meaning of the theory can best be grasped by consideration of an analogous relation which is sometimes thought to hold between primary and secondary qualities. For example, the chemical changes caused by light may be explained entirely in terms of its primary qualities (*i.e.*, wave length and frequency): its actual colour as perceived, being irrelevant to scientific explanation, is thus a mere epiphenomenon. This may be more than an analogy, as many philosophers hold that the secondary qualities exist only in relation to consciousness.

It may be argued against epiphenomenalism that it involves a logical incoherence. For the notion of explanatory cause on which it relies is that of the determination of events in accordance with laws, and laws of nature are established only by means of empirical correlations. Now empirical correlations are in fact found of the four types, physical-physical, physical-mental, mental-physical and mental-mental. In principle, therefore, laws of any of these types may be used in explanation, and the preference of the epiphenomenalist for the first two types rests partly on considerations of economy and partly on determination to be hard-headed.

It may also be objected that the epiphenomenalist cannot explain the emergence of mental phenomena in the evolutionary process, in which they are inefficacious and therefore useless.

The epiphenomenalist may reply to the second objection that mental phenomena are the inevitable, although otiose, accompaniments of physical developments which themselves have survival value; *e.g.*, the extreme complication of the brain tissues. To the first objection there is no complete logical answer; but it may be said that, while the choice of explanatory laws is to some extent arbitrary, it is both more economical and more fruitful to regard physical correlations as fundamental. This approach has led to the most spectacular advances in physical science in general and in medicine in particular. The force of this reply is somewhat weakened, however, by developments in psychiatry: for instance, in the treatment of mental illness by psychoanalysis.

Behaviourism.—Behaviourism (*q.v.*) in its crude form is the denial of the existence of mental processes. It thus dissolves the problem, but is patently false. A more subtle form has been developed by some philosophers with the help of the technique of linguistic analysis. Their thesis is that the language that we use in referring to "mental processes" in fact refers not to events different in kind from bodily processes but to these same processes in a more complicated way. For example, in attributing understanding to a man we are not ascribing some peculiar inner process to him but referring in a shorthand way to certain capacities, tendencies and dispositions to overt action. Although this thesis has been applied with considerable success to some of the mental concepts, it breaks down in the attempt to explain sensation and mental imagery. The reason is that sensing and imagining involve events which are inescapably "inner" or private, so that a full account of them cannot be given on the behaviouristic view. But it appears that the occurrence of such "inner" events is part of what we mean to assert by attributing a mind to an organism. If this is so, it follows that behaviourism cannot give a complete account of mind.

Parallelism.—This theory was first worked out by Spinoza.

He begins with the thesis that there can be no causal connection between the totally disparate. Therefore, like the epiphenomenalist, he regards physical nature as a closed system; but, unlike the epiphenomenalist, he regards psychical nature also as a closed system. Each complete event occurring in a human being has a mental and a physical side or component, and neither of these is to be regarded as a cause or explanation of the other. Nevertheless, since there is a complete correlation between the mental and the physical, it is possible, once the laws of correlation have been worked out, to infer from the occurrence of a physical to the occurrence of a mental event and vice versa. It appears that parallelism, in order to be consistent, must be universal and so involve panpsychism, the theory that all physical events have a mental side and that all physical objects in some sense have "minds"; for if mental events cannot be caused by physical events, it is impossible that mind which was not present from the beginning should have manifested itself in the course of the evolutionary process. But panpsychism is made possible only by an immense and unplausible extension of the notion of unconscious mind, such as is found in Leibniz. Without this, universal parallelism is inconsistent with the facts. Even in animals and human beings there appear to be many physical events which have no mental correlates. This consideration has led some thinkers to adopt a narrower form of parallelism; that is, a parallelism between mental and cerebroneural events. This, however, is difficult to distinguish from epiphenomenalism.

Supplementary Arguments.—It is now necessary to mention certain empirical discoveries which are or have been thought to be relevant to the problem.

The first is the verification of the evolutionary hypothesis, especially with regard to the descent of man. This renders untenable any theory which, like that of Descartes, makes a sharp division between man and other animals, by attributing to man a peculiar kind of soul substance. If universal parallelism is to be rejected, the evolutionary hypothesis seems at first to favour the interactionist; but if he is to make good his case against the epiphenomenalist, he must be able to point to some respect in which the possession of consciousness is favourable to the survival of the organism. This is more difficult than would at first appear. The capacity to discriminate between distant objects, for example, which is given by sight, is obviously advantageous; but it seems clear that the same advantage would be gained if the organism had a capacity to respond in a discriminating way to different objects such as that which a self-directing machine has. Again, processes akin to ratiocination can be completed by machines. If the facts of evolution are to be cited in support of interactionism, it is consciousness of the process, not simply the possession of certain faculties, that must be shown to favour survival.

Secondly, the construction of self-directing and self-correcting machines (*see* N. Wiener, *Cybernetics*, 1948) has been thought by some to be relevant to the mind-body problem. The relevance of these facts, however, is indirect. The occurrence of "intelligent" or "goal-directed" behaviour in machines does not tell in favour of behaviourism. It rather seems to make clear the distinction between the concept of mentality and that of goal-directed activity, for however successful and complicated the behaviour of machines, we do not attribute minds to them. It does, however, tell indirectly in favour of epiphenomenalism, as showing that consciousness of such behaviour is irrelevant to its efficiency.

Thirdly, arguments for parallelism or epiphenomenalism have been drawn from the discovery of the detailed correlation between brain events of certain types and mental events of certain types. More specifically, neurophysiologists have succeeded in mapping the areas of the brain, stimulation of which is correlated with the different types of sensory experience. By direct stimulation of the brain in the appropriate areas it is possible to produce, for example, visual sensation without the normal stimulus via the eye and the optic nerves. The areas of the brain which are involved in the movement of the various parts of the body have also been located. Logically the facts in question seem to be capable of interpretation on any theory, and some of their discoverers, as C. S. Sherrington, E. D. Adrian and J. C. Eccles, have interpreted them in an interactionist manner. (*See* BRAIN.)

Finally, the empirical data collected in the study of psychical research and parapsychology (*qq.v.*) seem to indicate that mental events are governed by laws independent of the laws of physics and thus to tell in favour of interactionism. It seems clear that the type of fact generally referred to by the terms "telepathy" and "clairvoyance" cannot be explained in terms of physical or physiological laws known at present, but it is by no means certain that they could not be accommodated by an epiphenomenalist theory. Moreover the situation is logically complicated by the fact that the more securely clairvoyance and telepathy are established as natural phenomena, the more difficult it is to produce a near-decisive proof of human survival after death, the one piece of empirical evidence which would tell decisively in favour of interactionism. Phenomena formerly interpreted as communications from the dead can often be explained in terms of paranormal cognition by the living.

It will be seen from the foregoing discussion that the problem is not purely scientific but also metaphysical; it cannot be completely solved on empirical grounds, and a decision in favour of one theory or another must rest partly on the interpretation of the key terms, such as "cause."

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BODY-SNATCHING, the secret disinterment of dead bodies in order to sell them for purposes of dissection. Prior to the licensing of medical schools and legal provisions for making cadavers available for anatomical study, "resurrectionists" did a lucrative business, and it was prudent to protect the graves of the newly buried against violation. Body-snatching was a misdemeanour at common law. *See* CORPSE. (B. CE.)

BODY TEMPERATURE: *see* ANIMAL HEAT.

BOECE (BOYCE), **HECTOR** (*c.* 1465–*c.* 1536), Scottish historian and humanist, author of an important Latin history of Scotland, was born at Dundee about 1465. He was educated at Dundee and the University of Paris, where he was appointed regent (professor) of philosophy in the college of Montaigu and became a friend of Erasmus, who in two epistles wrote of him in the highest terms. The chief adviser of William Elphinstone, bishop of Aberdeen, in the foundation of Aberdeen university, he was its first principal and was in Aberdeen about 1500 when lectures began in the new buildings. As principal he read lectures on divinity: he received a small pension from the court (1527–34), was a canon of Aberdeen, vicar of Tullynessle and then rector of Tyrie.

His first work, *Episcoporum Murthlacensium et Aberdonensium ... Vitae*, was printed at the press of Jodocus Badius (Paris, 1522). The portion of the book in which he speaks of Bishop Elphinstone is of enduring merit; it includes an account of the foundation and constitution of the college and some notices of its earliest members. But Boece's fame rests on his history of Scotland, *Scotorum Historiae a prima gentis origine* (Paris, 1527; Scots trans. by John Bellenden, *q.v.*, *Croniklis of Scotland*, ?1536). The 1527 edition contains 17 books: another edition (1574) containing the 18th book and a fragment of the 19th, was published by Ferrerius, who added an appendix of 35 pages. Boece's history is no mere chronicle, for he knew and copied Livy. It is a glorification of the Scottish nation, based on legendary sources, and is more interesting as romance than as history. Raphael Holinshed embodied an English version of Bellenden by William Harrison (*q.v.*) in his *Chronicles* (1578) and thus the plot of Shakespeare's *Macbeth* is traceable to it. It had a wide currency abroad through its French translation, by Nicolas d'Arfeville, and coloured French ideas of Scottish history for a long period.

Boece professed to have obtained from the monastery of Icolmkill, through the good offices of the earl of Argyll and his brother John Campbell of Lundy, the treasurer, certain original histories of Scotland, including that of Veremundus, of whose writings nothing is now to be found.

BIBLIOGRAPHY.—Bellenden's Scots trans. was reprinted for the Ban-

natyne Club (1821) and the earlier ms. version first printed for the Scottish Text Society in 2 vol., ed. by R. W. Chambers, E. C. Batho and H. W. Husbands (1938—for 1936—and 1941): William Stewart's verse translation, *The Buik of the Croniclis of Scotland* (completed *c.* 1535) was issued in 3 vol., in the "Rolls Series," ed. by W. B. D. Turnbull (1858). Vol. i of a 16th-century Scots manuscript version found at Mar Lodge, Braemar, now in the Pierpont Morgan library, New York, was first printed for the Scottish Text Society in 1946 (for 1943). *Episcoporum . . . Vitae* was reprinted for the Bannatyne Club (1825) and trans. by J. Moir for the New Spalding Club (1894). A commonplace verse rendering of the *Life of Bishop Elphinstone*, written by Alexander Gardyne in 1619, remains in manuscript. (X.; N. D.)

BOECKH, AUGUST (1785–1867), the German professor who helped more than any other man of his period to enlarge the scope of classical scholarship, was born at Karlsruhe on Nov. 24, 1785. As a student at Halle under F. A. Wolf, and as a young lecturer and (1807) professor at Heidelberg alongside the comparative mythologist F. Creuzer, he learned to value the contribution which knowledge of Greece and Rome makes to the history of culture. In 1811 he became professor of classical literature at the new University of Berlin where he remained until his death on Aug. 3, 1867.

His talents were unusually varied. A good Greek scholar, he had a gift for mathematics and a solid interest in the details of social history. During his formative years at Heidelberg he made his mark with an edition of the pseudo-Platonic dialogues; but he also wrote papers on Plato's *Timaeus*, showing the impact of astronomical hypotheses on cosmology, and a treatise which discussed the changes introduced by actors into the Greek tragedies. The publication of his Pindar made him famous. The first volume (1811) transformed the appearance of the text, rejecting the traditional division into short lines, and founded the scientific study of Greek metres in their relation to music. The second volume (1821), containing the *scholia*, was less revolutionary, and after that Boeckh abandoned textual criticism except for occasional articles and a mediocre edition of Sophocles' *Antigone* (1843). Philosophy likewise claimed less of his attention, though he produced an article on Plato's cosmology (1852). His love of mathematics combined with his interest in antiquities to attract him to new fields. With his *Staatshaushaltung der Athener* (1817; Eng. trans., *The Public Economy of Athens*, 1828) and treatises on the Laurium silver mines, on the weights, coinage-standards and measures of the ancients and on inscriptions about the Athenian navy (1840), he placed Greek economic history on a firm basis. He continued his study of the astronomers, and a fine series of monographs, of which *Zur Geschichte der Mondcyclen der Hellenen* (1855–56) was the most important, elucidated the obscurities of classical chronology.

These extensive researches were pursued simultaneously with a great public enterprise. In 1815 the Berlin academy decided to publish a *Corpus inscriptionum Graecarum* with Boeckh as editor. The first volume appeared in 1828. It was followed in 1843 by the second, prepared with the help of J. Franz, and in 1853 and 1877 by two others in which Boeckh had little part. The work has been severely criticized, for Boeckh accepted incorrect transcripts and his restorations were often unjustified, so each volume required supplements almost as soon as it was printed. For all that, the *Corpus* must rank as a great achievement. Its topographical classification was eminently sound, it brought together material previously scattered in a number of inaccessible sources, and subsequent advances in epigraphy could hardly have occurred without its help.

Boeckh also deserves to be remembered for his brilliant attempt to formulate systematically the aims of classical scholarship. His recommendations are embodied in the *Encyklopedie und Methodologie der philologischen Wissenschaften* edited from his lectures by E. Bratuscheck (1877). There the classical scholar's task is defined as the reconstitution of the mental world of Greece and Rome, not only from written memorials, but from art, institutions, customs and history. This catholic concept owes a plain debt to Hegel, but it had a value independent of its idealist presuppositions. It provided a much-needed counterweight to the rigidities of G. Hermann (*q.v.*) and his school who took a purist pride in limiting their work to textual criticism and interpretation. Some at least of the credit for the impressive strides made in classical learning outside the purely linguistic field since the early 19th century must go to Boeckh's imaginative teaching and example.

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BOEHMITE, alpha alumina monohydrate, is one of two known alumina monohydrates; the beta-form is diaspore (*q.v.*). It is a common constituent of bauxite (*q.v.*), particularly the bauxites of Europe, accompanied chiefly by iron oxide and clay minerals. The pure mineral contains 85% alumina and 15% water, whereas a typical boehmite-bauxite may contain 70% alumina. Western hemisphere bauxites commonly contain only a few per cent of boehmite, gibbsite (*q.v.*) predominating.

Artificial boehmite with properties of the natural mineral can be prepared from gibbsite by dehydration or hydrothermally, or by direct precipitation from solutions.

Boehmite bauxites are treated by the Bayer leaching process, using more drastic conditions than for gibbsite bauxites. Following selective solution of boehmite, alumina is reprecipitated as gibbsite for further treatment for production of aluminum or alumina chemicals. On calcination, boehmite passes through possibly three essentially anhydrous intermediate phases, including gamma alumina, until, at around 1,200° C., alpha alumina (corundum) is formed. The exact nature of the intermediate phases is not known but is of considerable interest to chemical, ceramic and catalyst industries because of certain adsorptive properties. (*See* also ALUMINUM.)

Boehmite is orthorhombic; refractive indices are uncertain but the mean value approximates 1.64. Cleavage is pinacoidal. Specific gravity is 3.01 to 3.06 (artificial), and hardness is about 4. The formula is $Al_2O_3.H_2O$ or AlOOH. (W. K. GR.)

BOEOTIA (mod. Gr. VOIOTIA), a district of ancient Greece, now comprising most of the modern prefecture (*nomos*) of the same name, with its administrative centre at Levadhia (Lebadea). The modern district extends farther than the ancient Boeotia in the northwest to include part of ancient Phocis (*q.v.*). Boeotia is bounded by Attica on the southeast, by the Gulf of Corinth on the south, by Phocis (mod. Gr. Fokis) on the west, by Locris (Fthiotis or Phthiotis) on the north and by the Gulf of Euboea on the east. Area 1,225 sq.mi. (3,174 sq.km.). Pop. (1961) 114,256.

Boeotia is entered through the Cephisus (Kifisos) valley. It has two extensive fertile plains separated by a low ridge, an outlier of Mt. Helicon or Elikon (5,735 ft.), on which Thebes (Thivai) stands. The northern plain is a lacustrine basin, now drained, containing Lake Copais (Kopais), which the Cephisus river inundates unless the underground channels (*katavothrai*) are kept clear. The southern plain is watered by the Asopus (Asopos) river. The plains being shut off from the sea by foothills, the climate is torrid in summer and raw in winter. The soil is rich and suitable for crops (wheat, cotton, tobacco, olives, grapes) and pasture. The main road through Greece enters Boeotia at Parapotamii (Anthokhori or Belesi) between Mt. Parnassus (*q.v.*; 8,061 ft.) and Mt. Cnemis (Knimis; 3,000 ft.), and passes through Thebes and over Mt. Cithaeron (Kithairon; 4,623 ft.) to Attica. It is thus a fertile district of strategic importance historically.

History.—Paleolithic and Neolithic settlements occurred in the northern plain; and Early and Middle Bronze Age peoples (the latter speaking Greek) occupied both plains. Mycenaean Boeotia was second only to the Argolis in the eastern Peloponnese. The Cadmea (the citadel of Thebes), and in northern Boeotia the treasury of Minyas at Orchomenus (*q.v.*) and the castle of Gla or Goulas show the strength of its rulers; and mythology tells of Minyas, Cadmus, Heracles and Oedipus, and of the sack of Thebes (*q.v.*) a generation before the Trojan War (*see* TROY). A new people appeared before and after the Trojan War, the Boiotoi, who gave their name to the country, Boeotia instead of Cadmeis. This generation may have composed epic poems from which the *Iliad* of Homer (*q.v.*) descended; for they spoke Aeolic, the dialect in which epic originated, and their cities were men-

tioned first in the catalogue of Greek ships in the second book of the *Iliad*, together with the name Boiotoi. The tradition of epic survived in the work of the Boeotian poet Hesiod (*q.v.*).

In classical times Boeotia was famous for music, lyric poetry such as that of Pindar (*q.v.*) and political experiment. Although the population was partly Aeolic and partly northwestern Greek in origin, many cities combined to form about 550 B.C. the Boeotian league of which the coinage carried a shield as the emblem of unity in defense and religion. While Thebes led the federal movement and Orchomenus led the separatist states, Athens intervened in 519 B.C. to annex Plataea (*q.v.*) as well as Hysiae and Eleutherae, small states on the frontier between Athens and Thebes, and defeated the Boeotians in 506 B.C. Enmity between Athens and Thebes influenced Thebes and most of Boeotia, excepting Thespiae (*q.v.*), in siding with Persia during the invasion of Xerxes in 480, and the victorious Greeks punished Boeotia by disbanding the Boeotian league. A period of weakness ensued during which Sparta restored the league and Athens destroyed it again, setting up democratic governments in the cities (457 B.C.). But in 446 B.C. the cities rebelled, joined the Spartan alliance and reconstituted the Boeotian league, which entered the Peloponnesian War (*q.v.*) on Sparta's side. Their victory over Athens at Delium (424 B.C.) established their military reputation and justified an independent policy. The Boeotian league led the rising against Sparta in the Corinthian War (395–386 B.C.), but Persia's support of Sparta resulted once again in the dissolution of the Boeotian league.

Meanwhile the Boeotian league had developed from the 6th-century alliance of sovereign states into a close-knit confederacy, organized in 11 wards by 431 B.C. Each ward, comprising one or more cities, returned a general (*boeotarch*), several judges and many councilors to the federal government, which consisted of four councils with sovereign authority. One council in turn prepared the business for the assembly of all four councils. Later, about 400 B.C., a single council was instituted, its 660 members being returned by the 11 wards. Indirect representative government of this kind was called oligarchical by the Greeks, and the cities in the wards were also oligarchically governed, the franchise being limited to the propertied classes. Thebes held a predominant position in the league. The council met there; and Thebes, having reduced its neighbours to tributary status, controlled four of the wards and supplied the finest contingent to the federal army. But in 382 B.C. Sparta treacherously occupied the Cadmea and held Thebes in bondage.

The revival of Thebes began in 379 B.C. when together with Athens it challenged the supremacy of Sparta (*see* GREECE: *History*). Two brilliant Thebans, Pelopidas and Epaminondas (*qq.v.*) and the Boeotian hoplites destroyed Spartan power and challenged Athens' supremacy at sea (371–362 B.C.). The Boeotian league revived on a democratic system. All Boeotians, whatever their property, were members of an assembly convened at Thebes, and their vote decided all matters of policy. Executive officials, elected in the wards which were now reduced to seven (Thebes controlling three), were answerable to the assembly of Boeotians. This experiment of direct rule by an electorate numbering at least 25,000 men was at first eminently successful. Other districts under federal systems contracted alliance with Boeotia: Aetolia, Acarnania, Phocis and Thessaly in central Greece, and Arcadia and Achaea in the Peloponnese. But this great block of military power was soon split by imperialist ambitions, and the Boeotian league itself destroyed Orchomenus (363) and intervened in the Achaean league (366) and the Arcadian league (362).

Decline set in rapidly when Phocis hired mercenary troops and ravaged Boeotia (354) in the Sacred War which Philip II of Macedonia ended in 346 B.C. as an ally of Thebes. Although the Macedonian alliance might have been profitable, Boeotia chose to join Athens in the fight for Greek independence and her finest troops—the sacred band of Thebans—fell to a man in the battle of Chaeronea (338). The Boeotian league was again dissolved and a Macedonian garrison controlled Thebes. In 335 B.C. when Thebes rose for the second time against Alexander the Great of Macedonia, it was destroyed on the order of the Greek league with the connivance of Alexander. Thereafter Boeotia had little history. It passed under the control of the Aetolian league and the Macedonian kings, and suffered from the general decline which Roman government brought to Greece.

See also Index references under "Boeotia" in the Index volume.

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(N. G. L. H.)

BOER, Dutch form of the English word "boor," in its original meaning of husbandman or farmer (Ger. *Bauer*), a name applied to South Africans of Dutch or Huguenot descent, especially to early settlers of Transvaal and the Orange Free State (*qq.v.*) and their descendants. *See* SOUTH AFRICA, REPUBLIC OF: *History*.

BOERHAAVE, HERMANN (1668–1738), Dutch physician and professor of medicine who was the first great clinical, or "bedside," teacher, was born at Voorhout near Leiden on Dec. 31, 1668, and died at Leiden on Sept. 23, 1738. He graduated in philosophy at Leiden and in medicine at Harderwyck. He spent the whole of his professional life at Leiden, being professor of botany and medicine, rector of the university, professor of practical medicine and professor of chemistry. His genius so raised the fame of the University of Leiden, especially as a school of medicine, that students came to it from all parts of Europe. Through his pupils he exerted an influence on later medical teaching at Edinburgh, Vienna and in Germany, and because of this influence he is often credited with founding the modern system of medical instruction. (*See* MEDICINE, HISTORY OF: *Boerhaave.*)

His principal works are *Institutiones medicae* (1708); *Aphorismi de cognoscendis et curandis morbis* (1709), on which his pupil and assistant, Gerard van Swieten (1700–72), published a commentary in five volumes; and *Elementa chemiae* (1724).

BOER WAR: *see* SOUTH AFRICAN WAR.

BOËTHIUS, ANICIUS MANLIUS SEVERINUS (*c.* 480–524), Roman scholar, philosopher, theologian and statesman, author of the celebrated work *De Consolatione Philosophiae* ("On the Consolation of Philosophy"), belonged to the Christian family of the Anicii, of whom one member, Olybrius, had been emperor in 472. After the early death of his father, who had been consul in 487, Boëthius was brought up in the house of Q. Aurelius Memmius Symmachus, a senator of high intellectual and moral qualities, whose daughter Rusticiana he married. After holding some of the highest offices in Italy under the Ostrogothic king Theodoric (consul in 510, possibly head of the senate and, above all, *magister officiorum* or head of the civil and other services *c.* 520–522) and after greeting in the senate his two young children as joint consuls in 522, he was accused of conspiring against the king in favour of the eastern emperor Justin I. He was accused of supporting the senator Albinus in his dealings with the emperor, of writing subversive letters and of magic practices. The religious situation at that time made such accusations plausible, and Boëthius' position is not completely clear in spite of his self-defense in *De Consolatione Philosophiae*. Imprisoned, probably in Pavia (*in agro Calventiano*), in 522 and perhaps tortured, he was put to death in 524. Two centuries later he was reburied in the church of S. Pietro in Ciel d'Oro in Pavia; and his remains seem to have remained there ever since, except for an interruption between 1799 and 1923 (when they were in the cathedral). Boëthius was held as a martyr and a saint; a local cult of him was approved by the ecclesiastical authorities. His contemporaries regarded him as a man of profound learning: the grammarian Priscian speaks of him as having attained the summit of honesty and of all sciences; Cassiodorus, who succeeded Boëthius as *magister officiorum*, employs language equally strong; and Ennodius, the bishop of Pavia, knows no bounds for his admiration. During the middle ages, the influence of Boëthius was very powerful, because he had preserved much of the culture of later antiquity.

Writings.—Boëthius' writings can be grouped under four headings: (1) theological treatises; (2) works on the four "arts" of the *quadrivium*, arithmetic, geometry, music and astronomy; (3) logi-

cal works; and (4) the philosophical and poetical *De Consolatione Philosophiae*.

Five theological treatises have survived: the first, *De Trinitate;* the second, *Utrum Pater et Filius et Spiritus Sanctus de divinitate substantialiter praedicentur;* the third, *Quomodo substantiae, in eo quod sint, bonae sint, cum non sint substantialia bona;* the fourth, *De Fide catholica,* which would seem to be authentic, though doubts have been expressed about it; and the fifth, *Contra Eutychen et Nestorium.* (A work entitled *Hebdomades* has not been preserved.) The *De Trinitate* and *Contra Eutychen et Nestorium* are the two most important of these five and seem to be connected with the "Scythian" controversy of 519–521 (a sequel to the termination of the Acacian schism; *see* PAPACY). In the *De Trinitate* Boëthius tries to explain philosophically the apparent absurdity of the unity-and-trinity of God on the basis of the Aristotelian categories: God is substantially—or rather, supersubstantially—one, while the three Persons are internal relations (these conclusions are confirmed in the second treatise listed above). In the *Contra Eutychen* two opposite doctrines, according to which either the double nature in Christ implies a duplicity of substance or the unity of substance implies a single nature, are tentatively answered by means of subtle distinctions between the concepts of essence, substance, etc., and of the definition of *persona* as *naturae rationabilis individua substantia.*

Of Boëthius' writings on the four advanced arts of the medieval curriculum, the *De Institutione arithmetica* and *De Institutione musica*, both of them adaptations and re-elaborations of Nicomachus of Gerasa's Greek handbooks, have survived entire. The *Geometria,* a translation or elaboration of Euclid's *Elements,* is almost completely lost; and nothing remains of Boëthius' work on astronomy (based, Cassiodorus says, on Ptolemy).

Boëthius' vast production in the field of logic is preserved almost complete: only his translation of Aristotle's *Posterior Analytics* and possibly some commentaries on Aristotelian works seem to have disappeared. This logical corpus includes: translations of Porphyry's *Isagoge* and of Aristotle's *Categories, De Interpretatione, Prior Analytics, Topics* and *Sophistici Elenchi;* two commentaries on Porphyry's work, one on Aristotle's *Categories,* two on the *De Interpretatione* and perhaps parts of a commentary on the *Prior Analytics;* an incomplete commentary on Cicero's *Topica;* an elementary treatise on categorical syllogisms, partly in two recensions (*Prolegomena,* often wrongly called *Introductio ad syllogismos categoricos,* and the actual *Introductio* in two books, wrongly called *De Syllogismo categorico*); a treatise *De Syllogismo hypothetico;* a short treatise on different kinds of classification, *De Divisione;* and the *De Differentiis topicis,* in which Cicero's and Themistius' systems of *"loci dialectici et rhetorici"* are compared with each other. Most of what is included in the commentaries and treatises probably derives from the teachings of the Porphyrian school.

The *De Consolatione Philosophiae,* which Boëthius wrote when he was in prison waiting for the execution of his death sentence, is his best title to fame as a writer and as an independent philosopher. In its five books, poems in various metres—some of them of considerable literary value—alternate with longer sections in prose, often rhetorical and sophisticated, sometimes full of dignity, occasionally moving. Dry philosophical arguments are expounded in florid language. Boëthius exhibits there the Neoplatonism and the Stoicism which he had imbibed in Rome (most probably he never was in Athens—as many believed in the past—or in Alexandria—as was later suggested by P. Courcelle). Since the work deals with philosophy and with what might be termed natural theology, Boëthius ignores the possibility of finding consolation in any Christian belief; but there is nothing in the work to suggest that Boëthius was not a Christian when he was writing it. The first book opens with a few verses, in which Boëthius describes how his sorrows had brought him to a premature old age. As he is thus lamenting, a majestic woman, whom he recognizes as his guardian Philosophy, appears. Resolving to apply the remedy for his grief, she questions him for that purpose. She finds that he believes that God rules the world, but does not know what he himself is; and this absence of self-knowledge is the cause of his weakness. In the second book, Philosophy presents to Boëthius Fortune, who enumerates the blessings that he has enjoyed and then proceeds to discuss the unsatisfactory blessings that are bestowed by her. In the third book, Philosophy promises to lead him to true happiness, which is to be found in God alone: since God is the highest good and the highest good is true happiness, God is true happiness. Nor can real evil exist, for God is all-powerful, and since He does not wish evil, evil must be nonexistent. In the fourth book, Boëthius raises the question why, if the governor of the universe is good, evils exist and why virtue is often punished and vice rewarded. Philosophy proceeds to show that in fact vice is never unpunished, nor virtue unrewarded. From this, Philosophy passes on to a discussion of the nature of providence and fate and shows that every fortune is good. The fifth and last book raises the question of man's free will and God's foreknowledge and, by an exposition of the nature of God, attempts to show that these doctrines are not inconsistent: the conclusion is that God remains a foreknowing spectator of all events and that the ever-present eternity of His vision agrees with the future quality of our actions, dispensing rewards to the good and punishment to the wicked.

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(L. M.-Po.)

BOETHUS (fl. 2nd century B.C.), Greek sculptor of the Hellenistic age, was probably a native of Chalcedon. He was noted for his production of metal objects and for his representation of children, especially for a group of a boy and a goose, of which several marble copies survive.

See M. Bieber, *The Sculpture of the Hellenistic Age,* pp. 81 ff. (1955); G. Lippold, *Handbuch der Archäologie,* III, i, p. 328 (1950).

(C. C. V.)

BOG is soft, spongy, water-logged ground, composed of vegetation, chiefly mosses (during the early history of the bog) in various stages of decomposition. Though the term bog is widely used to mean almost any wet surface covered with vegetation, plant ecologists and geographers use it in a more restricted meaning. A bog is an area which has no external drainage or almost none. Vegetation begins to accumulate and continues to accumulate indefinitely. As it partially decomposes and becomes compressed by the weight of the overlying material, it forms a layer of organic material called peat (*see* FUELS: *Peat*).

In some cases the peat in a bog is almost pure organic material; in other cases it may be mixed with small quantities of mineral matter washed in from the sides of the depression. If there is open water (a pond or small lake) in the depression, the edges will be invaded by a floating mat of vegetation, commonly water lilies and sedges. This floating mat thickens from both the top and the bottom and eventually will become sufficiently solid and thick to support a man. Bushes and branched shrubs gradually invade the area, followed by tamarack. Animal life is usually rather scarce in bogs.

Water movement in a bog is at a minimum, and so, even as the surface rises as a result of accumulations of peat, erosion does not remove the material; consequently organic accumulations in the bottoms of peat bogs can reach considerable thickness.

(W. C. C.)

BOGAZKOY, a Turkish village (pop., 1960, 1,539) about 125 mi. E. of Ankara, near the ruins of ancient Hattushash (Hattusas), capital of the Hittite empire. The remains consist of a large fortified city on a steep slope enclosed by deep ravines and falling northward more than 800 ft. from summit to base. Much of the city wall, its towers, gates and subterranean passages are still visible above ground. Five temples, the largest in the northern and lowest quarter of the city, have been excavated, as well as the acropolis (now Buyuk kale), formerly the residence of the great kings of Hatti. Three royal archives of clay tablets written in cuneiform (in Babylonian, in Hurrian, in Hittite and in some local Anatolian languages) constitute the main source of information on Hittite history and culture. The one was found in 1907 in the above-mentioned large temple, the two others in 1906 and in 1931–33 in the acropolis. A rock face (Nishan Tash) in the higher quarters of the town bears an inscription of the great king Suppiluliumas in nine lines of Hittite hieroglyphs.

Bogazkoy was first inhabited in the later phase of the 3rd millennium B.C.; *i.e.*, in pre-Hittite times. During the 19th century B.C., under the name Khattush, it was a trading centre for Assyrian merchants, who lived side by side with the local inhabitants. Old Assyrian business tablets and storerooms of this period in the northern part of the town were excavated in 1938 and 1953. Shortly after 1800 B.C. Khattush, which was the residence of King Pijushtish, was stormed by Anittas, the Hittite king of Kussara, and laid in ruins. But in the 16th century B.C. the Hittite capital was transferred to Hattushash (the Hittite name of Bogazkoy). The Hittite kings had their residence there for more than three centuries, with the exception of King Muwatallis (1315–1290), who, probably on strategic grounds, preferred Dattassa, a town in southeastern Asia Minor. Hattushash, considerably enlarged and strengthened about 1400 B.C. (at the time when the Hittite empire gained the position of a great power on an equal basis with Egypt and Babylonia), came to an end shortly after 1200 B.C. The so-called "Peoples of the Sea," wandering seafarers of the Aegean, probably in alliance with Anatolian peoples who had formerly been vassals of the Hittites, overthrew the Hittite empire and ruined the capital. Many traces of that event have been found everywhere in the city. Later occupation of the spot in the Phrygian, Hellenistic and Roman periods was unimportant. The former opinion that the Pteria of Herodotus was identical with Bogazkoy was not confirmed by the excavations.

About one mile to the east is a sculptured rock grotto, called Yazilikaya. Between it and the town Hittite burials (and also traces of cremation) were found in 1952, on the site of what was evidently the necropolis of Hattushash. In the grotto are two natural chambers of different sizes adorned with reliefs, 67 in the large gallery, 15 in the small. In front of the rock chambers, excavations in 1938 brought to light architectural constructions, laid out essentially on the same plan as Hittite temples. The reliefs of the rock temple, the most important known specimens of imperial Hittite monumental art (14th and 13th centuries B.C.), show in the big chamber two processions, one of gods and the other of goddesses, arranged according to their rank in the Hittite (or Hurrian ?) pantheon.

The small chamber may have been the mortuary temple of a Hittite king Tudhaliyas. Two reliefs of great kings also are carved in the rock of Yazilikaya. *See* also HITTITES.

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BOGNOR REGIS, a seaside resort and urban district in the Chichester parliamentary division of West Sussex, Eng., 65 mi. S.S.W. of London by road. Pop. (1961) 28,144. Hotham house and Dome house (now a teachers' training college) were built about 1792 by a London merchant who made Bognor fashionable. "Regis" commemorates King George V's convalescence at Craigweil house (now demolished) in 1929. The town, which has long sandy beaches, dates from the 18th century, the mother parish being South Bersted.

BOGOMILS (BOGOMILES), members of a religious sect that flourished in the Balkans between the 10th and 15th centuries. It arose in Bulgaria toward the middle of the 10th century from a fusion between a set of dualistic, neo-Manichaean doctrines imported from the near east, notably from the Paulicians of Armenia and Asia Minor, and a local Slavonic movement whose aim was to reform, in the name of an evangelical Christianity, the recently established Bulgarian Orthodox Church. The Bogomils were so called after their founder, the priest Bogomil, whose name is a Slavonic translation of the Greek Theophilus. Their doctrines and behaviour are described in detail by the Bulgarian priest Cosmas in his "Sermon Against the Heretics," written in Old Church Slavonic, probably soon after 972. Their central teaching, based on a dualistic cosmology, was that the visible, material world was created by the devil. Hence they denied the doctrine of the incarnation and rejected the Christian conception of matter as a vehicle of grace. They rejected baptism and the Eucharist, and spurned the cross, miracles, church buildings, the order of priesthood and the whole organization of the Orthodox Church. The moral teaching of the Bogomils was as consistently dualistic: if the visible world is the creation and the realm of the evil one, all contact with matter and the flesh, which are the devil's best instruments for gaining mastery over men's souls, should be avoided. The Bogomils consequently condemned those functions of man that bring him into close contact with matter, especially marriage, the eating of meat and the drinking of wine. In fact, until the 14th century, the moral austerity of the Bogomils invariably was acknowledged by their fiercest opponents; and they have been called with justification "the greatest puritans of the middle ages." Cosmas describes them as social anarchists and accuses them of spurning manual labour and of preaching civil disobedience.

During the 11th and 12th centuries Bogomilism spread over many European and Asian provinces of the Byzantine empire. The alarming growth of the heresy in Constantinople resulted, about 1100, in the trial and imprisonment of prominent Bogomils in the city and in the public burning of their leader, Basil, vividly described by Anna Comnena. The sect had by then gained many adherents in the aristocratic families of Byzantium. In the *Panoplia dogmatica* of Euthymius Zigabenus, composed about that time, the Bogomils are credited with a complex doctrinal system: a cosmology in which the Judaeo-Christian version of the book of Genesis is interpreted in a dualistic sense, by a sophisticated use of allegory and a strong admixture of unorthodox mythology; a Christology in which the classical docetism (*i.e.*, disbelief in the reality of the incarnation) of the early Bogomils and of the Paulicians is curiously allied with elements of the New Testament and a pseudo-trinitarian theology; a negative attitude to the Old Testament, combined with a readiness to use parts of it for exegetical purposes; and use of the allegorical method in interpreting scriptural texts in accordance with Bogomil doctrine.

In the second half of the 12th century Bogomilism spread westward. The Serbian ruler Stephen Nemanya (*c.* 1167–96) was obliged to summon a general assembly of his land to check this peril. More important still was its extension to Bosnia, where Bogomilism, modified and known as the Patarene or Bosnian faith, was embraced by the rulers and the nobility and developed, between the late 12th and the 15th centuries, into a national movement. About 1150 the influence of Bogomilism on the dualistic sects of Italy and France became clearly apparent. The Cathar or Albigensian movement was, in all probability, not simply an offshoot of Bogomilism but rather a revival of earlier heterodox trends in western Europe, to which Bogomilism gave a more coherent and

systematic form (*see* CATHARI). However, from the middle of the 12th century Bogomilism certainly exerted a direct and paramount influence upon the doctrines and the ritual of the Cathars, and by the early 13th century the dualistic communities of southern Europe formed a single network, stretching from the Black sea to the Atlantic.

In the country of its birth Bogomilism remained a powerful force until the late 14th century. The Bulgarian authorities convened several church councils, notably the Council of Trnovo (Turnovo) (1211), to condemn its teachings. But after the Ottoman conquest of southeastern Europe obscurity descended upon the sect. Many Bogomils, especially in Bosnia, were converted to Islam. A vague dualistic tradition that has left traces in the folklore of the Southern Slavs, and some curiously carved funeral monuments scattered in the mountains and forests of Bosnia and Hercegovina, are all that remain today of the most powerful sectarian movement in the history of the Balkans.

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BOGOR, a foothill city in western Java, Indon., formerly named Buitenzorg ("without care") by the Dutch, and capital of a regency and residency of the same name. Pop. (1956 est.) 115,585. It lies about 30 mi. S. of Jakarta and 870 ft. above sea level. The climate is healthful with an annual average mean temperature of 77.7° F. The site for the city was chosen in 1745 by Governor General van Imhoff as a residence instead of Jakarta (then Batavia). Its famous botanical gardens were laid out in 1817 by C. G. E. Reinwardt, a former professor of botany at Amsterdam, and have become one of the world's outstanding centres of research, with an extensive scientific library, laboratory and zoological museum. Other scientific institutions at Bogor include the General Agricultural Experimental station, the Forestry Research institute, a laboratory for chemical research and an institute for rubber research. The former residence of the Netherlands Indies' governor general, built in 1856, is now the presidential summer residence and houses part of the president's art collection. Bogor is a residential town, many of its inhabitants working in Jakarta, to which it is connected by road and electric train service.

The residency of Bogor (4,483 sq.mi.) consists of the regencies of Bogor (1,437 sq.mi.), Sukabumi and Tjiandjur. Most of the residency is mountainous, with many volcanoes and fertile plateaus. The chief crops are rice, tea, cinchona (quinine), rubber and coffee.

BOGORAZ, VLADIMIR GERMANOVICH (1865–1936), Russian anthropologist, whose study of the Chukchi ranks among the great works of ethnography, was born in Ovruch, Volhynia, on April 27, 1865, and began his career at the University of St. Petersburg. He joined the revolutionary party, Narodnaya Volya (People's Will), and was arrested in 1886, imprisoned and then exiled to Siberia. While in exile in the Yakutia region he worked with Vladimir Jochelson on the ethnography and linguistics of the area. From his place of exile he also published poems and stories under the name of N. A. Tan.

From 1895 to 1897 he was a member of the Sibiriakov expedition under the Russian geographical society to northeast Siberia. In 1900–01, when Franz Boas organized the Jesup North Pacific expedition under the program of the American Museum of Natural History, New York, Bogoraz was charged with responsibility for the Anadyr (northeast Siberian) section. At this time he gathered materials on the ethnography of the Chukchi. On his return to St. Petersburg in 1901 he was under police surveillance, and moved to New York, where he produced one of his greatest works, *The Chukchee*. He returned to Russia in 1904 where he helped organize the first peasant congress and the Labour group in the state duma.

In 1918 he was appointed professor of Leningrad university and curator of the Museum of Anthropology and Ethnography. The following year he organized the ethnographic faculty of the university with L. Y. Sternberg. During the 1920s and early 1930s he directed the work of the Arctic Institute of the Institute of the Peoples of the North in Leningrad. He published grammars, a dictionary, textbooks for Chukchi children, collections of folklore, ethnographic studies, historical sketches and a novel about the Chukchi. He also wrote on the folklore of the neighbouring Koryak. Finally, he produced a number of general studies of Siberian ethnography, folklore, and history, remaining outside the Communist party of the Soviet Union.

Bogoraz was a man of wide interests and creative activity in many spheres, both scholarly and political. He died in Leningrad on May 12, 1936. (L. K.)

BOGOTÁ (SANTA FE DE BOGOTÁ), the capital of the Republic of Colombia and of the interior department of Cundinamarca. Pop. (1961 est.) 1,256,640. The city is on the eastern margin of a large elevated plateau 8,563 ft. above sea level. Several streams, one of which, the San Francisco, passes through the city, unite near the southwestern extremity of the plateau and form the Río Funza, or Bogotá, which finally plunges over the edge at Tequendama, 20 mi. from Bogotá, in a perpendicular fall of about 475 ft. The city is built upon a sloping plain at the base of two mountains, Guadalupe and Monserrate, upon whose crests stand two imposing churches. From a broad avenue on the upper side, downward to the west, slope the streets, through which run streams of cool, fresh water from the mountains above. The north and south streets cross these at right angles, and the blocks thus formed are like great terraces. A number of well laid out plazas, or squares, ornamented with gardens and statuary, have been preserved; on these face the principal public buildings and churches.

Bogotá is the political, financial and social centre of the republic and has some industrial and considerable commercial activity. Railway lines connect the city with the major settlements of the plateau and the upper Magdalena river, and it is located on the Colombian portion of the Simón Bolívar highway which runs from Cúcuta to the Ecuador border. Disadvantages resulting from Bogotá's isolated land position were alleviated to some extent by the development of air transport. Good air service is available to all the major cities of the republic and to international points.

Bogotá is an archiepiscopal see, founded in 1561, and is one of the strongholds of medieval clericalism in South America. It has a cathedral and about 30 other churches, some dating from the 16th century. It also has many old conventual buildings now used for secular purposes, their religious communities having been dissolved by Tomás Cipriano de Mosquera and their revenues devoted in great measure to education. The capitol, occupied by the executive and legislative departments, is an elegant and spacious building, erected after 1875.

Bogotá has always taken an interest in education, and has been called the "Athens of South America." Its institutions of learning include a university, several colleges and schools, a public library, a national observatory, a natural history museum and a botanic garden. The plain surrounding the city is fertile and intensively cultivated; it pastures cattle and produces cereals, vegetables and fruit in abundance. It was the centre of Chibcha civilization before the Spanish conquest and sustained a large population. The Banco de la República has an outstanding collection of pre-Colombian gold objects.

Bogotá was founded in 1538 by Gonzalo Jiménez de Quesada and was named Santa Fe de Bogotá after his birthplace, Santa Fe, near Granada, Spain. To this was added the name of the locality used by the Chibchas, Bacatá, which in time was written Bogotá. It was made the capital of the viceroyalty of Nueva Granada and soon became one of the centres of Spanish colonial power and civilization on the South American continent. In 1811 its citizens revolted against Spanish rule and set up a government of their own. In 1814 Bolívar captured the city and the capital was transferred to Bogotá. Bolívar departed early in 1815, and the following year the city was occupied by the Spanish general Pablo Morillo (1777–1838), who subjected it to a ruthless military gov-

ernment until 1819, when Bolívar's victory at Boyacá compelled its evacuation. On the creation of the republic of Colombia, Bogotá became its capital, and when that republic was dissolved into its three constituent parts Bogotá remained the capital of Nueva Granada (which became officially Colombia in 1861).

(A. J. L.; J. W. Mw.; X.)

BOGRA (Bagura), a town in the Rajshahi division of East Pakistan, the headquarters of Bogra district, is 57 mi. N.E. of Rajshahi, on the west bank of the Karatoya river, a tributary of the Jamuna. Pop. (1961) 33,799. Good communications make it the commercial centre for the southern part of the Barind tract between the Ganges and the Jamuna: it is at a major road junction and is on the metre-gauge railway from Santahar to Kurigram. It has a match factory and oil mills, and there is a nursery for sericultural development. It is the seat of Azizul Haq college, affiliated to Rajshahi university.

Bogra District is a level plain, crossed by many streams, lying west of the Jamuna. Area 1,502 sq.mi. The eastern part, between the Karatoya and the Jamuna, is low-lying and abounds in *khals* or water gullies and *jhils* or marshy meres; the west is higher and above the flood level. Almost all the population (1,574,105 in 1961) depends on agriculture, rice being the staple crop.

Seven miles northwest of Bogra lie the extensive mounds known as Mahasthan, which are identified by inscriptions going back to Mauryan times with the city of the Pundra kingdom, Pundranagara or Pundravardhana. Antiquities found there indicate that the city flourished throughout the subsequent centuries, while excavations revealed also rich remains of the Gupta and Pala periods, including many molded terra-cotta plaques. (K. S. Ad.)

BOHEMIA (Czech Cechy, German Böhmen), a historic country of central Europe, bounded on the south by Austria, on the west by Bavaria, on the north by Saxony and Lusatia, and on the east by Silesia and Moravia. For centuries a kingdom, it was from 1918 to 1939 and from 1945 to 1949 the westernmost province of Czechoslovakia. On Jan. 1, 1949, however, the provincial organization was dissolved, and Bohemia lost its political identity, being divided among a number of new districts of the Czechoslovak state.

HISTORY

The Latin name of the country is derived from that of a Celtic tribe, the Boii (*q.v.*), who were supplanted by the Germanic Marcomanni in 8 B.C. It is probable that Slav peoples entered the country by the 1st century A.D., but the stages of Slav immigration cannot be reliably established. The most powerful of the Slav tribes were the Cechove (Czechs) who gradually subjugated other peoples in the area. After their settlement in Bohemia the Cechove were in turn conquered by the Avars, but they succeeded in overthrowing their oppressors in the early years of the 7th century.

Early History to 1526

The Premyslid Dynasty.—According to early tradition the founder of the first Czech ruling house was Premysl, a plowman, married to Princess Libuse (Libusa). The scanty records concerning Bohemia date from the 9th century, when several attempts made by German-speaking missionaries to introduce Christianity into Bohemia met with little success. The Slav tribes east of Bohemia were organized early in the 9th century into a powerful political unit known as Great Moravia (*see* Moravia). Invited in 863 by its prince, Rostislav, Cyril (Constantine) and Methodius, Greek monks from Salonika, came to preach the gospel there. Using the Slav language in religious instruction and in divine service, they secured a notable success, despite political maneuvers against them supported by the German ecclesiastics, advocates of the Latin rite, who claimed jurisdiction over the territory. From Moravia, Christianity spread rapidly to Bohemia and to other Slav countries. Some legends ascribe the conversion of the Bohemian prince Borivoj and his consort Ludmila to Archbishop Methodius. Some of Methodius' disciples moved to Bohemia and helped to establish the Slav liturgy in that country.

During the 10th century Bohemia was consolidated politically. After the collapse of Great Moravia *c.* 907, the western portion of that empire was attached to Bohemia and continued to exist as a province. The eastern half, inhabited by Slovak tribes, was annexed by Hungary. The rulers of Bohemia successfully defended their lands against their Germanic neighbours west and southwest. In the latter part of the 10th century Bohemia extended its frontiers into Silesia and the lowlands farther east. Of the Bohemian rulers at this period the best known was Borivoj's grandson Vaclav (St. Wenceslas). By his zeal in spreading Christianity he antagonized adherents of heathen concepts. In 929 Vaclav was murdered by his brother Boleslav I (929–967). After his death Vaclav was venerated as the patron saint of Bohemia. Under Boleslav II (967–999) the church in Bohemia was organized and a bishopric was founded in Prague (*c.* 973). At that time the Latin was replacing the Slav liturgy which by the 11th century had been completely supplanted. The second bishop of Prague, Voytech (Adalbert), tried to improve the standards of church life but found little understanding among his countrymen for his lofty ideals. Disillusioned, he left his diocese to inaugurate missionary activity among the heathen Prussians on the shores of the Baltic and suffered a martyr's death in 997.

The death of Boleslav II was followed by a period of fratricidal warfare between his sons which was terminated in 1012 when the youngest, Oldrich, established himself. By the death of Oldrich in 1037 much of the dynasty's territory had been lost to powerful neighbours, but with the accession of his son Bretislav I (1037–55) the tide turned again in favour of the Premyslid house. The boundaries of Bohemia became stabilized and the process of internal regeneration was accelerated.

For about a century and a half, although the Premyslid family had no serious rivals within the country, feuds among its members hindered political development, the chief source of trouble being the absence of any strict law of succession. Whereas at some periods the principle of seniority was observed, the oldest member of the dynasty succeeding to the throne, at other times claims were made on the basis of a right of primogeniture. Dynastic rivalries not only caused domestic distress but also invited foreign intervention.

In the early period of its history Bohemia became dependent on the East Frankish kingdom. Later the German kings as emperors (*see* Holy Roman Empire) were able to exact tribute from the Bohemian princes, and the struggles over the succession served the emperors as justification for military intervention as well as for attempts to strengthen the ties linking Bohemia with the empire. Some princes co-operated with the emperors in military expeditions and were ultimately compensated for their services. Prince Vratislav II (1061–92) obtained from the emperor Henry IV the title of king of Bohemia (1085) as a personal privilege. Early in the 12th century the princes of Bohemia gained the dignity of a cupbearer to the emperor, one of the highest court offices. For personal participation in a campaign in northern Italy, Prince Vladislav II (1140–73) was awarded the royal crown by the emperor Frederick I Barbarossa (1158). Vladislav's gains were mostly dissipated by his successors under whom the Premyslid state was considerably weakened and temporarily divided. In 1182 Barbarossa, taking advantage of a disputed succession, was able to separate Moravia from Bohemia, but the division had no real or lasting significance.

In 1197 Premysl Otakar (Ottokar) I became undisputed overlord throughout the Premyslid domains, and in 1198 he was able to secure the royal title for his descendants as well as for himself. The imperial charter of 1212 granted by the emperor Frederick II and known as the golden bull of Sicily finally established the relationship between Bohemia and the empire and gained for the Bohemian king the right of investiture of bishops. Premysl Otakar I led his kingdom from depression to political prominence and economic prosperity. Under King Vaclav I (1230–53), colonists from abroad, mostly German-speaking, were invited to settle in royal boroughs and in the border areas. His son Premysl Otakar II (1253–78) was one of the greatest rulers of Bohemia. Through marriage he obtained possession of the Austrian lands, and in 1260 the nobility of Styria also recognized him as their

ruler. Both personal bravery and financial resources facilitated his penetration into other Alpine provinces. Before his opponents made a common front to check his advance Premysl exercised influence in Carinthia as well as in some territories along the Adriatic coast. The extension of his dominions involved Premysl in repeated wars with Hungary. In the battle of Kressenbrunn (Austria) in 1260, Premysl Otakar II decisively defeated Béla IV of Hungary. Another enemy, who appeared on the scene in 1273, proved more dangerous than the Hungarians. In that year Rudolf, count of Habsburg, was elected king of the Romans, and soon after claimed the Austrian lands as vacant fiefs of the empire. A war ended in Premysl's defeat (1276). He was obliged to surrender to Rudolf all territorial acquisitions, retaining only the inherited provinces of Bohemia and Moravia. Humiliated by harsh peace terms, he prepared for a new campaign. In 1278 he invaded Austria and attacked Rudolf's army, allied with the Hungarians, at Dürnkrut on the Marchfeld, but lost both the battle and his life (Aug. 26, 1278).

The years of trouble closed with the coronation of Premysl's son Vaclav (Wenceslas) II. Under him Bohemia quickly recovered from the catastrophe and again played an active part in international affairs. Diplomatic dexterity and enormous wealth, derived chiefly from silver mines, opened to Vaclav II the way to Poland. After a few initial successes in Little Poland he obtained the Polish crown (1300). In 1301 he was seriously considered as a candidate for the vacant throne in Hungary. After his premature death in 1305, his only son Vaclav (Wenceslas) III inherited Bohemia, but he was assassinated on his way to Poland. Thus in 1306 ended the long rule of the Premyslid dynasty.

The Luxembourg Dynasty.—The Bohemian throne was contested by several candidates and finally, in 1310, the crown was offered to John of Luxembourg, son of Henry VII, king of the Romans. John was married to Eliska (Elizabeth), the second daughter of Vaclav II, and became the founder of the Bohemian branch of the Luxembourg house. His successors ruled in Bohemia for more than a century.

Soon after his succession John's German advisers were a cause of discontent to the Bohemian nobles and in 1318 they were finally dismissed. After this date John devoted little time to domestic affairs, the government of the country being virtually controlled by the Bohemian noble Henry of Lipa. The king was imbued with the spirit of chivalry and spent most of his life abroad, participating in numerous campaigns. John fell at Crécy (1346) fighting for the French. Under John and his successors new territories were acquired, mostly by peaceful means, and incorporated into the kingdom, which was made up of five provinces—Bohemia, Moravia, Silesia, Upper Lusatia and Lower Lusatia—and held a prominent position among central European countries.

To John's son and successor, Charles (*see* CHARLES IV), Bohemia owed more than to any of its earlier rulers. With John, Charles, who had been appointed administrator of the country in 1341, paved the way for the elevation of the bishops of Prague to the rank of archbishops (1344). Before succeeding to the Bohemian throne as Charles I (1346) he was elected king of the Romans as Charles IV, and in 1355 he was crowned emperor in Rome. He confirmed or revised the earlier documents regulating the relations between Bohemia and the empire, and issued charters stabilizing the position of the incorporated provinces under the Bohemian crown. He kept Bohemia at peace and contributed largely to the welfare of its inhabitants. By circumspect policy Charles re-established the balance between the royal authority and the aspirations of the landowning nobility. His efforts to codify the customary laws and to stabilize the legal system were opposed by the nobility, but he retreated without jeopardizing his prestige. Charles resided in Prague, and under him the city was enlarged by the foundation of a new district (*nove mesto*). Architects, sculptors and painters from other countries were employed by the king, the church and the wealthy noblemen. This gave rise to the flourishing of the late Gothic style in Bohemia and its sister provinces. In 1348 Charles founded at Prague a university which became a centre of intellectual activity. Charles died in 1378.

Under Charles's son Vaclav IV, crowned king of Bohemia already in 1363 and German king as Wenceslas (*q.v.*) from 1378, Bohemia lost much of its power. Internally it suffered from conflicts between the ruler and the lords. There were also struggles between the king and the hierarchy, represented by John of Jenstejn, archbishop of Prague. The movement for church reform that originated under Charles IV acquired under Vaclav IV such force that it dominated the history of Bohemia for several decades. An overwhelming majority of the Czechs espoused the reform program formulated by John Huss (*q.v.*; Czech, Jan Hus), and attempts to settle the conflict between the reform party and the hierarchy made no headway. In 1414 Huss accepted the invitation of Vaclav's brother, Sigismund, king of the Romans, to attend the Council of Constance (*q.v.*). He proceeded there with a letter of safe conduct guaranteeing his return issued by Sigismund, but was imprisoned, declared a heretic and burned on July 6, 1415. The inevitable and immediate result was the outbreak of civil war in Bohemia. Until 1436, when peace was made, Bohemian history is essentially the record of the Hussite wars (*see* HUSSITES).

BY COURTESY OF CZECHOSLOVAK NEWS AGENCY

KARLSTEIN CASTLE NEAR PRAGUE, ERECTED BY MATTHIAS OF ARRAS FOR CHARLES IV OF BOHEMIA. BUILT IN 1348–67, THE CASTLE WAS FULLY RESTORED IN 1888–97

George of Podebrady.—In 1436 Sigismund, who had inherited a claim to Bohemia on his brother Vaclav's death in 1419, proceeded to Prague and was accepted as king. He died in the following year (1437) and was succeeded by his son-in-law, Albert of Austria, whom the estates chose as their king. Albert died after he had reigned over Bohemia less than two years. Though it was known that Albert's widow, Elizabeth, would shortly give birth to a child, the question as to the succession to the throne again arose; for it was not until 1627 that the question whether the Bohemian crown was elective or hereditary was to be finally decided. The nobles formed two parties opposed to each other both in political and in religious matters. The Hussite lords from various parts of the country were organized, under Ptacek of Pirkstejn, to promote national interests. As a fairly large number of moderate Catholics joined them, they could be described as a national party. Many knights and the royal boroughs, both predominantly Hussite, also ranged themselves with this party. The other party represented conservative elements, mostly Catholics, although some moderate Utraquists (partisans of communion in both kinds) joined it. Oldrich of Rozmberk (Rosenberg) was the most powerful of the Catholic lords, but the actual leader of the conservative and pro-Habsburg nobles was Menhart of Hradec.

In 1440 the two parties came to an agreement known as the Letter of Peace, in which they pledged themselves to respect the

compacts of Prague (1433; *see* HUSSITES) and to work for the confirmation of John of Rokycany as archbishop of Prague, elected in 1435 but not recognized by the pope. In Feb. 1440, Queen Elizabeth gave birth to a son, known in Bohemia as Ladislav (Laszlo V of Hungary, also called Ladislas Posthumus). After protracted negotiations the estates of Bohemia recognized the rights of this infant in principle (1443), putting off a definite agreement on the terms of his admission to the throne of Bohemia. Ladislav remained in Austria under the guardianship of his uncle, the German king Frederick III, and Bohemia continued to be the scene of conflicts between the rival parties of the nobility.

After Ptacek's premature death in Aug. 1444 one of his followers, George of Podebrady (*q.v.*), assumed the leadership of the national party. For almost four years the course of public life in Bohemia was strongly influenced by the contest between Menhart of Hradec and the youthful Hussite leader.

The national party, representing a distinct majority of the population, made several agreements with its opponents to replace the outdated Letter of Peace of 1440. These efforts were hindered by Oldrich of Rozmberk who was in fact not interested in the establishment of a provisional government, fearing that George of Podebrady would play the leading role in it. Of the many provincial diets held at this period the most memorable was the general meeting of the estates of Bohemia, held in Prague during 1446. Delegates from the incorporated provinces of the kingdom (Moravia, Silesia and the Lusatias) joined with the estates of Bohemia. A committee representing three estates (lords, knights and the royal boroughs) prepared resolutions relating to political and religious conditions in the kingdom. Envoys were elected to ask Frederick III's permission for Ladislav to journey to Bohemia in order that he might be brought up among the Czechs. An attempt to elect a regent was frustrated by Rozmberk's intrigues. An attempt to obtain the pope's recognition of John of Rokycany was equally unsuccessful. Although members of the Catholic party agreed that a mission should be sent to Rome, they did not abide by the vote and used their influence to dissuade the papal court from granting concessions to their Utraquist opponents.

The meagre results of congresses and provincial assemblies convinced George of Podebrady that he would only be able to unify and pacify the country by defeating Menhart's party. He spent more than a year in consolidating the national party and, masking his preparations, assembled a considerable army in the second largest city of Bohemia, Kutna Hora (Kuttenberg). Then, instead of marching against unruly elements in the remoter parts of the kingdom, he attacked Prague, Menhart's chief stronghold, and surprised it early in Sept. 1448.

This military victory, which was soon followed by the death of Menhart, confirmed George's power and prestige. With his large following he was able to keep in check Rozmberk's partisans, who were to persist in opposition until Rozmberk's death in 1462. Although Rozmberk's faction tried to prevent an agreement between George and Ladislav's guardian, Frederick III, the latter was so impressed by George's power and political dexterity that he preferred to negotiate with him rather than with Rozmberk. In 1451 Frederick, as emperor, appointed George governor of Bohemia. Two years later Frederick III released Ladislav from his custody.

After his coronation on Oct. 28, 1453, Ladislav ruled in Bohemia with George's advice and effective help. As Ladislav could claim to be the rightful king and was known as a fervent Catholic, he was quickly recognized in the incorporated provinces and tightened their links with Bohemia. His reign, however, was cut short by his sudden death on Nov. 23, 1457. George was accused of having poisoned the adolescent king, but research has proved this accusation to be entirely unfounded. The throne was again vacant. Several foreign candidates, including Ladislav's brothers-in-law, William, duke of Saxony, and Casimir IV of Poland, presented themselves as candidates. The estates of Bohemia reaffirmed the elective character of the crown of Bohemia and on March 2, 1458, elected George of Podebrady king. As not only the Utraquists but also the Catholics voted for him, the election represented a considerable achievement.

In the early part of his reign King George was allied with Matthias I Corvinus (Mátyás Hunyadi), king of Hungary. Matthias sent to Bohemia two Hungarian bishops who crowned George king according to the rites prescribed by Charles IV. Thereafter, George's principal concern was to have his title recognized by the estates of the incorporated provinces. On the whole he succeeded, except with the Catholic and predominantly German city of Breslau (Wroclaw), capital of Silesia, though a provisional agreement with the municipality was reached late in 1459 with the help of papal envoys. In his home and foreign policy George was loyally supported by the Utraquists, especially the lesser nobility and the royal boroughs. For their benefit he attempted in 1462 to get the compacts of Prague solemnly sanctioned by Pope Pius II. When his petition was rejected, George assembled the estates at Prague in Aug. 1462 and declared his devotion to the Utraquist principle of communion in both kinds and his readiness to risk his life and crown in the defense of his faith.

In the ensuing conflict with the papacy George's following was considerably reduced. The city of Breslau repudiated the interim agreement and placed itself under papal protection. In 1465 a group of Catholic noblemen, headed by Zdenek of Sternberk, formed a hostile league at Zelena Hora (Grünberg) and entered into negotiations with Breslau and other Catholic centres. In the following year Pope Paul II granted his moral support to the confederates by excommunicating George and by releasing all Roman Catholic Bohemians from their oath of allegiance to him. It was also through papal influence that, in 1468, Matthias of Hungary deserted his former ally and gave his support to the league of Zelena Hora. Desultory warfare broke out between the two parties, in which George was at first successful; but fortune changed when the king of Hungary invaded Moravia and obtained possession of Brno, the capital. At a meeting of the Catholic nobles of Bohemia and Moravia at Olomouc (Olmütz) in Moravia, Matthias was proclaimed king of Bohemia (May 3, 1469). In 1470 George obtained some successes over his rival, but he died on March 22, 1471. George of Podebrady, the only Hussite king of Bohemia, and Charles IV were the rulers of Bohemia who most endeared themselves to their countrymen.

Vladislav II.—After protracted negotiations Prince Wladyslaw, son of Casimir IV of Poland, was elected king of Bohemia as Vladislav II at Kutna Hora, on May 27, 1471. This election was a victory for the national party, and may be considered as evidence of the strong anticlerical feeling in Bohemia. Matthias was an unconditional adherent of Rome, while the Polish envoys who represented Vladislav promised that he would maintain the compacts. The new king was involved in a struggle with Matthias of Hungary until 1478, when a treaty concluded at Olomouc secured Bohemia for Vladislav, Matthias retaining Moravia, Silesia and Lusatia during his lifetime, although they were to be restored to Bohemia after his death.

The reign of Vladislav was marked by a decrease of the royal prerogative, while the nobility attained an unprecedented power at the expense not only of the royal authority but also of the rights of the townsmen and peasants. Decrees of 1487 and 1497 practically established serfdom in Bohemia, where it had hitherto been almost unknown. It is impossible to exaggerate the importance of these measures for the future of Bohemia. The rulers of the country were thenceforth unable to rely on that numerous sturdy and independent peasantry of which earlier Bohemian armies mainly consisted. Various enactments also curtailed the rights of the Bohemian townsmen. It was tacitly assumed that the townsmen had no inherent rights, but only such privileges as might be granted them by their sovereign with the consent of the lords and knights. Civil discord was the inevitable consequence. Several meetings of the diet took place at which the towns were not represented. The latter in 1513 formed a confederacy to defend their rights, and chose Prince Bartholomew of Münsterberg—a grandson of King George—as their leader.

The Diet of St. Wenceslas.—Vladislav was elected king of Hungary (as Ulaszlo II) in 1490, and many of the events of his later life belong to the history of Hungary, where he died in 1516. His successor was his son Louis, who had already been crowned as king of Bohemia at the age of three. According to the instructions

of Vladislav, Sigismund, king of Poland, and the emperor Maximilian I were to act as guardians of the young king. The Bohemian estates recognized this decision, but they refused to allow the guardians any right of interference in the affairs of Bohemia. The great Bohemian nobles, and in particular the supreme burgrave, Zdenek Leo, lord of Rozmital, ruled the country almost without control. The beginning of the nominal reign of King Louis was marked by an event which had great importance for the constitutional development of Bohemia. At a meeting of the estates in 1517 known as the diet of St. Wenceslas they settled the questions that had been the causes of discord. The townsmen renounced certain privileges which they had hitherto claimed, while the two other estates recognized their municipal autonomy and tacitly sanctioned their presence at the meetings of the diet, to which they had already been informally readmitted in 1508. At the first sitting of this diet, on Oct. 24, it was declared that the three estates agreed thenceforth "to live together in friendly intercourse, as became men belonging to the same country and race." In 1522 Louis arrived in Bohemia from Hungary, of which country he had also been elected king. He soon became involved in bitter conflicts with magnates competing for high offices in the kingdom. About the same time religious controversies flared up, echoing Martin Luther's activities. Some clerics in hitherto entirely Catholic German-speaking areas joined the Reformation, and some of Luther's ideas were also received sympathetically by resolute Utraquists. In 1525 King Louis returned to Hungary and opened his campaign against the Turks. He requested aid from his Bohemian subjects but only one faction of the nobility, headed by the lords of Rozmberk, granted the required subsidies, while their rivals, led by Leo of Rozmital, purposely delayed sending any forces to Hungary. There were, therefore, but few Bohemian troops at the battle of Mohács (Aug. 29, 1526), at which Louis was decisively defeated and shortly after was drowned while retreating.

Habsburg Rule, 1526–1918

Ferdinand I.—The crown left vacant by the death of King Louis was claimed by the archduke Ferdinand of Austria, by virtue of the hereditary rights invested in his wife Anna, Louis's sister, by the succession pacts concluded by Ferdinand's grandfather Maximilian. The Bohemian estates, however, denied these rights and claimed the exercise of their prerogative to fill the vacant throne by election. Ferdinand acquiesced, then outmaneuvered and defeated his most dangerous rivals, the dukes of Bavaria, and was unanimously elected on Oct. 23, 1526. The incorporated provinces (Moravia, Silesia and the Lusatias) of the Bohemian crown, however, which the Bohemian magnates had neglected to convoke for the electoral diet, revenged themselves by recognizing Anna and Ferdinand as their sovereigns by hereditary right. This national division enabled Ferdinand to refuse to sign the severest clauses of the electoral capitulation presented to him by the diet. In 1541, a fire having destroyed the state archives, Ferdinand, with the forced consent of the diet, substituted an act recognizing his wife's hereditary right instead of the act registering his election, and in 1547 he exacted from the diet a fresh confirmation of this recognition.

KINGDOM OF BOHEMIA FROM THE 14TH TO THE 17TH CENTURY

In consolidating and strengthening his position in Bohemia, Ferdinand first set about restoring the power of the monarch. The country had suffered so severely from anarchical conditions that it was in general grateful to a prince who could restore public order and security. Even the establishment of central authorities to direct the affairs common to all the sovereign's dominions (foreign relations, military organization, finance) encountered little opposition, as the measures decided by these authorities were executed in Bohemia only by the constitutional national authorities. Where the king and the nation clashed was on the religious question, and the defeat of the nation resulted from its divisions.

Conditions in those parts of the kingdom of Bohemia which had been solidly Catholic had been changing rapidly since the appearance of Martin Luther. Among the German-speaking inhabitants of Silesia and of the Lusatias Lutheranism made rapid progress, and even the Hussite Church with its Czech membership was split under the impact of Luther's activities. The majority, usually designated as Neo-Utraquists, favoured close co-operation with the Reformed churches outside Bohemia, but the conservative minority clung to the hope of reunion with the Roman Catholic Church on the basis of the compacts. The Unity of the Czech Brethren constituted yet another religious body: founded about 1457, it had broken away in 1467 from both the Catholics and the Utraquists and had established its own clergy. The Unity was originally a tiny group, but it attracted new members, including some noble families, by its discipline and striving for the pure Christian life. Also must be mentioned radical groups like the Anabaptists, which had found refuge in Moravia after 1526 and were sheltered by wealthy lords. Ferdinand was fully occupied by the wars against the Turks and by urgent affairs in his other dominions and for 20 years he exercised little influence on religious developments in Bohemia but as a firm Catholic he was bound, when the time came, to favour his coreligionists. In 1546 Bohemia was drawn into the great duel between the house of Austria and German Protestantism.

The Bohemian estates long wavered between resistance and obedience to the king, who summoned them to assist the cause of his house; finally (1547) the diet met unconvoked by the king, despite his express prohibition (which made its action revolutionary), drew up a list of demands which would have given it supreme power and reduced the king to a figurehead, and nominated a provisional directory. The defeat of the German Protestants at Mühlberg suddenly reversed the situation; it was now Ferdinand who dictated. His rigour was directed chiefly against the towns, which he had long considered the chief hotbeds of rebellion and heresy, particularly Prague. Their administrative autonomy was replaced by the authority of royal judges and, in Prague, of royal captains also, and their judiciary autonomy by a new royal court of appeal; and under pretext of revising old privileges, they were deprived of most of their domains, which passed to the king (who, however, later restored many of them). These measures impoverished the burgesses and rendered them politically impotent; thereafter, administratively and in the diet, the towns were puppets of the king. The nobles and knights most compromised also had their estates confiscated or reduced to fiefs. There were few death sentences; only two nobles and two burgesses were executed on the eve of the opening of the "bloody diet" (Aug. 22, 1547) which recorded Ferdinand's measures and again recognized that the crown was hereditary. The lords and knights had viewed without displeasure the humiliation of their old rivals, the towns, but this naturally increased their own dependence on the king. The latter was able partially and temporarily to repair his disorganized finances, out of the yield of the confiscated estates. Believing that he would easily master heresy in the Czech countries, Ferdinand proceeded with much rigour against the Czech Brethren whom he regarded as the ringleaders (together with the towns) in the revolt. Persecution, however, only enhanced the Brethren's courage and determination, and the diet of Moravia, where tolerance was general, opposed the king's demands. While Lutheranism increasingly

penetrated the Utraquist Church, Ferdinand thought to recover heretics by persuading the pope to concede communion in both kinds to lay persons (1564). He also introduced the Jesuits into Bohemia (1561), and their work prepared the generation which after the battle of the White Mountain realized Ferdinand's plans much more fully and boldly than he himself had conceived.

Maximilian II.—To ensure respect for the hereditary principle, Ferdinand had made the estates recognize his eldest son, Maximilian, in 1549. This custom of recognition of the heir presumptive during the king's lifetime was again followed in the cases of Maximilian's own three successors, his sons Rudolf and Matthias and the latter's nephew Ferdinand. As a young man, Maximilian had appeared favourably inclined toward the Protestants; but after his election as emperor (1564) he adopted his father's policy in a milder form. He readily accorded the diet the abrogation of the compacts, which, originally a guarantee of religious liberty, had become under Ferdinand an obstacle to the free development of Protestantism in its various forms, including the Unity; but he refused to authorize the Neo-Utraquists to adopt the Augsburg Confession. In 1575 the Lutheran and Calvinist tendencies agreed on the text of a new confession, the Bohemian Confession. Maximilian managed to dissuade the estates from giving this legal sanction, and he persuaded them to content themselves with his word of honour to respect religious liberty and with the right of electing 15 "defenders" to watch over the liberty of the Protestant faith; promises which Rudolf repeated on his recognition as king. Maximilian died on Oct. 12, 1576, disappointed in his far-reaching international ambitions. He left the royal authority weaker and less respected than he found it.

Rudolf II.—In the middle of the 16th century more than two-thirds of the population of Bohemia was Protestant (Neo-Utraquist or Lutheran) and one-tenth the Unity of the Czech Brethren. Rather more had remained Catholic, especially in southern Bohemia and Moravia; among the nobles, however, the proportion of Catholics was much higher (about one-fourth). As soon as the Counter-Reformation began, this Catholic minority gained in numbers and vigour; various nobles, including some great families, reverted to the old faith; the Catholic magnates began to impose their religion throughout their domains. While the old Utraquist Church, not adhering to the Bohemian Confession, fell into final collapse, the Czech Neo-Utraquists and the German-speaking Lutherans improved their organization and overcame their former doctrinal confusion. The Unity of the Czech Brethren co-operated with the Neo-Utraquists in practical matters but worked out its own system of doctrine, more of the Calvinist than the Lutheran type. A selected group of scholars, inspired by the initiative of John Blahoslav, one of the most remarkable leaders of the Unity of the Czech Brethren, translated the Bible into Czech. It was published in six volumes in 1579–94 at Kralice at the expense of Lord John of Zerotin. It was re-issued several times and came to be known as the Kralice Bible. Though they were scholarly men, the Czech Brethren, with but few exceptions, were not experienced in worldly affairs and were numerically too weak to help the nation greatly in the impending struggle.

The religious divisions were partly the manifestation of social and national conflict. The economic evolution of the 16th century tended to enrich the magnates, who extended their great properties at the expense of the knights, while the cities decayed in consequence of the shifting of the great trade routes. The economic condition of the peasants improved slightly, but their legal status grew worse, the greater need of labour inducing the magnates to restrict increasingly their liberty of movement. The spread of Protestantism in Bohemia had attracted German immigrants, who advanced the linguistic frontier and forced the estates, first of Moravia, then of Bohemia, to issue laws in the early 17th century protecting the use of the Czech language in public life.

Rudolf II, with his unstable, suspicious and melancholy character and narrow Spanish upbringing, was not the man to pilot the kingdom through a formidable crisis. His arbitrary attempt to exterminate Protestantism in Hungary evoked István Bocskay's formidable rebellion, which forced Matthias, the king's lieutenant in Hungary, to sign the peace of Vienna with the rebels and that of Zsitvatorok with the Turks (1606). On Rudolf's refusing ratification, Matthias, supported by the Hungarian and Austrian magnates, rose against him; Moravia followed him, whereupon Bohemia remained faithful to Rudolf. The peace of Liben (1608) left Matthias in possession of Moravia and Austria, and recognized him as future king of Bohemia. The fratricidal struggle naturally profited the nobles; Matthias was curbed by a confederation of his new subjects, and Rudolf had to sign a series of articles designed to exclude all foreign influence from Bohemia and vest all real power in the diet. He demurred only to the religious demands; but, Matthias having yielded on this point, the diet of 1609 finally forced Rudolf to grant confessional liberty for the nobles and royal towns, liberty of conscience for all, a constitutional guarantee for the Bohemian Confession, appointment of the consistory by the estates and control of the university by defenders chosen by them. This famous charter, known as the *Majestat* (or "Letter of Majesty"; July 9, 1609), was accompanied by an agreement between Catholics and Protestants, indubitably sincere but so obscurely drafted that it afterward provoked disputes which developed into the rebellion of 1618. While the last remnants of the traditionalist Utraquist Church reverted to Catholicism, the new consistory was composed of Neo-Utraquists and the Czech Brethren. Because of the wisdom of Vaclav Budovec, the moral leader of the Unity, the new regime opened smoothly. Rudolf, whose sole thought was now revenge against Matthias, encouraged his cousin Leopold, bishop of Passau, whom he hoped to make his successor, to conspire with the Catholic magnates to cancel the *Majestat* and release his mercenaries upon Bohemia, which they invaded as far as Prague. The country rose against the invaders; Matthias came to the estates' assistance, who in turn elected him king of Bohemia on May 23, 1611, and Rudolf, who had betrayed all parties, had to abdicate (Aug. 11, 1611), dying soon after (Jan. 1612).

The Revolt.—Under Rudolf, Prague had been the capital of the Habsburg domains. Matthias moved the capital to Vienna, thereby confirming the estates in their suspicions and opposition. Nevertheless the diet of 1617 dared not refuse to recognize as their future king the archduke Ferdinand of Styria, Matthias' nephew, a pupil and docile instrument of the Jesuits. For several years, however, the leaders of the Protestant party had been in communication abroad to prepare a revolt; Bohemia was also affected by the situation in Germany, where conflict between the Catholic league and the Protestant union was growing acute. Violation of the promises contained in the *Majestat* regarding the royal and church domains and Matthias' action in entrusting the government to a council composed of fanatical Catholics brought the outbreak nearer. Rejection of the claims presented in March 1618 by the Protestant assembly legally convoked by the defenders in virtue of the *Majestat* led in May to the famous Defenestration of Prague, when the two most ardent Catholics of the council, Jaroslav of Martinic and William of Slavata, were hurled into the moat of the castle (being, incidentally, only slightly injured). The diet appointed a council of 30 directors, decided to levy an army, decreed the expulsion of the Jesuits and confiscation of their property and negotiated for an agreement with the other lands of the Bohemian crown. They reached agreement with Silesia, at the price of relaxing the ties between that province and the crown; the scruples of Charles of Zerotin delayed the adherence of Moravia until most of its importance was gone. The Protestant party itself was divided by the reappearance of old misunderstandings between Lutherans and the Czech Brethren, gravitating at this time to Calvinist centres in Switzerland, Germany and the Netherlands. The Lutherans were estranged when, on the death of Matthias, the diet again proclaimed the throne elective and invited a Calvinist, the elector palatine, Frederick V, to fill it (Aug. 1619). A young, inexperienced and weak sovereign; an undisciplined and selfish oligarchy; an inferior army and lack of foreign allies; exhaustion after the great effort of the 15th century; decline of self-confidence, especially the absence of what had been the nation's strength in the Hussite wars, the enthusiasm of the peasant masses, now reduced to serfdom and consequently deaf to any sentiment beyond that of their misery and social hatred—these causes explain the

defeat of the insurgents at the battle of White Mountain, at the gates of Prague (Nov. 8, 1620). Frederick, the "winter king," fled, followed by many of the magnates, abandoning the country to Ferdinand, who had become emperor in Aug. 1619, and to the Jesuits.

The Reaction, 1620–27.—Prince Charles of Liechtenstein, the new governor, presided over the political reaction, the papal nuncio, Giovanni Carafa, over the ecclesiastical. The execution in June 1621 of 27 real or alleged leaders of the revolt (3 lords, 7 knights, 17 burgesses) preluded the general confiscation of the rebels' properties, whereby three-quarters of the estates (excluding those of king and church) changed hands; this gigantic expropriation, which was attended by scandalous corruption, substituted for the old aristocracy new families, Spaniards, Walloons and Germans, who had furnished the emperor's mercenary officers. One of the most greedy and best favoured of them was the celebrated Wallenstein (*q.v.*). The concession of communion in both kinds was revoked, all pastors were expelled, and all Protestant schools were closed, and the ancient and glorious university, the entire conduct of public instruction and the censorship were all delivered to the Jesuits (1622). In 1625 the re-Catholicization of the towns by fines, prison and bailiffs began; by 1626 it was complete, at least outwardly. In 1627 all nobles refusing to adopt Roman Catholicism, which the new constitution proclaimed as the sole recognized religion, were expelled. Revolts of the peasants against conversion were fairly easily repressed. The serfs had not the last resort of nobles and burgesses who refused conversion—emigration. Thirty-six thousand families emigrated, comprising nearly a quarter of the nobility and urban population of Bohemia, the moral and intellectual flower of the nation. In 1627 Ferdinand enacted a new constitution. Absolute heredity was established, the practice of securing recognition for the future king disappearing; the estates were forbidden any legislative initiative on any important point; Roman Catholicism was proclaimed the sole religion; the clergy were constituted as the leading estate in country and diet; and German was admitted beside Czech as the official language. Legally, the Bohemian lands preserved their independent identity; actually, they were absorbed in the Habsburg monarchy, keeping their own administrative forms so long as they remained patrimonial, losing them increasingly as Bohemia was transformed into a modern state.

National Decline.—In 1648 the peace of Westphalia sanctioned internationally the policy practised by the Habsburgs in Bohemia since 1621. Its articles pertaining to Bohemia were a heavy blow for the Czech exiles who thereby lost the last hope of a restitution of ancient liberties to their homeland. Few of them returned, as the terms imposed by the ruler included recantation. The exiles were scattered throughout the Protestant world and a handful of them reached the shores of the "new world." The Neo-Utraquists and the Lutherans preferred Saxony to the more distant countries. Members of the Unity of the Czech Brethren moved either to Hungary or to Poland. Several prominent exiles settled in the Polish city of Leszno (Lissa), among them J. A. Komensky (Comenius, *q.v.*) who lived there from 1628. From Leszno, Komensky visited England, Sweden and Transylvania to advocate his schemes for educational reform. From 1656 to his death Komensky lived in Amsterdam, using his talents to advance learning and to edify the scattered members of the Unity. His death on Nov. 15, 1670, and his burial at Naarden marked the end of organized activities of the Czech emigration, and indeed of Czech intellectual life. Bohemia, exhausted by the wars and depopulation, was falling rapidly into misery and torpor. The peasant class, now sole representatives of the nation, were crushed under the yoke of greedy and brutal foreign adventurers, their new masters. The large landed properties, which formerly covered one-third of the country, now occupied two-thirds, while the estates of the knights and the towns had become insignificant. The population was reduced by 50% or more. The peasant, with three days of *corvée* (compulsory labour on the manorial estates) a week under the law of 1680, rising to six at busy periods under that of 1738, his dues multiplied fivefold between 1660 and 1730, could hardly live, fell into debt and degenerated physically; frequent risings were brutally repressed. Czech fell to be a peasant tongue, German monopolizing polite society and public life. The old ties with Moravia, which gravitated increasingly toward Vienna, were relaxed. In Slovakia, Czech gained a little ground, because of the Bohemian immigrants; and the Slovak peasants, with the Ruthenians, formed the bulk of the forces raised by the Hungarian rebel chiefs against the Habsburgs; but they were led in the name of Hungarian liberty, for the benefit of Magyar nobles. The reconquest of Hungary from the Turks, the peace of Szatmár, and the adoption of the pragmatic sanction (1720 in Bohemia), guaranteeing the succession of Maria Theresa, further strengthened the position of the dynasty and consolidated the unity of the Habsburg monarchy.

(O. O.)

Period of Enlightened Despotism, 1740–90.—In the early years of Maria Theresa's reign, by the treaties of Breslau (1742) and Dresden (1745), the Bohemian crown lost to Frederick the Great of Prussia the rich province of Silesia, except for the three duchies of Troppau, Teschen and Jägerndorf (*see* AUSTRIAN SUCCESSION, WAR OF THE). At the same time the last fragments of Bohemian independence were diminished by various reforms which inaugurated the administrative centralization of the Habsburg lands. In 1749 the Bohemian chancellery was merged with that of Austria in Vienna, and in 1751 local administration, such as it was, was reorganized, being removed from the control of the nobles represented in the Bohemian and Moravian diets and placed within that of a bureaucracy based on Vienna. The fact that, when Charles Albert of Bavaria had temporarily occupied Prague in 1741 with the intention of establishing his claim to the empire, many members of the Bohemian nobility had done homage to him was something that Maria Theresa did not forget. Centralization was carried through with all the more zeal in Bohemia.

The misery of the Bohemian peasantry was only intensified by the long years of fighting with Prussia and its allies, often on Bohemian territory, between the accession of Maria Theresa and the end of the Seven Years' War in 1763. In the last years of her reign there occurred two events of major importance. In 1773 the Jesuit order was dissolved, leaving its wealth and power in Bohemia to be taken over by the government; in particular the Jesuit university of Prague and many Jesuit schools were inherited by the state. In 1775, after the desperation of the serfs had broken out in revolt in various districts of Bohemia, the so-called *Robotpatent* (from the Czech *robota*, "work") was issued, which restricted the *corvée* and other forced labour and encouraged landlords to convert serf dues into money payments. Thus the door had been opened to great changes at the time of Maria Theresa's death in 1780.

Her son, the emperor Joseph II, who had in fact shared the government with her since 1765, believed in a more sweeping transformation. He was an enlightened despot par excellence and desired to bring about a more humane and efficient system of government. His Edict of Toleration (Oct. 13, 1781) completed the process which began with the fall of the Jesuits and abolished the draconic dispositions which had throttled religious life in Bohemia since Ferdinand II's day; Protestants were now free to practise their religion. At about the same time, on Nov. 1, 1781, Joseph issued another of his most important decrees which is sometimes rather hastily described as having abolished serfdom; in effect it restored to the peasants the personal liberty that they had lost in the 15th century, the rights to marry, to move or to undertake work without seigneurial permission, but they were left with heavy economic obligations to the nobility. By an edict of Feb. 10, 1789, the emperor hoped to abolish most of these too: henceforth the peasants were to pay maximum dues of 30% of the total yield of their land, 12% to the state and 18% to landlord and priest. Personal services, such as the *corvée*, were to be abolished.

In the interests of efficiency Joseph II believed in standardization, and he therefore, in 1784, introduced German as the language of administration in Bohemia, as in nearly all the other provinces under his rule. At the same time German replaced Latin in the University of Prague. Already in 1770 German had replaced Latin in the Bohemian grammar schools, and in 1774 German had been established as the language to be used in the increasing number of elementary schools except in the lowest classes. Thus by

the time of Joseph II's death in 1790 Bohemia seemed superficially to have lost any separate character. Nevertheless better social conditions, greater educational facilities and the feeling of release which the Edict of Toleration and the relaxation of the censorship had brought about helped to kindle a new interest in the history of the Czechs and their language.

Joseph was succeeded by his brother, Leopold II, amidst a great outburst of protest from the church and nobility against the dead emperor's reforms. In Bohemia, however, in spite of its exaggeratedly feudal tradition, an instinctive adaptation to the spirit of the age of the French Revolution caused many nobles to adopt liberal formulas; some of them, too, began to interest themselves in the Czech language as a weapon with which to resist the centralist German-speaking authorities. Although less fierce than in Hungary, Bohemian opposition to Vienna proved sufficiently obstinate. The emperor Leopold made peace with the nobility by sacrificing to it the edict of 1789 which had abolished forced services and limited the taxes on land, while many of Joseph's other innovations were frequently ignored in practice. Leopold, however, made a notable concession to the new interest in Czech among the educated classes in Bohemia by founding a Czech language professorship in the Charles university in Prague. Almost simultaneously the idea of Czech solidarity with the Serbs, indeed of Pan-Slav solidarity, began to be voiced in Bohemia: it was positively expressed, for example, by the scholar and patriot, Josef Dobrovsky —a young man at the time—who delivered a public address in Leopold's honour on the occasion of the emperor's coronation as king of Bohemia in Prague in 1791. After Joseph II had refused any such concession to what he condemned as Bohemian particularism it was characteristic of Leopold that he made the conciliatory gesture of being crowned with St. Wenceslas' crown. Unfortunately for Bohemia and for Austria, Leopold II died in 1792.

The Revival of National Sentiment, 1792–1848.—The French Revolutionary and the Napoleonic Wars (1792–1815) suspended the political life of the shaken Habsburg monarchy and reduced it to financial extremity. In the Bohemian provinces events in France awoke some faint echo in the peasant masses, while the passage of Russian troops in transit further stimulated nascent Slav sentiment among the Czechs. The first generation of "awakeners," with Dobrovsky and Josef Jungmann in command, introduced the scientific study of the Czech language. After the final overthrow of Napoleon in 1815 the Czech national movement, hitherto inspired mainly by 18th-century rationalism, came under the influence of German romanticism. The study of history now supplanted that of philology, and the historian Frantisek Palacky (1798–1876) became the leading figure. Palacky was a Protestant Moravian who had been educated at the Lutheran *lycée* of Bratislava (Pressburg) in Slovakia. He was supported by a small group of aristocrats, and notably by Count Kaspar Sternberg, who had founded the Bohemian museum in 1818. These people were evidently more concerned with the protection of the territorial integrity of Bohemia—upon which their power depended—against Viennese centralism, than with the emergence of the Czech nation. Provincial patriotism again, although of a very different trend for it was antifeudal, inspired the new German literature of Bohemia at this time. After the European revolutions of 1830 had revealed the instability of the restoration settlement of 1815 and the Polish insurrection of 1831–32 had aroused feelings of Slav solidarity toward the Poles among the Czechs, their national renaissance became more of a political and a liberal movement. Karel Havlicek, a liberal democrat and the disciple of French thinkers and writers, joined Palacky, a liberal conservative, as a leader of Czech opinion. It was in 1836 that Palacky's *History of Bohemia* began to appear: after five years it began to encounter difficulties with the censorship because it justified Huss and his Czech compatriots.

The Revolution of 1848.—During the 1840s the Bohemian diet increasingly demanded the decentralization that the nobles desired. But with the revolution of 1848 the leadership of Bohemia temporarily passed from the aristocracy to the newly emerging German and Czech middle classes. The Czechs' program comprised an autonomous Bohemia constitutionally governed and recognized as having the same status as Hungary. This Bohemia was still to form part of an Austrian empire, which was mainly Slav in population; it was on no account to be drawn, as the Bohemian Germans wished, into a united Germany where all but the German inhabitants were sure to be ignored. For this reason Palacky refused an invitation in April 1848 to join the revolutionary German parliament at Frankfurt. Indeed the Slav reply to the large claims of the German patriots and to the growing intransigence of the Magyars of Hungary (to whom the Slovaks were subject) was to call a Pan-Slav congress which assembled in Prague on June 2, 1848. Ten days later young Czech radicals staged a revolutionary demonstration there which was very soon suppressed by the Austrian army under Alfred von Windischgrätz (the first prince of the name). The imperial government proceeded to ignore the constitutional concession it had made to the Czechs on April 8 in accordance with the demands of their program. Nevertheless when Josip Jelacic, the *ban*, or governor, of Croatia, brought a Croat army to the rescue of the emperor against the Magyars and the left-wing Germans of Austria, the Czechs and the other Slavs were bound to side with the archduke Francis Joseph and the Croats. A constituent assembly met in Vienna in July but was dispersed when Windischgrätz occupied the imperial capital in October. In Nov. 1848, shortly before Francis Joseph became emperor, an assembly was convened at the small Moravian town of Kremsier (Kromeriz), where a promising draft constitution aimed at the autonomy of the nationalities within the empire was prepared. On March 7, 1849, however, the Kremsier parliament was dissolved (as a result of the imperial manifesto published on March 4 proclaiming a unitary constitution for the whole empire), and the imperial government soon after returned to a rigid absolutism for another decade.

Czech and German Rivalry, From 1848.—The only clear gain from the revolution of 1848 was the final liberation of the peasants. None of the national groups which made up the Austrian empire profited more than the Czechs from the Act of Emancipation of Sept. 7, 1848, which abolished the feudal system of land tenure. As Joseph II had wished, all forced services came to an end and the peasants became the owners of a part of the land that they tilled or they paid a free money-rent for all of it. It has been seen that after the Thirty Years' War the Czechs had survived only as a nation of serfs and that until the beginning of the 19th century any middle class that there was had consisted of a handful of intellectuals. It is also true that until 1919 Bohemia and Moravia remained the home of huge estates owned by a German-speaking aristocracy. The establishment of peasant ownership nevertheless enabled the Czechs to begin to build up a certain modest national wealth in land while the recognition of personal liberty fortified their claim to education in their own language. In 1859 Francis Joseph announced that in secondary schools in predominantly non-German districts education need not be completed in German provided that the pupils had a thorough knowledge of the German language: from about the same time elementary schools in the Czech villages were conducted only in Czech.

Up to the middle of the 19th century Bohemia, roughly speaking, had been divided into a Czech central region which was agricultural and an important German fringe which was predominantly industrial. In July 1851 the abolition of tariffs between the Austrian lands and Hungary helped to induce a period of economic expansion and change, stimulated also by the construction of railways. Soon independent Czech-owned small industries began to develop, and Czech labour, which was cheaper, began to penetrate into the German industrial areas, especially into the lignite mines in northern Bohemia. The new national awareness after 1848 caused one of the most bitter racial conflicts of the 19th, and indeed of the 20th, centuries. Until 1848 and indeed much later, the Germans of Bohemia took it for granted that theirs was the ruling race in the whole Habsburg monarchy. They felt outraged by the emergence within their own provincial frontiers of a Slav community with a higher birth rate than their own which seemed prepared to challenge their supremacy and which even claimed historic priority over the Germans, as the true Bohemians.

The Czech challenge was increasingly made in economic and educational terms. In 1868 the first major Czech bank, the Zivno-

stenska Banka, was established. This helped the Czechs to acquire more land and industrial property and thus the property qualifications which had become necessary in 1861 for political enfranchisement (*see* below).

A law of 1868 provided for elementary state education throughout Austria, and according to article 19 of the Austrian constitution of Dec. 1867 it was claimed that if 40 children speaking a minority language lived within a radius of about one-half mile they should become entitled to a school of their own. This claim, even when it was recognized, often led to violent disputes, the provision of a school perhaps depending upon the arrival of a Czech family in a German-speaking district or vice versa. From 1880 onward each side had a school union of its own to sponsor private schools: each side also had a national gymnastic society, the *Sokol*, acquiring an almost mystical significance for the Czechs. Because of their educational zeal and their natural thrift and industriousness the Czechs developed a flourishing middle class, often peasant-born, in the second half of the century. They were able to establish themselves in the liberal professions and later crowded into the public services, not only in Bohemia but throughout Austria. Thus in the end the imperial bureaucracy acquired a disproportionately large number of Czech officials. This was not unimportant in preparing the way for the future Czechoslovak state.

Politically the first decade after the revolution of 1848 was one of centralist absolutism with as severe a censorship as before. The concordat of 1855 re-established a clericalism which was distasteful to much German, as well as to much Czech, opinion in Bohemia. After various fruitless experiments, on Feb. 26, 1861, a new constitution was inaugurated by the February, or Schmerling, patent drafted by the minister of the interior, Anton von Schmerling. A main function of the provincial diets became the election of the imperial parliament, or *Reichsrat*. The diets themselves were thenceforward to be elected by a series of electoral colleges which greatly favoured the Germans and the wealthier classes, mostly German in any case, at the expense of the Slavs and the poorer populations of the Habsburg empire. Since the Czechs constituted the most powerful Slav group, it was in Bohemia that opposition to the Schmerling franchise system was most intense. Many middle-class Germans of Bohemia and Moravia, on the other hand, were now drawn into the government in Vienna; these were people who believed far more dogmatically than the aristocracy in the necessity for a German ruling race. Thus the Schmerling constitution accentuated the growing conflict between the two races of Bohemia. It should be added that many Czechs continued to accept germanization because of its practical advantages: the Czechs who resisted German pressure were all the more pugnacious.

The two most prominent Czech leaders, Palacky and his son-in-law, F. L. Rieger, aware of the pressure exerted in Vienna by the Hungarian aristocracy in favour of Magyar nationalist claims, had already in Jan. 1861 allied themselves with a group of the Bohemian nobility in the hope of exerting similar pressure in the name of the Czechs. This alliance with the so-called "historic" party of the Bohemian aristocracy was based upon the conception of the territorial integrity of Bohemia and Moravia (what the Germans called *Böhmisches Staatsrecht*); by insisting upon this Palacky and Rieger hoped to safeguard the Bohemian inheritance as effectively as the Hungarians were stressing the integrity of the Magyar inheritance, the lands once ruled by St. Stephen. Both Czechs and Hungarians resisted the Schmerling constitution as best they could, the Czechs boycotting the *Reichsrat* from 1863 onward, and indeed for the following 15 years.

A new government in 1865 headed by Richard Belcredi, a member of the "historic" party, brought a *détente* together with the suspension of the February patent. But in the following year the Austrian armies were humiliatingly defeated by the Prussians in the Seven Weeks' War and a new Germany was at once projected to which Austria was not to belong. This aroused Slav hopes of a still more Slavonic Austria, hopes which were dashed in 1867 when the emperor felt it necessary to yield to the Hungarians' demands and sign the *Ausgleich*, or Compromise, with them. According to this his domains were divided into two virtually sovereign states linked with one another for diplomatic and military purposes; the Slavs were subjected to the Germans in Austria and to the Magyars in Hungary, the Czechs and Slovaks being cut off from one another by the frontier newly recognized between Austria and Hungary within the Habsburg empire, which thus became the Dual Monarchy. From the Czech point of view, as Palacky said, this was twice as bad as centralism since it meant centralism twice over. Four years later Francis Joseph seemed to be willing to give to the Czechs what he had given to the Magyars, but he suddenly changed his mind and left them with nothing but a feeling of having been betrayed by the dynasty. When in 1873 the diets ceased to elect the *Reichsrat*, the electoral colleges remained to give both diets and *Reichsrat* their old bias as before. The policy of Palacky and Rieger had failed. Yet, disappointed though they were, the Czechs were unable to devise a policy other than that of passive resistance which they continued until 1878. In that year the German Liberals of the monarchy opposed the occupation of Bosnia-Hercegovina by Austria-Hungary because they objected to a further increase of the Slav population. The emperor Francis Joseph and his generals disliked this criticism of imperial foreign policy and the Liberal ministry was dismissed in favour of a more clerical and, in many ways, a more conservative government headed by an old friend of the emperor's, Eduard Taaffe. Taaffe, who took office in 1879, expressly set out to take more account of the Slavs in the monarchy and annoyed the Germans by appointing a prominent Czech called Prazak to be a minister in the central government in Vienna. By this time the Czechs had returned to the *Reichsrat*.

The Czechs gained appreciable advantages from the new regime. By a language decree of 1880 the Czech language was placed upon the same footing as German in the Bohemian administration and courts of law. In 1882 a Czech university separate from the German one was established in Prague, thus at last providing the Czechs with higher education in their own language. At about the same time a Czech national theatre, paid for by private subscription, was opened in Prague. But the Czech national leaders were embarrassed by the need, as one of them said, of thus "picking up crumbs," and of depending so much on the government in Vienna and the "historic" nobility, which was growing more intransigent in its clerical conservatism. By reaction the influence of the Young Czechs, a more advanced fraction, grew. A compromise concluded by the more conservative Old Czechs with leaders of the Germans of Bohemia in 1890, although offering real gains to the cause of the Czechs, was denounced by the others because it left the German language in a slightly privileged position. At the elections the next year the Old Czechs were roundly beaten by the Young Czechs. Taaffe's resignation in 1893 put an end to this phase.

On both sides in Bohemia, and in Moravia too, racial feeling was becoming exacerbated by extremists, the most notorious of them all being the Pan-German group led by Georg von Schönerer which won keen support among some of the German Bohemians. In 1897 a decree issued by the minister-president Kasimir Badeni put the Czech language on the same footing as German for all administrative purposes; this would have compelled German officials in Bohemia to learn Czech. It was greeted with an uproar and was subsequently withdrawn. With tumults in both the *Reichsrat* and the Bohemian diet the quarrel between the Germans and the Czechs began to threaten the stability of the Habsburg monarchy. As minister-president (1906–08), Max von Beck tried to arrive at a solution by reforming the franchise for the *Reichsrat*. In 1907 he put through a law that reorganized the constituencies along racial lines and gave a vote to every male over 24; the old system of privileged voting remaining valid for the diets of the provinces or crownlands only. Although Beck's reform introduced a far more equitable method of voting, German votes for the *Reichsrat* were still appreciably weighted as against those of the Slavs.

In more tranquil Moravia another compromise had been achieved in Nov. 1905 which went far to safeguard the rights of the Czech population—comprising 70% of all Moravia's inhabitants—while retaining a slight German predominance. This arrangement worked reasonably well for the remaining years of the Habsburg period. In Bohemia, however, the problem of racial conflict was insoluble. The elections to the *Reichsrat* in 1907 greatly increased the Czech representation in Vienna, particularly that of the Czech

Agrarian party and of the Social Democrats. Even in the diet in Prague the Czechs, as they grew richer, gained more and more seats. All the more obstinately did the Bohemian Germans block any reform of the franchise for the Bohemian diet. By 1913 the negative attitude of both nationalities had indeed paralyzed the diet, and an imperial commission was substituted for its executive committee.

Since the Russian revolution of 1905 the Pan-Slavism of the Czechs had grown, and when in 1908 Austria-Hungary proclaimed the definite annexation of Bosnia-Hercegovina they were angered that these territories should be kept from the Southern Slavs or Yugoslavs. From this time onward their hostility to Austrian foreign policy became pronounced: they condemned it as anti-Slav, subordinate to Germany and increasingly dominated by the Magyars, whose power in the monarchy grew as the German-Slav division of Austria became more apparent. The Czechs moreover felt concerned by the increased persecution of the Slovaks—whom they increasingly regarded as a part of their own race—in Hungary (*see* SLOVAKIA).

Masaryk.—Below the surface of all the political turbulence and the racial pettiness which was common to both Germans and Czechs, a new spirit, modern, critical and scientific, had been growing among the Czechs since the division of Prague university. It found political expression in the numerically small "Realist" party led by the Slovak professor T. G. Masaryk (*q.v.*) who lectured in philosophy at the Czech University of Prague. Masaryk gathered around him a group of young intellectuals who tried to introduce a more balanced and humane approach among the Czechs and to substitute among the Slovaks the idea of self-help in the place of their natural fatalism and Russophile mysticism. Masaryk's courage and energy in the Zagreb and Friedjung trials won him a unique authority among all the Slavs of Europe: for Czechs and Slovaks he embodied the spirit of the Bohemian Brethren applied to modern society.

During World War I Masaryk and other Czech leaders directed their energies toward achieving Czech independence, and the last few years of Bohemia's history as a province of the Habsburg monarchy are better regarded as the prelude to the proclamation, on Oct. 28, 1918, of the republic of Czechoslovakia (*q.v.*) with the history of which that of Bohemia is thereafter inseparable.

See also Index references under "Bohemia" in the Index volume.

(E. WI.)

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(O. O.; E. WI.)

BOHEMIAN FOREST, the covering term for the southwestern highlands of the Bohemian massif largely on the German-Czechoslovak frontier, which extend from the upper valley of the Ohre in the northwest to a section of the Danube valley in Austrian territory (between Melk and Krems) in the southeast.

The terminology of the ranges which compose the highlands is intricate and confused. The main group, the Sumava (Forest mountains), average 3,500 ft. in height and rise to the summits of Arber (Javor), 4,780 ft., on the Bavarian side of the frontier and Plechy (Plöckenstein), 4,521 ft., on the Czechoslovak side. They are mainly composed of granite and give the impression of mass rather than height, with a fault-line scarp to the southeast and a gradual slope on the inner side. The forest cover, both coniferous and deciduous, is thick and the population is scanty.

To the northwest, the much lower range of the Cesky Les (Oberpfälzer Wald) is separated from the main group by the Domazlice (Taus) pass at 1,404 ft. The gradients are gentler and the hills largely cleared for upland farming. To the southeast the Vyssi Brod pass (2,339 ft.) separates the Sumava highlands from the Novohradskehory and the Greinerwald, mainly in Austrian territory. On the inner side of the Sumava, the upper valley of the Vltava (Moldau) forms a broad longitudinal trough with considerable groups of foothills beyond it. To the southeast, the parallel and lower ranges of the Bavarian forest lie close but wholly within German territory. All belong to this southwestern rim of the Hercynian massif, composed of Archean rocks and raised to their present elevation through the pressures of the much later Alpine mountain building to the south.

See also CZECHOSLOVAKIA: *Physical Geography.* (H. G. S.)

BOHEMIAN LANGUAGE: *see* CZECH LANGUAGE.

BOHEMIAN LITERATURE: *see* CZECHOSLOVAK LITERATURE.

BOHEMIAN-MORAVIAN HIGHLANDS (Czech CESKO-MORAVSKA VRCHOVINA), the southeastern bounding ranges to the Bohemian massif that divide the two former provinces of Bohemia and Moravia, now in Czechoslovakia. They extend approximately from the basin of the Dyje (tributary to the Morava) in the south, to the upper basin of the Morava river in the north. The average height of this hill country is 2,000 to 2,500 ft., although the Jihlava heights in the south rise to 2,746 ft. (the Javorice summit) and the Zdar group in the north to 2,743 ft. (Devet Skal). There is a considerable variety of rock type and structure. Much of the highland is composed of ancient gneiss and granite rocks common to a great part of the Bohemian massif, but a substantial belt of Permian sandstone crosses it from north to south; on the Moravian side, the Drahanska Planina group of hills are of Devonian limestone and contain the famous Moravian karst (the Macocha abyss and caverns).

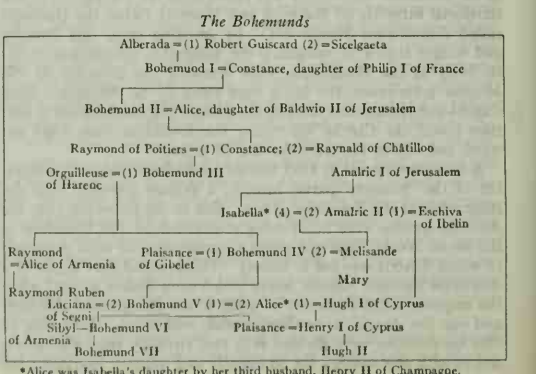
The highlands are bleak, sparsely populated country from which there has been a steady exodus to the more promising lowland on either side. The ancient town of Jihlava (Iglau), with its silver mining traditions, lies at 2,350 ft. on the southern route across the hills. Ceska Trebova at 1,400 ft. is near the summit of the northern route.

See also CZECHOSLOVAKIA: *Physical Geography.* (H. G. S.)

BOHEMUND, the name of a series of Frankish princes of Antioch, afterward counts of Tripoli. Their connection is shown in the table.

BOHEMUND I (*c.* A.D. 1057–1111), prince of Antioch, was the eldest son of Robert Guiscard, by an early marriage contracted before 1058. He served under his father in 1081 in the attack launched by the Normans of southern Italy on the Byzantine empire and commanded during Guiscard's absence (1082–84), penetrating into Thessaly but being repulsed by the emperor Alexius I Comnenus. This early hostility to Alexius had a great influence in determining the course of his future career and thereby helped determine the history of the first crusade. On the death of Guiscard in 1085, his younger son Roger succeeded to the duchy of

The Bohemunds



*Alice was Isabella's daughter by her third husband, Henry II of Champagne.

Apulia and Calabria, and the landless Bohemund rebelled against him. The war was finally composed by the mediation of Pope Urban II and the award of Taranto and other possessions to Bohemund. In 1096 crusaders began to pass on their way through Italy to Constantinople, and Bohemund joined the crusade. He gathered a fine Norman army, at the head of which he crossed the Adriatic and penetrated to Constantinople along the route he had tried to follow in the 1080s. At Constantinople he did homage to the emperor. From Constantinople to Antioch, Bohemund was on important occasions the real leader of the first crusade. His high military ability enabled him to devise measures to counter the unfamiliar tactics of the Turks. The capture of Antioch was in fact a result of his connection with Firuz, one of the commanders in the city; but it seems probable that Bohemund persuaded the leading crusaders against an immediate assault in Oct. 1097 and did not bring matters to an issue until it seemed certain that the other commanders would allow his claims to dispose of the city. By the early summer of 1098 their assent could no longer be withheld in the face of the approach of a great Turkish army of relief under Kerbogha. Antioch fell on June 2, 1098, and Bohemund claimed it by right of conquest, with a reservation in favour of the emperor if he should fulfill his promise to aid the crusaders. But Bohemund was not secure even after the city's surrender and the defeat of Kerbogha; he had to make good his claims against Raymond IV of Toulouse, whom he had alienated and who soon became the ally of Alexius. He obtained full possession in Jan. 1099. Bohemund went to Jerusalem at Christmas 1099 and had Daimbert of Pisa elected as patriarch. It might seem in 1100 that Bohemund was destined to found a great principality in Antioch, which would dwarf Jerusalem; he had a fine territory, a good strategical position and a strong army. But he had to face two great forces—the Byzantine empire, which claimed the whole of his territories and was supported in its claim by Raymond of Toulouse, and the strong Muslim principalities in the northeast of Syria. Between these two forces he failed. In 1100 he was captured by the Danishmend amir of Sivas, and he languished in prison until 1103. His nephew Tancred took his place; but meanwhile Raymond established himself with the aid of Alexius in Tripoli and was able to check the expansion of Antioch to the south. Ransomed in 1103 by the generosity of an Armenian prince, Bohemund resumed his offensive against his Muslim neighbours. In May 1104, however, he was severely defeated near Rakka on the Euphrates and, despairing of his own resources, returned to Europe for reinforcements. He was enthusiastically received and won the hand of Constance, daughter of Philip I of France. He exerted himself to organize a crusade against Byzantium and collected an army with which he besieged Durazzo. But Alexius proved too strong, and Bohemund had to submit to a humiliating peace at the Devoll river (1108), by which he became the vassal of Alexius with the title of *Sebastos* and promised to admit a Greek patriarch into Antioch. Bohemund never returned to Syria, and was buried at Canosa di Puglia, in Apulia, Italy, in 1111.

Bohemund II (1108–1131), son of Bohemund I and Constance of France, went in 1126 from Apulia to Antioch, which, since the fall of Roger, the successor of Tancred, in 1119, had been under the regency of Baldwin II; and soon after his arrival he married Alice, the younger daughter of Baldwin. After joining with Baldwin in an attack on Damascus (1129), he was slain on the northern frontier by a Muslim army (1131).

Bohemund III (d. 1201) was the son of Constance, daughter of Bohemund II, by her first husband, Raymond of Poitiers, and succeeded his mother in the principality of Antioch in 1163. In the following year he suffered defeat and capture by Nureddin at Harenc (Harim) in northern Syria. Thereafter the principality of Antioch was never again a power in the Levant. Until about 1180 it was a Byzantine protectorate, and it was the influence of Manuel I Comnenus that secured Bohemund's early release from captivity. In 1177 he made an unsuccessful attempt to recapture Harenc. In 1180 he deserted his second wife Irene, or Theodora Comnena, for a certain Sibyl, and he was in consequence excommunicated. By his first wife, the princess Orguilleuse, he had had two sons, Raymond and Bohemund (the future Bohemund IV). Raymond married Alice, a daughter of the Armenian prince Ruben (Rhupen), brother of Leo of Armenia, and died in 1197, leaving a son, Raymond Ruben; and the problem that occupied the last years of Bohemund III was to determine whether his grandson, Raymond Ruben, or his younger son, Bohemund, should succeed him in Antioch. Leo of Armenia championed his great-nephew, Raymond Ruben. Bohemund the younger, however, prosecuted his claim with vigour and even evicted his father from Antioch about 1199; but he was ousted through the efforts of Leo (then king of Armenia by the grace of the emperor Henry VI), and Bohemund III died in possession of his principality (1201).

Bohemund IV (d. 1233), younger son of Bohemund III and Orguilleuse, became count of Tripoli in 1187 and succeeded his father in the principality of Antioch, to the exclusion of Raymond Ruben, in 1201. After Raymond Ruben's death in 1221, Bohemund reigned in Antioch and Tripoli until his own death.

Bohemund V (d. Jan. 1252), son of Bohemund IV by his wife Plaisance (daughter of Hugh of Gibelet), succeeded his father in 1233, and carried on the struggle with Armenia until 1251, when the marriage of the future Bohemund VI to the sister of the Armenian king finally brought peace. By his first marriage (1225) with Alice, the widow of Hugh I of Cyprus, Bohemund V connected the history of Antioch for a time with that of Cyprus. He had resided chiefly at Tripoli, and under him Antioch was left to be governed by its bailiff and commune.

Bohemund VI (1237–1275) was the son of Bohemund V by Luciana, a daughter of the count of Segni (nephew of Innocent III), and succeeded his father in 1252. His sister Plaisance had married in 1250 Henry I of Cyprus, the son of Hugh I; and the Cypriot connection of Antioch was thus maintained. In 1252 Bohemund VI established himself in Antioch, leaving Tripoli to itself, and in Feb. 1258 he procured the recognition of his nephew, Hugh II of Cyprus, as king of Jerusalem. In 1268 he lost Antioch to the Mamelukes under Baybars. Thus fell the richest and oldest of the Frankish middle eastern principalities. Bohemund died in 1275.

Bohemund VII (d. 1287), son of Bohemund VI by Sibyl, sister of Leo III of Armenia, succeeded to the county of Tripoli in 1275, with his mother as regent. He had trouble with the Templars who were established in Tripoli, and in the very year of his death he lost Laodicea to the sultan of Egypt. He died without issue, and within two years Tripoli was captured by the Egyptians (1289).

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BÖHM, GEORG (1661–1733), German composer known for his keyboard music. He was born at Hohenkirchen, near Ohrdruf, Thuringia, Sept. 2, 1661, the son of an organist-schoolmaster. After an early education at Goldbach and Gotha, he went to Jena university in 1684, and left probably in 1690. In 1698 he became organist of St. Johannis, Lüneburg, where he remained until his death on May 18, 1733.

Bach may possibly have studied with Böhm, and was certainly influenced by his work. Though Böhm wrote many cantatas and sacred songs, he is chiefly remembered for his keyboard works, in which he deploys differing styles for harpsichord and organ. The harpsichord suites are in the manner of J. J. Froberger. Böhm is at his most original, however, in his impressive toccatas, preludes, fugues and postludes for organ, and above all in his organ partitas on chorale melodies, where he shows an independence and freedom owing much to the spirit, though not to the technique, of earlier harpsichord suites. His collected works were edited by J. Wolgast, two volumes (1927–33). (C. P. Co.)

BÖHM-BAWERK (Böhm von Bawerk), **EUGEN** (1851–1914), Austrian economist, was born at Brünn on Feb. 12, 1851. He was professor of economics at Vienna and several times Aus-

trian minister of finance. Böhm-Bawerk's theory of interest, based on a combination of the time preference and marginal productivity principles and derived from the marginal utility theory of value—of which he also gave the most comprehensive presentation—marks a major step forward in the understanding of why capital yields profit. Even critics of his theory recognize his merits as a historian of interest theories; his critical analysis of the Marxian theorem of the declining rate of profit is widely regarded as a classic. Having shown earlier that interest must appear in all rational economic calculation, even in that of a noncapitalist society, he developed, toward the end of his life, a general concept of laws of economic rationality, valid regardless of the social order and limiting the effectiveness of power in economic affairs. His work, like that of other opponents of socialism, contributed substantially to the development of non-Marxist socialist theory after 1918.

Böhm-Bawerk's most influential writings were *Capital and Interest* (1884–89), trans. by William Smart (1932); *Positive Theory of Capital* (1891), trans. by Smart (1923); *Karl Marx and the Close of His System* (1896), translated and published together with related essays by other authors (1949); and *Control or Economic Law?* (1914), trans. by John R. Mez (1931). His collected essays were edited by F. X. Weiss (1924–26). (C. L.)

BÖHME (Böhm, Boehme, Boehm, Behmen), **JAKOB** (1575–1624), German mystic and philosophical theologian, early proponent of life philosophy (*Lebensphilosophie*), was born on or before April 24, 1575, in Altseidenberg, near Görlitz. After brief schooling he became a shoemaker. In 1600, under the influence of his Lutheran pastor, Martin Möller, he had a remarkable religious experience wherein he was given to know that "in Yes and No all things consist." This, the dialectical principle, became the germinating core of his thought, growing as he matured, leading him to write 29 books and tracts wherein he sought to reconcile the speculative thought of his time with a more traditional mysticism.

Böhme's first book, *Avrora, oder Morgenröthe im Aufgang* (1612), which he himself called "my childlike beginning," brought condemnation from ecclesiastical and civil authorities. After seven years of enforced silence he again took up his pen in 1619 to expound his views, and during the next six years he wrote some astonishing philosophical, theological and devotional works. Growing rapidly in his speculative powers, his mind broadened by contact with contemporary thought, he gained maturity in two works written in 1623: *Von der Gnadenwahl* ("On the Election of Grace") and *Erklärung über das Erste Buch Mosis*, better known as *Mysterium Magnum*. His devotional works were gathered by his admirers in a collection known as *Der Weg zu Christo (The Way to Christ;* 1623), and they have been reprinted often. He died on Nov. 17, 1624, leaving uncompleted several works that showed promise of even greater achievement.

Böhme's greatest speculative problem was to try to show how the Yes and No, good and evil, dark and light, came from the living heart of reality. His chief religious problem was to show how the duality of life, including the stubborn presence of evil in the world, was to be overcome through the reconciliation of these contrasts in spiritual unity. His speculations then tried to show how a dual and even threefold world emerged from a single source, how a threefold God emerged from one primitive power and how a threefold human nature came from the original creative act. These speculations, however, were a prelude to his chief interest: how this divided world is to be made one again, how the wrathful principle in nature and the stubborn recalcitrance of human sin are to be overcome. Böhme's thought took some bizarre turns, chiefly verbal, in his earlier works, and his reputation has suffered because of it.

Yet in spite of the Faustian mood sometimes associated with his work, his ideas have had far-reaching effect on western thought, both philosophical and religious. He was a main influence on the romantic age as well as on Schelling, Hegel, Schopenhauer, Nietzsche, Hartmann, Bergson, Heidegger and other philosophers. His religious thought was influential on George Fox and the early Quakers as well as on a host of German Pietists. Furthermore his influence continued to be reflected in modern theologians such as Nicolas Berdyaev and Paul Tillich.

Böhme's works were edited in collected editions by Gichtel (1682), Glusing (1715) and Ueberfeld (1730), the last being reprinted as the authoritative text by Peuckert (1955 *et seq.*). Early English translations by J. Ellistone, J. Sparrow and Blunden were reprinted by Watkins, and later translations of some tracts were made by Earle and Stoudt.

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BOHOL, an island and province north of the Mindanao sea in the Republic of the Philippines. Pop. (1960) 592,194. The province includes numerous small coral islands off the north and west coasts. The main island is composed of a volcanic core, in most places covered with coralline limestone, and has a land area of 1,575 sq.mi. It is generally flatter on the north and west coasts than on the east and south, where hills oftentimes rise abruptly almost from the water's edge. In the west central portion of the island and extending onto the Loon peninsula to the west are the spectacular "chocolate drop" or "haycock" hills. They are roughly symmetrical, conical limestone remnants of an earlier erosion cycle, a phenomenon known to be present in only two or three other places in the world.

Bohol is primarily an agricultural island and has about 25% of its land surface under cultivation. Rice, corn and coconuts are the principal crops, but tobacco, abacá, maguey and some fruit and vegetables are also grown. A secondary livestock industry, on the rougher terrain near the east coast, is centred at Ubay. Tagbilaran is the capital and commercial centre. Pop. (1960) 20,250. Loon (30,370) and Ubay (34,090) are the most populous municipalities. (An. C.)

BOHR, HARALD AUGUST (1887–1951), Danish mathematician, brother of the physicist Niels Bohr, was born in Copenhagen, April 22, 1887. He won early fame as a soccer player. He received his Ph.D. in 1910, became professor at the Polytechnic institute in Copenhagen in 1915, and at the university in 1930. His early mathematical research was mainly concerned with Dirichlet series and their application to analytic number theory through the Riemann zeta function. His most notable contribution to mathematics was the creation of the theory of the almost periodic functions. Bohr died in Copenhagen Jan. 22, 1951. (O. Oe.)

BOHR, NIELS HENRIK DAVID (1885–1962), Danish physicist, one of the most ingenious interpreters of his generation of the problems in modern theoretical physics. Born at Copenhagen on Oct. 7, 1885, Bohr received his doctorate at the University of Copenhagen in 1911, and proceeded immediately to the Cavendish laboratory at Cambridge, Eng., for further study under Sir J. J. Thompson. The following year he worked under Sir Ernest Rutherford at Manchester, Eng. Experiments by the latter in 1911 on the scattering of alpha-rays (*see* Radioactivity) had led Rutherford to propose a new "nuclear" theory of atomic structure.

Only ten years before, Max Planck, in Germany, had proposed a novel idea with respect to radiation—that it came forth from or was absorbed by atoms only in restricted amounts, or "quanta," of energy. Young Bohr, on his return to Copenhagen in 1913, following his year with Rutherford, applied the Planck quantum hypothesis to the Rutherford nuclear atom model, in an attempt to account for the known facts of radiation emitted by atomic structures. Hitherto these phenomena were completely obscure in terms of any classical theory. Bohr proceeded first by making two exceedingly bold assumptions: (1) that the electron cloud of any atom was a stable, nonradiating system when and only when its component electrons were each in certain "stationary states" of energy appropriate to each electron; (2) that radiation, when absorbed or emitted by an isolated atomic system, must be strictly monochromatic (*i.e.*, of a single frequency), and that this occurred when and only when the total energy of the atom was changed by

the transition of some one of its electrons from one of its many possible stationary states to another. At once Bohr was able to calculate very closely the frequencies of the entire spectrum of atomic hydrogen. His two assumptions remained a fundamental for modern theories of atomic structure. Supplementary to Bohr's two postulates was a statement of a "correspondence principle" to the effect that in certain limiting cases the laws of quantum theory converge toward and become identical with the laws of classical mechanics. Modern wave-mechanical theories (*see* QUANTUM MECHANICS: *The Bohr Atom*) confirmed Bohr's stationary states by criteria for stationary "electron waves"; and later the additional attribute of spin and the consequent possession of a magnetic moment by atomic electrons was all that was needed to make the restrictions on angular momenta of atomic electrons, that were implicit in Bohr's hypotheses, conform to the measurements of atomic spectra of later years.

U.P.I. COMPIX

NIELS H. D. BOHR, AT AGE 72, ON HIS ARRIVAL IN THE U.S. TO ACCEPT THE ATOMS FOR PEACE AWARD

Bohr's great achievement was recognized internationally by the Nobel prize award to him in 1922 and by many other honours, which included the Atoms for Peace award in 1957. In Jan. 1939 Bohr attended the Fifth Washington Conference on Theoretical Physics. He was then head of the Copenhagen Institute for Theoretical Physics, which had been established through his influence in 1920 and had become one of the leading intellectual centres of Europe. He brought to this conference the interpretation by Lise Meitner and Otto R. Frisch of his institute, that in the fission of uranium a crude analogy between an unstable heavy atomic nucleus and a rupturing water drop might be hazarded. Within a two-week period, a three-column letter to the editor of the *Physical Review* appeared in that journal in which he laid the broad foundations of a "liquid droplet" theory of nuclear phenomena. There followed extensive publications by Bohr and others showing provisional verification by observations of this second bold approach, this time toward understanding the innermost central character of atomic systems. He was awarded an honorary doctor of laws degree in 1961 by Harvard university. Bohr died in Copenhagen on Nov. 18, 1962.

English translations of Bohr's work include *The Theory of Spectra and Atomic Constitution* (1922); *Atomic Theory and the Description of Nature* (1934); and *Atomic Physics and Human Knowledge* (1962). *See* also references under "Bohr, Niels Henrik David" in the Index.

See W. Pauli, *Niels Bohr and the Development of Physics* (1955). (H. B. LM.; X.)

BÖHTLINGK, OTTO VON (1815–1904), German Sanskrit scholar whose works are of great value in Indian and comparative philology, was born on June 11, 1815, at St. Petersburg, Russia. In 1868 he settled at Jena, and died at Leipzig on April 1, 1904. His first great work was an edition of Panini's *Acht Bücher grammatischer Regeln* (1839–40), which was in reality a criticism of Franz Bopp's philological methods. This book Böhtlingk again took up 47 years later, when he republished it with a complete translation under the title *Paninis Grammatik mit Übersetzung* (1887). The earlier edition was followed by *Vopadevas Grammatik* (1847); *Über die Sprache der Jakuten* (1851); *Indische Sprüche* (2nd ed., 1870–73, to which an index was published by Blau, 1893); and other works. But his magnum opus is his great Sanskrit dictionary, *Sanskrit-Wörterbuch* (1853–75; new ed., 1879–89), which, with the assistance of his two friends, Rudolf Roth (1821–95) and Albrecht Weber (1825–1901), was completed in 23 years.

BOHUN, the name of an English family of Marcher lords prominent in the 13th and 14th centuries. Of Norman origin, the Bohuns went to England in or soon after 1066, but were not at first of much importance, and their early genealogy is somewhat uncertain. HUMPHREY DE BOHUN (d. 1129) acquired Trowbridge and lands in Wiltshire by marriage, but the true founder of the family fortunes was his son, HUMPHREY (d. *c.* 1166), whose marriage to Margaret, elder daughter of Miles, earl of Hereford (d. 1143), later brought the Bohuns the lion's share of his vast inheritance in the Welsh border counties, together with the office of constable of England. It was probably this Humphrey's son HUMPHREY (d. *c.* 1183) who, as constable, commanded the royal forces that routed the English rebels of 1173 at Fornham in Suffolk, and helped to defeat the Scottish invasion in 1174. He later married Margaret, sister of the captured King William of Scotland.

His son HENRY (d. 1220), who was created earl of Hereford by King John in April 1200, was one of the 25 lords elected to maintain the Magna Carta, and in the subsequent civil war he fought for the baronial party and was captured at the battle of Lincoln in 1217. His marriage to Matilda, sister and heiress of William, the last Mandeville earl of Essex, brought their son HUMPHREY (d. 1275), 2nd earl of Hereford, the title of earl of Essex (1236) and great estates in that county. Humphrey took part in the baronial movement (1258–65) against Henry III, but by 1263 he rejoined the royalists and was captured by Simon de Montfort at the battle of Lewes in 1264. His son HUMPHREY (d. 1265), however, was steadfast in his support of De Montfort, and died of wounds received fighting with him at the battle of Evesham (1265). This Humphrey made another of the judicious marriages which enriched the family fortunes: his wife, Eleanor, daughter of William de Braose, inherited the Welsh lordships of Brecon, Hay and Haverfordwest. Humphrey, 2nd earl of Hereford, was succeeded by his grandson, HUMPHREY (*c.* 1249–98), 3rd earl, who served Edward I loyally in his Welsh wars. Despite the unjust treatment he received when Edward I gave judgment in his disputes with John Giffard (1284) and the earl of Gloucester (1291–92), it is doubtful whether personal disaffection inspired his opposition to the king in 1297. With the marshal, Roger Bigod, earl of Norfolk, he refused to serve abroad unless the king were present in person, and the two earls led the movement which forced Edward I to confirm the charters.

HUMPHREY (*c.* 1276–1322), 4th earl, joined the lords ordainer against Edward II and helped to overthrow Piers Gaveston in 1312. He was taken prisoner at the battle of Bannockburn (1314), but was exchanged for the wife of King Robert I. He later supported the "middle party" until the rise of the Despensers drove the Marcher lords into rebellion; he was killed in the civil war that followed, at the battle of Boroughbridge on March 16, 1322. His sons and successors in the earldom, JOHN (1306–36) and HUMPHREY (*c.* 1309–61), led retired lives: neither was able to perform his duties as constable, and probably both suffered from a lifelong infirmity. The most active member of the family during this period was their younger brother WILLIAM DE BOHUN (d. 1360). He fought at the battles of Sluis (1340) and Crécy (1346), was the king's lieutenant in Brittany in the 1340s, and served against Scotland as admiral. Edward III rewarded his efforts with grants of land and the title of earl of Northampton (1337). William's son HUMPHREY (1342–73), succeeding both his father and his childless uncle, Humphrey, temporarily united the three Bohun earldoms of Hereford, Essex and Northampton in his own person, but his death without issue ended the male line of the family. His estates were partitioned between his daughters, ELEANOR (1366–99), wife of Thomas of Woodstock (afterward duke of Gloucester), whose share passed to the Staffords, and MARY (*c.* 1370–94), wife of Henry, earl of Derby (afterward Henry IV), who carried her portion to the house of Lancaster. (C. D. R.)

BOIARDO, MATTEO MARIA, CONTE (1441?–1494), Italian poet whose *Orlando Innammorato* was the first poem to

combine the Arthurian and Carolingian traditions of romance, was born at Scandiano, near Reggio Emilia, in May 1441. He spent much of his life after 1476 at Ferrara, under the patronage of the dukes of Este. He was captain of the ducal forces at Modena from 1480 to 1482, and at Reggio from 1487 until his death there, Dec. 19, 1494. Apart from his duties, his time was taken up by controversies with his relatives arising from a hereditary feud and, after his marriage (1479), with the care of his family.

His chief pleasure was in study and poetry and he wrote numerous works, both in Latin and Italian. Of the Italian the *canzoniere, Amorum libri tres* (published 1499), tells of his love for Antonia Caprara and, despite the strong Petrarchan influence, remains the most personal and spontaneous collection of lyrics in the 15th century. *Orlando Innammorato,* begun about 1476, was intended to consist of three parts, but only the first two (published 1483) and nine cantos of the third were completed at the poet's death. The great importance of *Orlando Innammorato* (to which Ariosto's *Orlando Furioso* was conceived as a sequel) is that it combines the Arthurian cycle of chivalrous love adventures with the Carolingian cycle glorifying military honour, patriotism and religion. The poem was not popular during the Renaissance, partly because of its dialectical and erudite language, partly because of the careless construction of the episodes and characters, but chiefly because of its delineation of strong and primitive passions, which, a true expression of Boiardo's poetic genius, was not in tone with the tendencies of the time.

Boiardo's complete works in two volumes were edited by A. Zottoli (1936–37).

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BOIE, HEINRICH CHRISTIAN (1744–1806), German writer and journalist, founder and editor of some influential literary periodicals, was born in Meldorf, Holstein (then part of Denmark), July 19, 1744. After studying theology and law at Jena he went to Göttingen in 1769. There, in 1770, he founded with Friedrich Gotter the *Musenalmanach,* which he edited until 1775 and then, with Christian von Dohm, produced *Das deutsche Museum* (1776–91; from 1789 *Neues deutsches Museum*). These periodicals—*Das deutsche Museum* was one of the best of its day—provided both an outlet and a stimulus for the Göttingen *Dichterbund* or *Hain,* the younger poets in revolt against the French influence of the Enlightenment. Boie became secretary to the commander in chief at Hanover (1776) and administrator of Süderditmarschen, a province of Holstein (1781). He died at Meldorf, March 3, 1806.

See K. Weinhold, *H. C. Boie* (1868); W. M. C. Hofstätter, *Das Deutsche Museum und das Neue Deutsche Museum* (1908).

BOIELDIEU, FRANÇOIS ADRIEN (1775–1834), French composer who developed the comic opera into an early form of romantic opera. Born at Rouen on Dec. 16, 1775, he studied with the cathedral organist, Charles Broche. His first operas were produced in 1793 and 1795. At Rouen he also composed and performed numerous piano sonatas, remarkable for their form, which constitute the first important body of works written for the piano by a French composer. In 1796 he settled in Paris where he met Joseph Méhul and Luigi Cherubini, and in the following year produced three one-act comic operas, *La Famille Suisse, L'Heureuse Nouvelle* and *Le Pari,* which established his reputation. Appointed professor of the piano at the conservatory in 1798, he continued to write for the theatre, his main successes being *Le Calife de Bagdad* (1800) and *Ma tante Aurore* (1803). From 1804 to 1810 he was chapelmaster and director of the opera at St. Petersburg where he wrote a score of choral music for Jean Racine's *Athalie.* Appointed director of music to Louis XVIII in 1816, he was elected a member of the French institute in 1817 and professor of composition at the conservatory in 1820. His main operas of this period were *Jean de Paris* (1812), *Le Petit Chaperon Rouge* (1818) and *La Dame blanche* (1825), on a libretto of Eugène Scribe derived from Scott's *The Lady of the Lake, The Monastery* and *Guy Mannering.* Proclaimed his masterpiece, it remained a standard work in the repertory of French opera. His last opera, *Les Deux nuits* (1829), contains some fine music but has a poor libretto. Ruined by the revolution of 1830, he died at Jarcy on Oct. 8, 1834.

Boieldieu's work illustrates the evolution of French operatic and instrumental music in the generation following the French Revolution. His operatic style in its lighter aspects was compared to that of Rossini. In scenes of mystery and romance that suggest Weber, particularly in *La Dame blanche,* he brought the comic opera to the borders of romantic grand opera. Besides operas and piano works he wrote numerous romances for voice accompanied by harp or piano, some showing his original melodic gifts.

See G. Favre, *Boieldieu: sa vie, son oeuvre,* 2 vol. (1944–45) and *La Musique française de piano avant 1830* (1953). (E. Lr.)

BOII, a Celtic tribe, one section of which settled in Cisalpine Gaul and another in what was later Bohemia, to which it gave its name. The history of both sections is puzzling and the relationship between them impossible to establish confidently. Livy, writing in the late 1st century B.C., stated that the Boii came over the Great St. Bernard pass about 600 B.C. But their lands in Italy were later concentrated around Bononia (Bologna), where archaeology shows that the Etruscans still held Felsina (the city's earlier name) well after 400 B.C. So even if Livy's date for the first Celtic invasions of Italy is correct, it would be doubtful whether the Boii in particular crossed so early; and the route he gives them seems impossible. In 283 the Boii were defeated by the Romans at Lake Vadimo (south of Orvieto), and in 225 at Telamon (Talamone) in Etruria. They gave valuable help to Hannibal in 218, and continued to resist Rome between 201 and 191; but they were then completely subdued and lost half their lands, Bononia being made a Latin colony in 189.

Archaeological evidence proves the existence of Celtic occupation in Bohemia by, at latest, 400 B.C. The first writer to mention Boii in this district is Julius Caesar, according to whom they crossed the Danube in 60 B.C. and attacked Noreia (Neumarkt in Styria in Austria). The Helvetii (*q.v.*) were joined by 32,000 Boii in invading Gaul, and Julius Caesar after his victory near Bibracte (Mt. Beuvray) in 58 allowed their survivors to settle in the territory of the Aedui between the Liger (Loire) and Elaver (Allier) rivers. The remaining Boii south of the Danube were exterminated by Burebista of Dacia about 50 B.C., and those in Bohemia were expelled by the Marcomanni (*q.v.*) in 8 B.C.

Strabo stated that many Boii were expelled from northern Italy in 191 B.C. and settled near the Danube; this is possible, but may simply be an attempt to explain the Bohemian Boii, who probably arrived much earlier. Most modern scholars suppose two roughly simultaneous migrations from Gaul, one eastward, the other across the Alps. If, however, the Boii entered Italy not by the St. Bernard but by the Brenner pass, they may have been an offshoot from a slightly earlier settlement near the Danube, coming to join other Celts already established in the Po valley.

BIBLIOGRAPHY.—Polybius, *Histories,* ii, 14–35, with commentary by F. W. Walbank (1957); Caesar, *Gallic War,* i, 5, 28–29; Strabo, *Geography,* v, 213; Tacitus, *Germania,* with commentary by J. G. C. Anderson (1938); J. M. Navarro in *Cambridge Ancient History,* vol. vii, pp. 41 ff. (1928). (G. E. F. C.)

BOIL. A boil (or furuncle) is an acute local inflammation of the skin and underlying tissues resulting from an infection by the bacterium *Staphylococcus aureus* that begins around the hair follicle and its associated sebaceous gland. From the time inflammation becomes noticeable, the boil increases variably in size with swelling, redness and pain. It ordinarily drains spontaneously through the follicle opening.

Groups of boils in which many hair follicles are infected are called carbuncles.

The term boil has also been applied to a variety of tropical infections of the skin but is properly used only with staphylococcal infections. *See* also Skin, Diseases of.

(D. M. P.)

BOILEAU-DESPRÉAUX, NICOLAS (1636–1711), French poet and literary critic, celebrated as the most influential exponent of classical standards for poetry, was born in Paris on Nov. 1, 1636, the son of a registrar of the grande chambre in the

parlement who had originally been a mere clerk in the registry (the poet's claim to be descended from a noble 14th-century family was based on forged documents). His mother died when he was 18 months old, and his childhood was not too happy. After studies at the Collège d'Harcourt and then at the Collège de Beauvais, which he left in 1652, he read law and was admitted as an advocate on Dec. 4, 1656. Early in 1657, however, his father died, and Nicolas promptly abandoned his legal career. He turned to the church and had himself tonsured, only to become a layman again.

Following the example of his brother Gilles Boileau, who was already well known as a man of letters, Nicolas tried his hand at poetry. At first he wrote satires, seeing himself as a rival to Juvenal. Next, from 1668 on, he wrote verse epistles in the manner of Horace. Then, in 1674, he published *L'Art poétique* and a translation of the pseudo-Longinus *On the Sublime*, as well as the first four cantos of *Le Lutrin* (the remaining two were not published until 1683). At this time he enjoyed the patronage of Madame de Montespan to a high degree, and in 1677 she secured his appointment as historiographer royal. For the next 15 years he refrained from expressing too forcefully his low opinion of contemporary poets. He was elected to the French academy in 1684.

In 1692 Boileau returned to controversy, angered by the success of the "moderns" against the "ancients." Regarding women as the most active supporters of the moderns, he wrote his satire *Contre les femmes* (published as *Satire x*, 1694). Thenceforward he found himself drawn into writing several more satires and epistles. When current controversy took an increasingly religious turn, he published his epistle *Sur l'amour de Dieu* (*Épitre xii*, 1698) and began another satire, *L'Équivoque*, against the Jesuits and the moderns. This last piece occupied his life from 1703 on and from 1707 to 1711 he tried in vain to get permission to publish it.

Boileau's last years were spent at Auteuil, where in 1685 he had bought a house in a handsome garden. There he was pleased to act as the grand old man of French literature, the last survivor of the age of greatness. He died in Paris on March 13, 1711.

Satires.—Boileau's satires must be considered in two groups: the first nine, written 1660–67; and the last three, written from 1692 on. The first nine, originally composed to be read in manuscript to a circle of friends, treat established reputations very disrespectfully, so that when an unauthorized edition of six of them appeared (1665), Boileau was seriously frightened and hurriedly issued an authorized edition (1666) with the most daring passages suppressed and the names of the victims altered. These early satires are lively and powerful, but it is clear that when he wrote them Boileau was not thinking of setting himself up as the legislator of Parnassus. For the later satires *see* above.

Epistles.—Boileau's *épitres* were intended to give him a more respectable air. Between 1669 and 1677 he published nine. Much more reserved in tone than the satires, the epistles have nevertheless certain merits, but noticeably less than those of Horace. In his old age he added three more to the series.

Le Lutrin.—This poem deals with a dispute among the canons of the Sainte-Chapelle in Paris which had caused some amusement in 1667. Boileau was well qualified to judge what had been going on and gives an amusing account of it. *Le Lutrin* is a burlesque poem on the lines of Alessandro Tassoni's *Secchia rapita* (1624), parodying epic style by applying it to a trivial topic.

L'Art Poétique and Traité du Sublime.—Long regarded as the voice of "everlasting reason," *L'Art poétique*, a didactic treatise in verse, has been of the greatest importance in the history of French and English classical poetry. Modern criticism, however, recognizes its intrinsic value to consist in the light that it sheds on literary controversy in the classical period.

The original mistake was the belief that Boileau had himself determined the rules that he defined. It is now accepted that, on odes, Boileau only says what Charles Cotin had said better before him; that Boileau's rules for tragedy were expounded quite satisfactorily by Jean Chapelain in 1630 and by the abbé d'Aubignac (François Hédelin) about 1640; that Boileau did nothing to destroy the vogue for burlesque, since burlesque died about 1656, before he had published a single line; and that the abbé Claude Fleury, with whom he was well acquainted, said ten years previously what Boileau had to say about eclogues. *L'Art poétique* is interesting, however, as a statement on behalf of the ancient party against the moderns. Boileau defines the literary forms used by the ancients because they, by implication, exclude these used by the moderns. He defines tragedy in order to set it up against the love-dramas that the moderns were producing and he attacks the Christian epic because the moderns had ill-advisedly raised the subject in the course of the controversy.

The same motivation was behind Boileau's *Traité du sublime*. The treatise *On the Sublime* attributed to Longinus had attacked meretricious ornaments of style, clever subtleties and turgidity—the very faults that Boileau discerned in the moderns. Also, the Greek treatise had hailed as "sublime" that same greatness of thought and imagery that Boileau recognized in the ancients and could not see in the moderns.

Good editions of Boileau's works are by Jacques Berriat Saint-Prix, 4 vol. (1830–37) and by Charles Boudhors (1932 *et seq.*)

See, for the original text of satires i–ix, A. Adam, *Les Premières Satires de Boileau* (1942) and for an assessment of Boileau's real position in the literary world of his time, Adam's *Histoire de la littérature française au XVIIe siècle*, vol. iii and v (1952–56). (AE. A.)

BOILER. In engineering, a boiler is a device for making steam from water. This operation requires a supply of heat at elevated temperature. The usual boiler has a furnace in which a fossil fuel (coal, oil or gas) is burned, and the heat released by combustion is subsequently transferred through metal walls to generate steam at a positive pressure within the boiler vessel. Some boilers utilize waste fuels and waste heat, as in certain industrial processes, or the heat from nuclear reactions, as in some atomic power plants.

The customary boiler, however, is direct-fired by a conventional fuel, and because of the two requirements—heat generation and heat absorption—the unit is more properly called a steam generator to indicate the inclusion of the many necessary components and accessories which reach beyond the simple implication of evaporation, or boiling from the liquid to the vapour state.

HISTORY

Introduction.—The origin of the steam boiler is contemporaneous with the invention of the steam engine. Its development has been a vital element in the successful generation of power by steam. In its earliest stages, during the 18th century, the pressure vessel or boiler was constructed of materials and in forms that were subsequently demonstrated to be entirely inadequate. Cast iron, lead, wood and brickwork—often in the form of flat surfaces—were prevalent. The tremendous potential hazards of such materials and designs were soon recognized. James Watt's "waggon" boiler (*see* below), built of wrought iron, marked a striking improvement in practice. Flat surfaces were stayed by the use of iron rods, and brickwork was reduced to a minimum by the incorporation of internal wrought-iron flues. These boilers operated at pressures of 5 to 25 lb. per square inch (p.s.i.) without undue hazards. With the development of the art of steam generation, pressures of approximately 100 p.s.i. were demanded in the latter half of the 19th century to serve compound steam engines. During the 20th century the introduction of steam turbines imposed tremendous burdens on the boiler designer. By the early 1960s boilers were being designed capable of generating steam at pressures as high as 5,000 p.s.i. with steam temperatures up to 1,200° F. Units were also being designed in sizes large enough to supply approximately 3,000,000 lb. of steam per hour.

The impact of this progress led to the exclusive use of steel for the pressure parts of the boiler and steel alloys, such as stainless steel, for the high-temperature parts of the superheaters. For economy in the use of metal and for maximum safety in the structure, boiler parts ideally should be of a spherical shape but for practical reasons are usually cylindrical. The pressure parts of modern boilers are essentially an assembly of steel cylinders, drums and tubes.

Safety.—The paramount need for safety in both the construction and operation of boilers was learned through bitter experience. No boiler can be built or run without full compliance with the

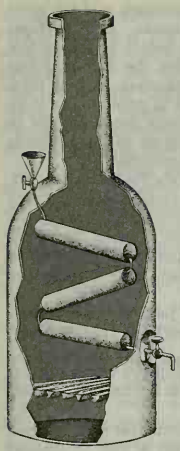

FIG. 1.—FIRST WATER-TUBE BOILER, BUILT BY WILLIAM BLAKEY IN 1766

most stringent boiler codes and laws, the enforcement of which rests within the police power of the state supplemented by the authority of the insurance underwriters. The design and construction of a boiler calls for most exact knowledge in the fields of machine design, metallurgy, heat transmission and fluid mechanics, coupled with experience of shop fabrication, welding and field erection techniques.

Early Boilers.—The earliest boilers recorded in history, such as those of Hero of Alexandria (*c.* 130 B.C.), were little more than playthings. During the Renaissance there were many attempts to picture or to devise ways in which the expansive power of steam might be utilized. Treatises by Matthesius in 1571, Ramelli in 1588, Branca in 1629 and Edward Somerset, marquis of Worcester, in 1663 all explored this fascinating subject. In 1679 Denis Papin devised a boiler that included what might be called the first safety valve. There followed more realistic efforts by Thomas Savery, 1698; Thomas Newcomen, 1690–1720; Haycock, 1720; John Allen, 1730; and others.

Watt's "Waggon" Boiler and Later Designs.—These early developments culminated in 1769 in James Watt's "waggon" boiler, the first truly successful boiler. It operated at 5 p.s.i. steam pressure. Just prior to Watt's invention William Blakey patented the first water-tube boiler in 1766 (fig. 1). In this same period the great improvements made by Watt and others in the steam engine resulted naturally in rapid development of boilers to provide the necessary steam. Richard Trevithick, about 1800, constructed a boiler for high pressure with an internal flue that gave much improved fuel economy. John Stevens, in 1803, invented a water-tube boiler of small tubes connected at one end to a reservoir. About 1820 the Cornish boiler appeared on the market and by successive steps was modified during the next 50 years, with many internal flues, ultimately leading to the fire-tube construction that was so popular toward the end of the 19th century. During this same period the water-tube boiler was being developed with the patent of Joseph Eve, 1825 (fig. 2), covering the first sectional design with well-defined circulation. In 1826 Goldsworthy Gurney employed small U-shaped tubes and in 1856 Stephen Wilcox was the first to use inclined water tubes connecting water spaces at the front and rear with a steam space above (fig. 3). There were many further steps in the development of the water-tube boiler using, for example, box headers or sectional headers, vertical or inclined headers, longitudinal or cross drums, curved tubes or straight tubes.

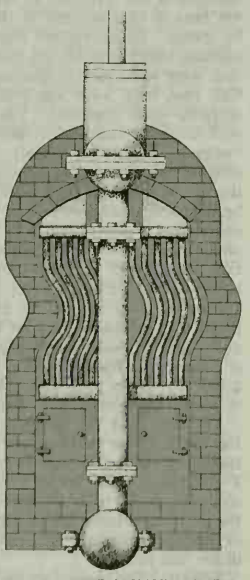

FIG. 2.—FIRST SECTIONAL WATER-TUBE BOILER WITH WELL-DEFINED CIRCULATION, BUILT BY JOSEPH EVE IN 1825

MODERN COMMERCIAL BOILERS

Introduction.—By the early 1960s the art of boiler design and manufacture had reached a degree of perfection that would have been considered unattainable only a short time previously. Before discussing the many aspects of modern boiler design, however, it would be well to illustrate the principle of operation of a typical steam generator so that the reader may become acquainted with the principal components involved and thereby be in a better position to understand the material that follows.

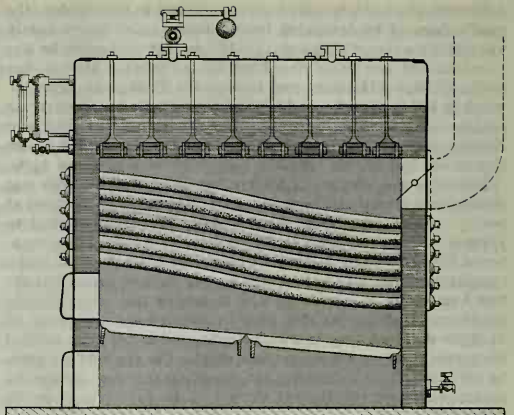

FIG. 3.—STEPHEN WILCOX BOILER OF 1856. INCLINED WATER TUBES CONNECTED WATER SPACES AT FRONT AND REAR WITH STEAM SPACE ABOVE

In a typical modern water-tube boiler the coal in lump form is stored in the coal bunker at a sufficient elevation to permit gravity feed through an automatic coal weighing device into the pulverizer. In the pulverizer the coal is ground into a fine dust, after which it is picked up by a stream of air coming from the air preheater and blown through tubes into the burners. In the burners the mixture of coal and air is joined by more air, called secondary air, from the air preheater, forming a combustible mixture that burns freely and creates a hot luminous flame that fills the furnace cavity. Heat from this flame is transferred to water circulating in tubes located around the walls and across the top of the furnace; when sufficient heat is transferred, steam is generated inside the tubes. This steam is released into the drum near the top and from there is delivered to the superheater tubes extending down into the furnace. The superheater tubes are arranged evenly across the furnace so that hot gases will pass over the tubes and transfer heat to the steam inside the tubes by convection. In this manner the steam is heated to a very high temperature before being delivered to the outlet header.

After passing over the superheater tubes the hot furnace gases are directed by baffles, passing first over tubes carrying relatively cold water from the large upper drum down to the centrally located drum; these tubes form a part of the natural water circulation system of the boiler. From here the gases flow over the economizer tubes and surrender additional heat. The economizer is a device for preheating boiler feed water before it enters the main boiler drum. From the economizer the flue gases pass down over the tubes of the air preheater, giving up additional heat to air needed for combustion. In this manner air coming from the forced-draft fan is preheated before joining the fuel in the pulverizer and burners. This increases combustion efficiency and also extracts valuable heat from the exhaust gases before they are discharged through the fly-ash separator, induced-draft fan and stack to the atmosphere.

The foregoing describes only one particular design and is presented to give the reader a general idea of the arrangement of drums, tubes and other components in a modern boiler. There are very many other designs and no one design or type is superior to all others, but each is good for some specific service conditions. The attempt to meet different kinds of service conditions leads to the wide diversity of designs found in modern usage.

Fire-Tube and Water-Tube Types.—Boilers are usually classified according to whether they are of (1) the fire-tube or (2) the water-tube type. In the former the hot gases from the furnace flow inside steel tubes, approximately four inches in diameter, with water on the outside of the tubes. In the latter the situation is reversed and the boiling water is inside tubes, from one to four inches in diameter, with the hot gases circulating over the outside of the tubes. Fire-tube boilers use straight tubes while water-tube boilers use either straight or curved tubes.

Each type requires a drum that is partially filled with water. The drum serves the important purpose of allowing the steam bubbles to be separated from the mass of boiling liquid, thus assisting in the delivery of dry or nearly dry (99% moisture-free) steam. In fire-tube boilers the drum surrounds the nest of tubes that are rolled into flat tube sheets. The tubes serve to stay or brace the tube sheets and are limited to a length of from 20 to 25 ft. so that boilers for pressure of more than 200–300 p.s.i. and capacities of more than 25,000 lb. per hour cannot be built without excessive drum thickness. Water-tube boilers, on the other hand, do not have these limitations because the tubes are outside the drum and a unit for 2,500 p.s.i. pressure, delivering 1,000,000 lb. of steam per hour, might have a 60-in. diameter drum, 6 to 8 in. thick and 45 ft. long. Drum thicknesses for lower pressures would be proportionately less.

The respective advantages of the two types of boilers are: for fire-tube boilers, simple, inexpensive construction for low-capacity and/or low-pressure service; for water-tube boilers, suitability for high pressures and temperatures, with maximum efficiency, flexibility in design and arrangements, quick steaming and maximum safety. Prior to 1900, this last advantage was so clearly recognized that the water-tube boiler was often called the safety boiler. The divided structure, together with the small quantity of water in the pressure vessel, serves to reduce the potential severity of explosion.

Service Criteria.—The wide variety of acceptable designs of commercial boilers is the consequence of attempting to meet the service conditions with the most satisfactory arrangements. The following service criteria are significant in dictating features of design acceptability:

Safety.—There is no substitute for a safe structure. The risks of potential damage by the expansive energy of hot water under pressure are so great that it is often necessary to sacrifice otherwise desirable features in order to comply with the requirements of codes and regulations for the design, construction and operation of boilers and other pressure vessels. The absolute requirement of safety is most clearly recognized when one considers the installation of a boiler in a hospital, theatre or ship.

Shape.—The physical shape is determined by the service application. For example, a locomotive boiler must conform to the limitations of the right of way as to headroom, width and radius of curvature of the track. The limitations on a marine boiler are entirely different. Those on a central station boiler are again different. If real estate is expensive, ground area occupied should be at a minimum and skyscraper construction prevails, with the boiler possibly 150 ft. high. If the stationary boiler is to be installed on inexpensive real estate, the structure can spread out laterally.

Bulk.—In transportation service, for example on a ship, it is desirable to use a design and details that restrict the amount of space occupied and thus improve the pay-load capacity of the vessel.

Weight.—Weight reduction is an objective in all commercial applications in order to keep the price of the boiler at a minimum. In transportation services, moreover, a reduction in weight, as well as in space occupied, increases equivalently the cargo-carrying capacity of the vessel or vehicle. Perhaps the most striking examples of both weight and bulk reduction are found in naval service. Such reduction leads to increased armament, cruising radius and speed—paramount objectives in naval-vessel effectiveness.

Setting.—A setting is necessary to confine the furnace operations and hot gases and to provide structural strength. Steel, brickwork and moldable refractories are the common materials employed. In transportation applications the attendant vibrations and pounding dictate the minimum use of brick, and the self-contained designs are preferred. For stationary service, the improved performance and maintenance obtained with brickwork can be utilized, if desired.

Character of Labour.—Highly skilled labour permits design details that could never be tolerated in regions where labour is unskilled.

Cleanability.—Impurities in furnace operations and in water lead to: (1) the fouling of surfaces by soot, slag and scale with attendant loss of capacity and efficiency; and (2) contamination of steam delivered by foaming, priming and ineffectiveness of separation with consequent fouling of equipment beyond the boiler. Provision must be made to facilitate removal of these impurities. The extent of the respective fouling sources will dictate design arrangement and details.

Life.—Some constructions are justified by long life, *e.g.*, public-utility plants, while others, as for contractors, need only short life.

Efficiency.—High efficiency can be built into a boiler by increased investment, if so desired. All applications, however, because of adverse fuel prices, load factors and the like, cannot support the same high investment. Efficiencies of boilers consequently show wide diversity.

Cost.—In any commercial application of a boiler the ultimate criterion of suitability rests in the total cost of the steam produced. This must reflect the carrying charges on the investment, together with the costs for fuel, labour, maintenance and supplies. In certain noncommercial applications, such as naval service, the cost criterion is subordinate to other needs, in this case, military efficiency.

General.—The preceding factors result in the wide diversity of boiler designs. The market requirements determine the propriety of alternative designs. The state of the art in the early 1960s is illustrated, in part, in the table. This material gives representative data and demonstrates the progress achieved through nearly two centuries of experience with boilers for power purposes. The limits of size, pressure, temperature and efficiency are all indicated in the table.

PRINCIPLES OF BOILER DESIGN

There are two important aspects of boiler design—structural and thermal. The scientific dictates of these phenomena must be combined with fabricating and operating techniques to give a suc-

Comparative Size and Capacity Data for Representative Modern Boilers

Application	Locomotive boiler	Marine boiler (large ocean liners)	Industrial boilers				Large utility boiler
			Horizontal return tubular boiler	Package unit	Small unit	Large unit	
Type	fire tube	water tube	fire tube	water tube	water tube	water tube	water tube
Fuel	coal, oil	oil	coal, oil, gas	oil, gas	coal, oil, gas	coal, oil, gas	coal, oil, gas
Steam output, lb. per hr.	50,000	150,000	15,000	30,000	100,000	600,000	1,750,000
Design pressure, p.s.i., gauge	250	850	175	250	450	1,500	2,700
Steam temperature, degrees F.	600 (superheated)	850 (superheated)	375 (saturated)	400 (saturated)	750 (superheated)	950 (superheated)	1,100 superheated and 1,000 reheated
Typical efficiency, per cent	50	88	70	80	86	88	90
Dimensions:							
Depth, ft.	47	16	13	22	35	54	80
Width, ft.	8	18	10	11	20	35	60
Height, ft.	9	19	26	12	35	120	150

cessful design. The rules of safety dominate, but the designer has great latitude within those rules to demonstrate his skill in the economic use of metal.

Structural Aspects.—A sphere, as noted previously, is the ideal form for a pressure vessel, but the difficulties of building spheres and the inadequacy of the spherical form for good heat transmission preclude its use and lead to the use of cylindrical parts—drums and tubes. The basic law of bursting strength states that the required thickness of a cylinder wall is directly proportional to the diameter of the cylinder and also to the internal pressure. Small diameters are therefore preferred to large diameters, and especially so with the higher steam pressures. The ends of cylinders must be covered and, since flat surfaces are the least desirable structural members, these ends are curved (bumped or dished) in order to avoid the use of stays and braces. Since water-tube boilers take the best advantage of these precepts, all large boilers (more than 25,000 lb. of steam per hour) and all high-pressure boilers (more than 200 or 300 p.s.i.) are of that type. Riveted construction was formerly used for drums, but welding superseded this technique. Boiler tubes are either seamless drawn or welded. Manholes and handholes are generally provided for access to internal parts. Tubes are arranged in bundles or banks together with drums and/or connectors by the use of expanding, rolling and welding techniques.

Provision must be made for supporting the dead weight of the boiler (perhaps as much as 2,000 or 3,000 tons). The difference between assembly and operating temperatures requires provision for unequal expansion of the parts without damage to the structure or associated equipment. Generally the boiler is so mounted that the drum is carried in slings or saddles and other parts are consequently free to move as needed. In marine applications the boiler is bottom-supported.

Thermal Aspects.—In the transfer of heat from hot gases to water in a boiler there are two objectives: (1) to transmit the most heat through a square foot of surface; and (2) to effect the transmission of the maximum quantity of heat generated in the combustion of the fuel. The first objective seeks to produce the maximum amount of steam per square foot of boiler surface. The second objective seeks to use the fuel or heat source with maximum efficiency. These objectives conflict because maximum steam-making capacity per square foot of surface calls for maximum temperature difference between gases and water, whereas maximum efficiency in the use of fuel calls for the maximum cooling of the gases and consequent lowest possible temperature for the gases leaving the surface. The latter means low temperature difference between gases and water, which is in opposition to the first objective.

Metals, it should be noted, lose their strength rapidly with increasing temperature. The problem, consequently, is to keep the metal safely below a predetermined maximum limit of temperature; *e.g.*, 950° F. with carbon steel, 1,200° F. with stainless steel. This requires a recognition of the fact that the flow of heat from furnace gases to boiling water is through a complicated path in which the hot gases offer a high thermal resistance while the metal and boiling water film offer thermal resistances that are only a small fraction of the gas film resistance. The metal temperature is accordingly fixed by keeping the metal wet. High heat-transfer rates, and therefore high steam-making rates per square foot of surface, are obtained by vigorous scrubbing action and gas flow velocity. If the metal is not kept wet, as when steam bubbles are allowed to accumulate, the metal temperature rises rapidly to a point where its structural strength is impaired; the metal then overheats, burns and ruptures. The metal temperature is controlled by ample circulation of water so that a scrubbing action removes the steam bubbles as soon as they are formed and replaces them with water to keep the surface wet. Circulation is usually accomplished by thermal convection effects. The boiler drum is placed at a sufficient height above the tube bundle so as to create a flowing current of liquid or steam-free water in the downcomers and a current of steam and water in the risers. The difference in density of these two columns establishes the convection circulation. Some large high-pressure boilers use pumps to control the circulation of the water. This results in greater latitude in the height and arrangement of surfaces but places dependence upon the reliability of the pump. Other designs, which can be adapted to operation at pressures above the critical (3,200 p.s.i.), use the once-through, or forced-circulation, principle.

With the provision of adequate circulation on the water side, it is then possible to improve heat transfer by reducing the thermal resistance of the gas side, which is essentially an insulating layer or film. This reduction is accomplished through suitable subdivision of the gas streams to give highly turbulent gas streams at high velocity. High temperatures, of course, are of great assistance in promoting heat transfer.

The surface that is exposed to direct radiation from the fire will generate the most steam per square foot not only because of temperature level but also because the gas film that clings to the surface does not retard radiant rays. High gas temperatures increase the steam-making capacity per square foot of boiler surface, but boiler efficiency cannot be high unless the furnace gases are cooled to the lowest practical value before discharge to the atmosphere.

High capacity per unit of surface and high efficiency are thus in opposition, and the designer must exercise his ingenuity and skill to get the most effective combination. In the ultilization of these skills, the water-tube boiler offers greater latitude of choice than does the fire-tube boiler, and therefore a greater diversity of designs of that type prevails. Curved tubes, in turn, give more freedom for choice in design than do straight tubes. The hot gases can be given flow direction over the surfaces by the judicious use of baffles.

Superheaters.—A superheater is a bundle of tubes arranged to take the steam from the boiler drum and raise its temperature a predetermined amount above the saturation value (perhaps as much as 300° or 400° F.). This assures the supply of superheated steam to, and the improved operating efficiency of, associated engines and turbines. Superheater tubes are of steel or steel alloys, usually 1 to 2.5 in. in diameter, and arranged in a general hairpin and continuous loop shape between inlet and outlet headers. Variations in arrangement and location in the boiler setting will change the performance characteristics. Resuperheaters, or reheaters, are incorporated in many large boilers to raise the temperature of the steam after it has been partially expanded in turbines operating on the reheat cycle.

Furnace Walls.—Refractory brick walls are satisfactory in small units but with high rates of firing in the furnace it is necessary to use water-cooled walls that are connected into the main circulatory system. Refractory cannot generally withstand the slagging and fusing action of the ash constituents of the fuel at high furnace temperatures. The extent and manner of water cooling is varied by the use of plain steel tubes, finned tubes and studded tubes, all with or without different thicknesses of plastic refractory. Outside the water tubes is an insulating jacket and casing that serves to keep the furnace gastight and to reduce heat loss to the surroundings.

Economizers and Air Heaters.—Economizers and air heaters are two important heat traps used in many boilers to improve efficiency by lowering the flue gas temperature below the value that could be obtained with boiler heating surface alone.

Economizers recover heat from the flue gases by transferring it to the feed water when the water is on its way to the boiler. This serves to raise the temperature of the water, usually without evaporation, and the water must be under boiler pressure. Economizers were formerly constructed of cast-iron tubes in the interests of corrosion reduction and cost, but cast iron proved unsuitable for pressures of more than 200 p.s.i. Steel-tube construction superseded cast iron. This necessitated the introduction of degasification of feed water to eliminate corrosion.

Air preheaters recover the heat from the flue gases by transferring it to the air supplied for combustion. This serves to raise the temperature of the furnace and to improve combustion rates and efficiency, as well as to lower the stack gas temperature and thus improve the over-all economy of steam making. Air heaters are of the recuperative or the regenerative type. The former generally

employs a bank of straight steel tubes, one to three inches in diameter, usually with the flue gases inside the tubes and air outside the tubes. The regenerative type, on the other hand, transfers the heat by the use of a slowly revolving drum of corrugated metal that moves alternately through the hot flue gas and cold air streams.

Economizers are more expensive than air heaters because of the pressure loading, but heat transfer rates are several times higher, so that there may be an economic advantage in their use. Flue gases, in any event, should not be cooled below the dew point (200° to 300° F.) or corrosion troubles will follow. Combustion air temperatures must not be raised too high (500° to 700° F.). Economic considerations ultimately determine the extent to which economizers and/or air heaters can be used.

Fuels, Furnaces and Firing.—The furnace is that part of the boiler into which the fuel—solid, liquid or gas—is fed, together with air, the resultant chemical reaction (combustion) releasing heat. Many stationary boiler installations are built to operate with either of two alternative fuels, and sometimes three, for most effective economics. Chemically there are only two elements of importance in this combustion reaction of fuel and air. They are carbon, which has a heating value of 14,100 B.T.U. per pound, and hydrogen, which has a heating value of 61,000 B.T.U. per pound. The basic chemistry of combustion is simple. Fuels, however, as presented by nature, contain many impurities such as water, sulfur and ash. Some of the carbon and hydrogen appears as hydrocarbon (volatile) compounds. It is in the burning of these fuels that many serious, and often unresolved, problems arise. In fact it is necessary to use a highly skilled fireman as well as to select a skilfully designed furnace. The release of heat is accomplished in the furnace, and the boiler surface will accept and transfer to water the heat that is so released. With a good furnace design it is possible to (1) reduce investment by generating the maximum amount of heat in a given furnace volume; and (2) reduce operating costs by high furnace efficiency. The latter requires the minimum of unburned combustibles in the furnace gases and in the refuse and the minimum of excess air to avoid dilution of the heat released and the lowering of the furnace temperature.

The problems encountered in attaining these objectives are concerned (1) with the feeding of fuel and air; and (2) with the mixing of the fuel and air, so that each molecule of carbon and hydrogen finds the necessary molecules of oxygen to produce carbon dioxide, water vapour and heat. The feeding is the easier problem and the mixing is the difficult, elusive problem with the goal a molecular mixture of chemical correctness.

Gaseous Fuels.—In the firing of gaseous fuels there can be varying degrees of mixing external to the furnace, thus changing the flame length and furnace volume.

Liquid Fuels.—In the firing of liquid fuels (oil burning) there can be no premixing of fuel and air. Fuel oil (Bunker C) for boiler firing is the heavy residue of refinery distillation. It is highly viscous, of good heating value (18,500–19,000 B.T.U. per pound; 145,000–150,000 B.T.U. per gallon), available in many markets at favourable prices and especially acceptable for marine applications regardless of price. As a substitute for the gaseous state, a spray-making device must be used when burning oil. Steam at 100 to 400 p.s.i. pressure can be used to atomize the fuel, or a mechanical atomizer may be employed in which the liquid fuel is put under pressure (from 100 to 1,000 p.s.i.) by a pump and delivered through a sprayer nozzle or tip into the furnace.

The alternatives in the choice of steam *v.* mechanical atomizers are based upon the operating range of capacity, the value of the water lost with steam atomizing and the over-all cost. Fuel is delivered by tanker, tank car or truck to large outdoor storage tanks or directly to the ship's hold for marine service. It is recovered from storage, as needed, with a system of pumps, strainers and heaters, to deliver clean fluid oil to the burners. Surrounding the burners are air louvers and registers to control and direct the requisite quantity of air and to contribute the necessary mixing and turbulence in the furnace.

Coal.—Because of prevalence and cost, coal is the common fuel for boiler firing. It is burned either in solid form, as on a grate, or, when pulverized, in suspension. The solid form of the fuel and its high ash content create problems not present in gas and oil firing. In installations burning less than half a ton of coal an hour, a fixed, shaking or dumping grate, with hand firing, may be used. Hand firing results in maximum labour costs and poorest efficiency because of poor control over combustion conditions. Stokers are used for mechanical capacities beyond the limit of hand firing and burn at rates as high as 10 or 20 tons of coal per hour. The stoker is more than a mechanical coal feeder. It is constructed to permit the feeding and proportioning of air, the removal of ash and the distillation, gasification, mixing and burning of the combustible.

One stoker type is the chain grate, in which a layer of coal three to six inches thick is fed in at the front end, with the grate traveling at a speed of about one foot per minute and refuse being discharged at the back end. This type is suitable for burning anthracite and noncaking bituminous coals.

Spreader stokers have a feeder mechanism that projects the coal onto a dumping or moving grate. These stokers carry thin fire beds (one to two inches thick), are built in sizes up to 15 tons per hour and are suitable for burning almost any coal but anthracite.

Underfeed stokers are used with coals that cake. Green coal is introduced from below into troughs fed by rams that serve not only to feed coal but also to break up the cake by agitation of the bed. On the inclined sides of the troughs are tuyères for the introduction of air. The coal gradually works to the upper surface of the fuel bed as it becomes incandescent. The entire mass moves slowly to the ashpit at the rear. The fuel bed is about two feet thick and is a good device for distillation, gasification, mixing and combustion.

Pulverized coal requires a mill where the coal is ground to the fineness of a powder (approximately 70% through a 200-mesh screen). Coals differ in grindability and require from 10 to 25 kw.hr. per ton for pulverizing. The system must have drying devices to avoid packing. The powdered coal may be delivered directly to the burners (unit system) or to a bin (storage system) from which it is in turn delivered to the burners. Pulverizing is analogous to spraying in oil burning. Primary air is used to blow the pulverized coal into the furnace. Mixing and turbulence shorten the flame, reduce the furnace volume and promote combustion.

Ash removal is a serious problem and, depending upon the fusion temperature of the ash, the furnace must be designed to operate with ash in the dry state or in the molten state. A furnace cannot work alternately wet and dry. It can be built to handle the ash one way or the other but not both.

Cyclone Furnace.—This furnace, one of the most modern developments, burns low-grade fuels of high ash content and low ash fusion temperature. Crushed coal in sizes less than one-quarter inch is fed into the cyclone. It swirls around the periphery of the cylindrical chamber like a cyclone and burns with high heat intensity. The hot gases escape through the opening at the back into the boiler furnace and the molten ash flows to the ashpit below. The cyclone furnace results in a steam-generator plant that occupies less volume for the same capacity than other accepted methods of firing coal in large installations.

Coal- and Ash-Handling Systems.—Coal is generally stored outdoors and in amounts suitable for supplying the plant over a period of one to six months to avoid problems of uncertain delivery caused by bad weather or strikes and to take advantage of favourable buyers' markets. Coal must be compacted to avoid deterioration, loss by wind and rain and spontaneous combustion. Various types of mechanical unloading and reclaiming equipment are used. Bunkers are included in the power plant. They are proportioned to assure adequate fuel supply with single shift operation of the coal-handling equipment. Coal is fed from the bunkers through hoppers to cyclones, pulverizers or stokers.

Ash-handling systems are diverse, ranging from the wheelbarrow to the mechanical systems using bucket, pneumatic or hydraulic conveyors. The ash must ultimately be deposited in some location where it will not prove a burden.

Waste Fuels and Waste Heat.—Waste fuels and heat from many industries, such as woodworking, pulp and paper, sugar refining, steelmaking and chemical producing, can be used for steam generation. Each waste fuel has its own peculiarities, such as high moisture content, low heating value and contaminants; thus diversity of furnace design prevails. In the case of waste heat from industrial furnaces, it is possible generally to make steam economically if the waste gases have temperatures of more than 800° or 1,000° F., depending upon fuel price and load factor.

Draft Systems.—The purposes of the draft system are: (1) to provide the air needed for the combustion of the fuel; and (2) to deliver the hot gases from the furnace to the boiler surfaces, and when sufficient heat has been absorbed to eject the spent gases to the atmosphere. The draft system regulates the flow of air to the furnace and thus controls the rate of combustion and the output of the boiler. The air that is supplied is always in excess of the amount required. Good practice is represented by 10% to 25% excess air with natural gas; 10% to 15% with cyclones; 15% to 30% with fuel oil and pulverized coal; 20% to 40% with large stokers; 30% to 60% with small stokers; and as much as 150% with hand firing. The maximum air requirements determine the capacity to be installed in the draft system with dampers, or their equivalent, for control at lighter loads.

Natural Draft.—Like circulation in a boiler, natural draft is a thermal effect caused by the difference in density of a vertical column of warm gas inside a stack and the column of cold air outside the stack. The taller the stack and the higher the stack gas temperature, for a given atmospheric temperature, the greater will be the draft. This theoretical draft is measured by the difference in pressure that exists at the base of the stack. When an opening is made at the base, air will flow in by virtue of the pressure difference. Stacks are built of brickwork, concrete or steel plate (lined or unlined) as determined by the service and the economics. They must be structurally sound to withstand the external wind pressures that will prevail.

Mechanical Draft.—This is used for heavy fires and high rates of combustion when stacks for natural draft would become prohibitively tall. This is especially significant when low stack temperatures (300° F.) are used in order to reduce the thermal loss to the atmosphere and thus improve the efficiency of steam making. Fans and blowers are employed to develop the requisite pressures, and a stack of minimum height is provided to discharge the gases at a reasonable distance above ground level for effective dissemination. The fan or blower may be placed ahead of the furnace to deliver air for combustion under positive pressure—consequently called forced draft; or the fan or blower may be placed at the flue outlet from the boiler setting, exhausting the products of combustion under negative pressure and delivering them to the base of the stack. This latter application is called induced draft, and equipment for this service must handle hot gases (up to 700° F.) contaminated with varying amounts of soot, cinders and dirt. The physical size of the fan or blower for induced draft is much larger than the equivalent forced-draft unit for the same service because the latter handles only air at atmospheric, not stack, temperature.

Jet blowers using steam as the actuating fluid can be installed for forced- or induced-draft service to entrain air or flue gas. These units are inefficient but simple, foolproof and low in first cost. They are commonly found on steam locomotives utilizing engine exhaust to create the induced draft at the base of the short stack, thus creating the characteristic pulsating noise and puff of the "iron horse."

Fans are driven directly by motors or turbines or indirectly through gears or variable-speed couplings. Some small installations use propeller-type fans in the interest of low initial cost and some marine installations use them because of their compactness. The general preference is for centrifugal types in which there is a rotor, similar to a paddle wheel. The rotor turns within a spiral or scroll case. Gas enters at the eye of the rotor and is discharged at the outer periphery to the scroll. Fans with variable speed, or its equivalent, are advantageous because of their high efficiency in service. Excellent control of draft is accomplished with this arrangement, with dampers as a supplement.

Balanced Draft.—This is a combination of forced and induced draft that maintains substantially atmospheric pressure in the furnace. It is employed on many large installations but there is an increasing tendency to use an airtight boiler casing and to put the entire boiler setting under positive pressure, thereby eliminating the induced-draft fans. This results in (1) the minimum of auxiliary power for draft creation; and (2) elimination of the air leakage into the boiler setting that causes dilution, chilling of gases and loss of efficiency.

Flues and Breeching.—Sheet metal platework, with or without cement or brick lining, constitutes the flue or breeching which connects the boiler to the stack.

Dust Catchers and Cinder Traps.—Pollution of the atmosphere by the discharge of cinders, fly ash, smoke and noxious gases is no longer tolerated as a necessary evil in enlightened communities. Proper control of combustion will reduce the smoke nuisance. The use of fuels that are low in sulfur content will reduce the toxic effects of sulfur dioxide and trioxide. Fly ash and cinders accompany coal firing. Some methods of firing are less troublesome on this score than others; *e.g.*, underfeed stokers and cyclone furnaces. In other cases most of the ash (as much as 90%) may appear in the flue gases. This ash is in the form of fine dust particles, many not visible to the naked eye but some as large as one-eighth of an inch across. Numerous varieties of dust separators and cinder traps are used for the separation of these particles. Mechanical separators, operating on inertia principles, are good with larger size particles and heavy dust loadings. Electrostatic precipitators that charge the dust particles and attract them to electrodes are especially helpful in the separation of the finer particles (less than 40μ). Good fly-ash elimination systems are large, bulky and costly but they often operate with sustained separation efficiencies in excess of 90%. Such performance generally results in a discharge (gas dust) loading of less than 0.85 lb. per 1,000 pounds of gas, which is acceptable under many air pollution control codes and laws. The demand for effective law enforcement is steadily increasing.

Boiler Accessories.—There is a wide assortment of supplementary apparatus and instruments that are needed to make a steam-generator installation operate satisfactorily. Some are required by law; others are chosen because they improve efficiency, maintenance or operating labour costs.

Pressure gauges are of the flexible (Bourdon) tube type. A flattened tube is formed into the arc of a circle and sealed at the free end; when subjected to internal pressure it tends to straighten out, thus moving a pointer across a dial on which appears a pressure scale.

Water columns give, in a gauge glass, a direct indication of the water level in the boiler drum. Low-water level will lead to burning of the boiler surface and high-water level will allow liquid water to pass into the steam line and damage running machinery. Remote level indicators and alarms for high and low water may be employed.

Try cocks are used to determine the water level when the water column is out of service. They operate on the principle that steam escaping from an orifice into the atmosphere is colourless for many feet, but water gives the characteristic white plume right up to the orifice.

Safety valves are required to relieve any excess pressure that might develop as a consequence of a drop in the steam take-off rate from the boiler without an accompanying reduction in the firing rate. They are of the spring loaded, poppet type, tamperproof, and are set at a pressure greater than the operating pressure. Their number, adjustment and setting are rigidly supervised by government and insurance inspectors with the responsibility for change resting in the licensed operator.

Feed System.—Continuity of feed water supply is an absolute essential for safety. The water must be available at a pressure sufficiently above the boiler pressure so that water will flow into the boiler when the feed valve is opened. Pumps are an essential auxiliary to all boilers and for assurance of service continuity they are installed in duplicate and with alternative drives. Steam drive usually gives greatest reliability but electric drive is more efficient.

Pumps may be of the reciprocating, centrifugal or injector types. The water is delivered through the piping system, with a level control valve and check valve, to the boiler drum.

Steam Take-off System.—Boiler drums serve to disengage steam from water, but assurance of dry steam is secured by a dry pipe in the boiler drum for small sizes. Highly developed scrubbers and separators are used in the larger designs. Clean (less than 3 parts per 1,000,000 of solids), dry steam is then assured for the superheater. Beyond the superheater there must be a stop valve for isolating the boiler from the rest of the plant when the boiler is shut down. It should have a nonreturn feature to protect the plant, when a tube failure occurs, by preventing the flow of steam into the damaged boiler from other sources.

Blowdown Systems.—Under efficient operation, any impurities that are present in the feed water are not carried over into the evaporated steam, so that they become concentrated in the water contained in the boiler. When the solids in solution approach values such as 1,000 to 2,000 parts per 1,000,000 it is necessary to have a blowdown arrangement. This allows impurities to be removed from the circulatory system with the minimum of water and heat loss.

Boiler Cleaning.—Despite all precautions that can be taken it becomes necessary to clean periodically the water-side surfaces of accumulated deposits and scale. This can be done with a mechanical tube cleaner that chips the scale loose or it can be done chemically with an acid solution. The chemical method must be carried out with skill to avoid damage to the metal of the boiler structure.

The gas-side surfaces must be cleaned regularly, perhaps once or twice a shift, to remove accumulations of ash, soot and slag. Soot blowers, using compressed air or steam, direct high-velocity jets at the surfaces to be cleaned. Gas-side cleanliness is essential to maintain the output and efficiency of the plant. Water-side cleanliness is necessary to prevent overheating of metal parts and accompanying burning and rupture.

Feed Water Treatment.—Boilers should be fed with chemically pure water. This means freedom from all scale-forming compounds, from acid, from floating contaminants such as oils and fats and from dissolved gases such as oxygen and carbon dioxide. In industrial process plants the make-up may run to 100%. This make-up water requires treatment for the removal of impurities; the steam exhausted from the steam power plant is condensed and returned to the boiler since this condensate is pure distilled water. Because of steam and water losses in the engine room, the boiler may require make-up feed water amounting to 1% or 2% of the steam supply rate. Various kinds of treating plants are employed, depending for their selection on the nature of the impurities to be removed, the operating pressure and temperature and the costs. Treating plants may include many of the following elements: sedimentation chambers, filters, chemical treatment with soda ash or zeolites, demineralization equipment, evaporators and degasifiers.

Instruments and Controls.—Skilful operation and supervision are necessary for the most economical performance of a steam-generating plant. For intelligent operation it is essential to provide the operator with the tools needed for effective performance. Boilers are accordingly equipped with varying degrees of instrumentation and control depending upon costs. Instruments are of the indicating, recording and integrating types and typically show pertinent temperatures, pressures, air and steam flows, fuel burned, draft pressure and flue-gas analyses.

Supplementary laboratory facilities give heating value of the fuel, refuse analysis, water and steam purity. A typical large modern steam-boiler plant has an elaborate instrument panel showing all of the readings needed for the skilful manipulation of the plant, which is remotely controlled from the instrument board. Television cameras transmit continuous pictures of firing conditions within the furnace and of the boiler water level. The entire operation can be turned from manual to automatic at the will of the operator. The automatic combustion-control system is remarkable in its supervision and leads to performance which could never be matched by simple manual operation.

MERCURY VAPOUR BOILER

Another type of boiler, one that received considerable attention prior to World War II, was the mercury boiler, used in the binary mercury-steam cycle. In this cycle mercury vapour generated in a mercury boiler is directed through a mercury turbine and then exhausted into a special condenser-boiler. In the condenser-boiler the latent heat of the mercury is transferred to water, which is thereby converted into steam. After being superheated in the furnace of the mercury boiler, the steam is employed for generating power using a conventional steam cycle. Thus, power is generated by both the mercury turbine and the steam turbine, but heat is rejected to the surroundings only in the steam portion of the cycle. This results in higher thermal efficiency than obtainable with the steam cycle alone because of the more favourable thermal characteristics of mercury vapour at high temperatures.

Because of practical difficulties, as well as economic and safety considerations, work on the binary mercury-steam cycle has been neglected in favour of the more modern high-pressure, high-temperature multiple reheat steam cycles.

In the early 1960s there were four mercury boilers in operation in the United States. All generated mercury vapour at pressures close to 145 p.s.i., corresponding to a saturation temperature of 964° F. The largest of these units was located at Kearney, N.J., and generated 2,200,000 lb. of dry saturated mercury vapour per hour at 155 p.s.i. absolute and 975° F.

NUCLEAR STEAM GENERATORS

Another type of steam generator that is entirely different in design from the fossil fuel boilers previously described, is the nuclear steam generator. In this type unit, heat is generated in a vessel by the fissioning of uranium-235 (U^{235}). The fission process takes place in the core of the reactor, which consists of suitably shaped elements of natural uranium (U^{238}) or some other uranium compound enriched with U^{235}. The elements are usually encased in a noncorrosive can or jacket. The core is supported in the vessel in such a way that a coolant can be directed around the elements of the core in the most effective manner for absorbing the heat released during the fission process. The rate of fission is governed by means of control rods, which reduce the rate of fission when inserted into the core and increase the rate when withdrawn.

In one type of reactor the coolant consists of ordinary water. When fission takes place the heat released is transferred to the water, causing it to boil and thus generating steam. The steam can be directed to a turbine for the generation of power just as in a conventional steam power plant.

Steam can also be generated indirectly with other types of nuclear reactors. In these a fluid other than water circulates through the reactor core and absorbs heat. This fluid is in turn circulated through heat exchangers and the heat is eventually transferred to water for the formation of steam. Among the fluids that can be employed are liquid sodium, various organic compounds and gases such as carbon dioxide.

For further information concerning nuclear reactors *see* NUCLEAR ENGINEERING: *Boiling Water Reactors.*

See CASUALTY INSURANCE: *Engineering Insurance;* HEATING AND VENTILATION: *Steam Heating;* MARINE ENGINEERING: *Steam Turbines and Boilers;* SHIP: *Introduction of Steam and Iron;* STEAM: *Steam Generation;* TURBINE: STEAM; *see* also Index references under "Boiler" in the Index volume.

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(T. BR.; RD. A. BR.)

BOILING POINT, the temperature, for any given liquid, at which the application of heat ceases to raise the temperature of the liquid and instead converts the liquid into its vapour. The boiling point of water under normal pressure (760 mm. mercury) is 100° C. or 212° F.

The effect of increasing the pressure is to raise the boiling point; the presence of dissolved impurities also raises the boiling point but to a much less marked extent. *See* BAROMETER: *Chief Types of Barometers: Hypsometer;* LIQUID STATE; SOLUTIONS: *Thermodynamic Properties: Elevation of the Boiling Point.*

BOISE, the capital and largest city of Idaho, U.S., and the seat of Ada county, in the southwest part of the state. Pop. (1960) 34,481, city; standard metropolitan statistical area (Ada county) 93,460. (For comparative population figures *see* table in IDAHO: *Population.*) Sheltered by a mile-high ridge on the north and east, Boise has a mild, four-seasonal climate; most winters have little snow, and hot summer days are balanced by cool summer nights. Low humidity and an annual rainfall of slightly over 12 in. make irrigation essential. Three important dams (Arrowrock, 350 ft. high; Anderson Ranch, 456 ft.; Lucky peak, 340 ft.) provide the region with water storage and recreational facilities.

Named by French Canadian settlers for the tree-lined river (Fr., *boisé,* "wooded") which provided relief for travelers across the desolate wastes of the Snake river plains, Boise became a welcome oasis on the Oregon trail. However, the town was not founded until the 1862 gold rush to Boise basin. Ft. Boise was established on what is now Government Island, July 4, 1863, and a community developed providing services for the nearby mines. Boise's position at the crossroads of the Oregon trail and a primary mining route (Boise basin to Owyhee) ensured the city's early growth. In 1864 Boise was incorporated as a city and became the capital of Idaho, as well as seat of the newly created Ada county. The *Idaho Daily Statesman,* established there in the same year, is the state's oldest newspaper.

Mementos of Boise's early history survive in contemporary cabins, Urquides Village established in 1863 for packers to the mines, some early Ft. Boise structures and the assay office building completed in 1872. Hot water (172° F.) from artesian wells still supplies heating for residences and public buildings.

Agricultural expansion and the growth of a commercial lumber industry contributed to the city's rapid growth in the early part of the 20th century. Left off the main line of the Union Pacific until 1925, Boise made early use of commercial aviation (1926). One of the world's largest construction companies grew up there; smaller diversified industries and extensive wholesale trade and trucking also developed. Federal and state agencies provide much local employment, and Boise is the Columbia basin headquarters for the U.S. bureau of reclamation.

Boise junior college, with an annual enrollment of more than 1,000 students, was established in 1932. (M. D. B.)

BOISGUILLEBERT, PIERRE LE PESANT, SIEUR DE (1646–1714), French economist and precursor of the physiocrats (*see* PHYSIOCRATIC SCHOOL), was an important advocate of economic and fiscal reforms for France, which was approaching economic collapse late in the reign of Louis XIV. He was strongly opposed to Colbert's economic policy of attempting to increase the manufacturing potential of France by keeping agricultural prices at a low level in the hope that low-wage goods would be an incentive to industry. Like his physiocratic successors, Boisguillebert felt that the wealth of the nation was dependent on the prosperity of the agricultural sector. He was an agricultural protectionist, but his belief in the natural order and his opposition to the medieval economic restrictions which had proliferated during this period brought him close to a *laissez faire* position. In matters of fiscal reform he advocated direct rather than indirect taxes, the reform of the taille, and an income tax consisting of a 10% levy (*dime*). For his views on these matters and his support of the disgraced Sebastien de Vauban (*q.v.*) he was for a time exiled.

See E. Daire, *Economistes financiers du XVIIIe siècle,* 2nd ed. (1851); Hazel van Dyke Roberts, *Boisguilbert, Economist of the Reign of Louis XIV* (1935). (L. N.)

BOISROBERT, FRANÇOIS LE METEL, SEIGNEUR DE (1589–1662), French poet, dramatist and wit, was born in Caen of a Huguenot family. Abandoning a legal career in Rouen, he went to Paris in 1616 and attached himself first to Cardinal du Perron, then to the queen mother, Marie de Médicis (who in 1618 engaged him to translate Guarini's *Pastor fido*), and finally to Richelieu. Having abjured his Protestantism, he took orders in the Roman Catholic Church in 1623 and subsequently received a canonry of Rouen and other benefices. With a reputation for repartee and practical jokes, he was kept as a jester by Richelieu (though the latter is said to have disliked him personally) and so acquired great influence over the fortunes of men of letters, both before and after his inclusion in the Académie Française (1634). His parody of Corneille's *Le Cid* was highly gratifying to Richelieu. Most of his 18 plays are tragicomedies, several of them adaptations from Spanish works: *La Folle Gageure* (1653), *L'Amant ridicule* (1655) and *La Belle Plaideuse* (1655), a source for Molière's *L'Avare,* deserve mention. His *Epîtres en vers* (1647; ed. by M. Cauchie, 2 vol., 1921–27) serve as an index of the literary quarrels of his time.

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BOISSIER, MARIE LOUIS ANTOINE GASTON (1823–1908), French scholar and historian of Roman civilization, was born at Nimes on Aug. 15, 1823. After 10 years as a lecturer at Nîmes, Boissier was appointed professor at the Lycée Charlemagne in Paris, and in 1862 succeeded Sainte-Beuve as professor of Latin poetry at the Collège de France. He was elected to the French academy in 1876, and appointed permanent secretary in 1895. He was long associated with the *Revue des deux mondes* in which his scholarly but by no means forbidding historical works appeared. He died at Viroflay on June 11, 1908. His works include studies of Roman Africa, the decline of paganism, the opposition to the Caesars and biographies of Latin poets. Between 1896 and 1906 several of his books were translated into English.

See P. Thoulouze, *Gaston Boissier* (1923).

BOISSY D'ANGLAS, FRANÇOIS ANTOINE DE (1756–1826), French statesman, a defender of moderate policies during the Revolutionary period, was born at Saint Jean-la-Chambre, near Annonay, on Dec. 8, 1756. Elected in 1789 by the third estate of the *sénéchaussée* of Annonay as deputy to the estates-general, he was *procureur général syndic* for the directory of Ardèche during the Legislative Assembly (*see* FRANCE: *History;* FRENCH REVOLUTION). Elected to the Convention in 1792, he sat in the centre, voting in the trial of Louis XVI for his detention until deportation should be judged expedient. A supporter of the Thermidorian reaction against Robespierre, he was in Jan. 1795 elected to the Committee of Public Safety. During the rising of 1 Prairial year III (May 20, 1795), he presided over the Convention and remained unmoved by the menaces of the insurgents. When the head of the deputy Jean Féraud was presented to him on the end of a pike, he saluted it impassively. His report on behalf of the committee that drew up the constitution of the year III showed keen apprehension of a return of the Reign of Terror, and his proposal to lessen the severity of the revolutionary laws led to his being suspected of disloyalty to the republic. As a member of the Council of the Five Hundred he became still more suspect. Proscribed after the coup of 18 Fructidor year V (Sept. 1797), he retired to England. Returning to France under the consulate, he was made a member of the tribunate in 1801 and a senator in 1805. Having voted for Napoleon's abdication in 1814 he was admitted to the chamber of peers on the first Restoration, but during the Hundred Days he rallied to Napoleon. Readmitted eventually to the chamber of peers under the second Restoration, he worked to secure the freedom of the press. Boissy d'Anglas died in Paris on Oct. 20, 1826.

BOITO, ARRIGO (originally ENRICO) (1842–1918), Italian poet and composer, whose fame rests upon his opera *Mefistofele* and the librettos based on Shakespeare's *Othello* and *The Merry Wives of Windsor,* which he wrote for Verdi. The son of an Italian miniature painter and a Polish countess, Boito was born at Padua, Feb. 24, 1842, and from 1853 to 1861 received his musical education at the Milan conservatory, where he also studied Italian literature. A traveling scholarship took him to Paris, where he met Verdi, for whom he wrote the text of the "Hymn of the Nations" in 1862. When war broke out in 1866, he joined Garibaldi's

volunteers. While working on *Mefistofele*, for which he derived his text from Goethe's *Faust*, he occupied himself with musical journalism, championing German, and attacking Italian, music and musicians with more vigour than discretion. Verdi was deeply offended by one of Boito's remarks, which seemed to reflect on his artistic integrity. By 1868, when *Mefistofele* was produced at Milan, Boito's polemics had provoked such hostility that the opera was withdrawn after two performances. A much-revised version was successfully produced at Bologna in 1875 and has remained in the Italian repertory. Boito's second opera, *Nerone*, occupied him for nearly 50 years and was still not quite finished when he died, at Milan, June 10, 1918. Completed by V. Tommasini and Arturo Toscanini, it was produced at La Scala, Milan, in 1924, but despite its grand design and spectacle, was found to be lacking in the musical character that distinguished *Mefistofele*.

A reconciliation between Boito and Verdi was effected in 1873 and Boito undertook the revision of the libretto of Verdi's *Simone Boccanegra*. His masterly versions of *Othello* and of *The Merry Wives* (the libretto for *Falstaff*) stimulated the imagination of the aged composer to its greatest feats. Besides the librettos for Verdi and for himself, Boito wrote texts for several other composers, the only survivor in the modern repertory being Ponchielli's *La Gioconda*.

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BOJER, JOHAN (1872–), Norwegian novelist known chiefly for his vivid and realistic studies of peasant life in his native province, was born at Orkesdalsøren, Tröndelag, on March 6, 1872. His first novel to command attention was *Et folketog* (1896). It was inspired by social fervour, and so were *Den evige krig* (1899) and *Moder Lea* (1900).

En pilgrimsgang (1902) and *Troens magt* (1903) show a more subtle portrayal of character and a surer grasp of plot, and there is further growth in *Fangen som sang* (1913) and *Den store hunger* (1916). *Den sidste viking* (1921), Bojer's most popular book, about fishermen in the Lofoten, is epic in conception and contains remarkable descriptive passages and dramatic situations. In *Vor egen stamme* (1924), about Norwegian emigrants to the United States, his sympathy, sense of adventure and achievement and understanding of the process of uprooting and readjustment, form a more complex pattern. In *Folk ved sjöen* (1929), probably his finest work, the simple, realistic framework of the story is transformed by his symbolical vision. Later publications were *Gård og grend* (1933), short stories; *Læregutt* (1942) and *Svenn* (1946), memoirs; and *Skyld* (1948), a novel. A number of his works have been translated into English.

See Carl Gad, *Johan Bojer, the Man and His Works* (1920); P. G. La Chesnais, *Johan Bojer* (1930). (G. RN.)

BOK, EDWARD WILLIAM (1863–1930), U.S. editor and author, born at Helder, Neth., Oct. 9, 1863, was taken at the age of six to Brooklyn, N.Y., where he entered public school without knowing English. The family's poverty caused him to go to work as an office boy for the Western Union Telegraph company. A youthful hobby of autograph collecting led him to meet outstanding political and literary personages with the result that he was encouraged to improve himself. Attending night school, he worked for Henry Holt & Company, book publishers, for two years, beginning in 1882, and then transferred to Charles Scribner's Sons, where, at the age of 24, he became advertising manager of *Scribner's Magazine*. In 1886 he established the Bok Syndicate Press for which he developed, as a regular newspaper feature, a full page of reading material for women. The striking success of the "Bok page" as a cultivator of feminine interests led Cyrus H. K. Curtis to invite the editorial innovator to the editorship of the *Ladies' Home Journal*.

Against the advice of his associates, Bok left New York city and went to Philadelphia, Pa., where he became one of the most original editors in the history of periodical journalism. He devised departments to inform and advise women on almost everything. He campaigned for woman suffrage, sleeping-car improvement, wildlife conservation and clean cities and towns. He opposed roadside billboards, public drinking cups and power company encroachment at Niagara falls, New York. His announcement in 1892 that he would accept no more patent medicine advertising opened the way for a crusade that enlisted other editors and culminated in the enactment of the Pure Food and Drug act of 1906. His boldest venture was to break the taboo against printed mention of venereal disease. By 1917 readers were sending him nearly 1,000,000 queries annually for public reply.

After editing the *Ladies' Home Journal* for 30 years, Bok retired in 1919 to write one of the most noted autobiographies, *The Americanization of Edward Bok*, published in 1920 and awarded a Pulitzer prize the next year. He devoted the rest of his life to benefactions, including the creation of the Philadelphia award to a citizen who performed a notable community service—an idea adopted in many other cities. In 1923, to mitigate the horrors of war which he had seen first hand at the battle fronts in 1918, he created the American Peace award of $100,000 for the best practicable plan through which the United States might co-operate with other nations in achieving and preserving world peace. Many plans were submitted and that of Charles H. Levermore was declared the winner. Bok established the Harvard advertising awards in 1923 and endowed the Woodrow Wilson chair of government at Williams college (Williamstown, Mass.). His last years went into developing the Mountain Lake bird sanctuary and building the "singing tower," both near Lake Wales, Fla. The tower, with its 71-bell carillon, was dedicated in 1929. Bok died in Florida on Jan. 9, 1930.

In addition to his autobiography, Bok published *Successward* (1895), *The Young Man in Business* (1900), *Two Persons* (1922), *A Man From Maine* (1923), *Twice Thirty* (1925), *America Give Me a Chance!* (1926), *Dollars Only* (1926) and *Perhaps I Am* (1928). (I. DD.)

BOKENAM, OSBERN (1392?–1447?), English author of a book of legends of women saints, was born on Oct. 6, 1392, if the statement in his "Life of St. Margaret" that he had lived "ful yerys fyfty" is to be taken strictly. His birthplace is unknown, but may have been Old Buckenham, Norfolk. In a concluding note to his *Legends of Holy Women* he is described as "a Suffolke man, frere Austyn of the convent of Stokclare." He traveled in Italy and in 1445 was a pilgrim to Santiago de Compostela. He wrote a series of 13 legends of women saints, over 10,000 lines in all, mainly in seven- or eight-lined stanzas. Bokenam, a follower of Chaucer and John Lydgate, doubtless had in mind Chaucer's *Legend of Good Women*, but his writing is crude and unskilful. There is more interest in the prologues than in the legends themselves, which are closely translated from the Latin. His chief but by no means only source was the *Golden Legend* (*Legenda Aurea*) of Jacobus de Voragine (*q.v.*), archbishop of Genoa, whom he cites as "Januence." The first of the legends, of St. Margaret, was written for his friend Thomas Burgh, a Cambridge friar; others are dedicated to pious ladies who desired the histories of their name saints. The manuscript Arundel 327 (British museum, London) is the only copy of Bokenam's work; it was finished in 1447 and presented by the scribe, Thomas Burgh, to a convent unnamed "that [the nuns] shulde have mynd on hym and of hys systyr Dame Betrice Burgh."

See the edition by M. S. Serjeantson, *Legendys of Hooly Wummen*, Early English Text Society, no. 206 (1938). Earlier editions were for the Roxburghe club (1835) and by C. Horstmann (1883). (N. D.)

BOKSBURG, a town of the Transvaal province of the Republic of South Africa, lies 15 mi. E. of Johannesburg. Pop. (1960) 70,933, of whom 27,806 were Europeans. Established in 1887 as the administrative centre of the East Rand, it is now the most important gold-producing town on the Witwatersrand. Buildings include the first post office, bank, hotel, school, public library, railway station and municipal offices on the East Rand. It is a rapidly expanding industrial and educational centre, with residential suburbs and good recreational facilities. Boksburg lake and Cinderella yachting lake are main pleasure resorts. The town adjoins Jan Smuts international airport and the important Germiston railway junction, and is on the main line to the port of Lourenço Marques, Mozambique; it is also the focal point of 11 main roads.

There is a wide variety of heavy and light industry including the manufacture of freight cars, rail points and crossings; transformers, switchgear, high tension insulators and electric motors; structural steelwork and fencing; soap, edible oils, ceramics, enamelware, plywood, stainless steelware, telephones, electronics, nuts and bolts, and the canning of fruits. In addition to gold, a main export is refractory fire clay products.

(W. C. D. S.; P. R. N.)

BOLANGIR, a town and district in Orissa, India. The town, headquarters of the district, is 155 mi. W. of Cuttack. Pop. (1961 census) 18,670. It contains Rajendra college (1943), affiliated to Utkal university, and Sailasri palace, the residence of the former ruler of Patna state.

Bolangir District was formed from the former principalities of Patna and Sonepur after their merger with Orissa in 1948. Pop. (1961) 1,070,016. Area 3,440 sq.mi. It is comparatively open country bounded northeast by the Gandhamardan hills (over 3,000 ft.); west by a narrow forest belt; and southeast by the Tel, a tributary of the Mahanadi (*q.v.*). To the northeast is a tract of forest and scrub jungle. Four-fifths of the population depends on agriculture, the main crop being rice, with some raggee millet and gram. Sonepur, at the Mahanadi-Tel confluence, is a weaving centre. Titlagarth, served by the Vizianagram-Nagpur metre-gauge railway, has ancient cave temples; Vaidyanath, on the Tel, has ancient sculptured monuments; and at Ranipur-Jharial is the temple of the 64 yoginis. (Ma. M.; N. K. S.)

BOLAN PASS, an important gateway through the Central Brahui mountains in Kalat, Pakistan, connecting Sibi with Quetta. The pass extends for 60 mi. from Rindli in the south to Darwaza near Kolpur in the north. For centuries it has been the route for traders, invaders and nomadic tribes between India and high Asia. By the treaty of Gandamak (1879) the Bolan route was brought under British control. The Sind-Pishin railway, linking plains and plateau, originally followed the Bolan river from Sibi; destructive floods in 1890, however, led to its abandonment, and the line now follows the Mashkaf valley (which debouches into the plains near Sibi) to its junction with the Bolan at the coal-mining town of Mach. The road still follows the old route via Rindli. The passage between the limestone rocks is in places extremely narrow; south of Mach it gradually widens out into Laleji plain.

The pass is subject to extremes of temperatures, the icy winter wind often being destructive of life. The climate is arid, and brown, yellow and gray unmodified by verdure are the predominant colours of the rocks. (K. S. Ad.)

BOLAS (Span. *boleadoras*) are South American Indian weapons made of stone balls, usually grooved and well polished, sometimes encased in animal hide, and attached to long, thin ropes which, when twirled and thrown, are designed to strike an animal so as to entwine its legs, rendering it immobile. They are classified into single-, double-, and triple-ball types, the last being the most commonly encountered archaeologically, historically and in modern times.

This weapon was characteristically used in hunting rhea, guanaco, puma (as a single-ball mace) and other animals found in open country. It was also employed against horses and cattle in post-Conquest times in the Gran Chaco, the Pampas and Patagonia. Although principally a hunting weapon, bolas were used effectively in combating Spanish cavalry and in intertribal skirmishes, once Indians had acquired horses and tribal segments had begun to expand beyond ancestral territories as a consequence of frequent predatory raids.

Bolas were widely distributed in South America. According to many Spanish chroniclers of the 16th, 17th and 18th centuries, they were used in highland Peru and Bolivia by the Quechua and Aymara, in Chile and Argentina by the Araucanians, and in the Argentine Pampas and Patagonia were the favourite weapon of the Charrúa, Querandí, Puelche, Tehuelche, and other peoples. In the Gran Chaco bolas were employed by the Abipón, Mocoví and, well into the 19th century, by the Lengua.

Bolas are used by the Uruguayan and Argentine gauchos. The single-ball type, called *bola perdida,* is used by the contemporary Uru who employ a *bola de paja* ("straw ball") in duck hunting in the marshlands along the southern border of Lake Titicaca. *See* also Weapons, Primitive.

See J. H. Steward (ed.), *Handbook of South American Indians,* Smithsonian Institution, Bureau of American Ethnology, Bulletin 143, vol. 5, pp. 253–54 with bibliography (1949); J. H. Steward and L. C. Faron, *Native Peoples of South America* (1959). (L. C. Fa.)

BOLE, in mineralogy, a yellowish, brownish or reddish clay allied to bauxite and laterite (*qq.v.*), is a hydrous aluminum silicate containing iron oxide. It occurs as partings or layers between successive ancient lava flows, as for example in Antrim, N.Ire., the west of Scotland and in the Deccan, India, probably representing the soils formed by weathering during intervals between eruptions.

BOLERO, a lively Spanish dance in $\frac{3}{4}$ time with a strongly marked rhythm. Not of folk origin, its creation, about 1780, is attributed to Sebastián Cerezo, celebrated dancer of Cádiz. In the bolero (probably from *volar* "to fly") the dancers, either singly or by couples, display virtuosic skill in many brilliant and intricately difficult steps to a constant rattle of their castanets. Distinctive features are the *paseo* ("walk"), *bien prado* ("sudden stop"), *cuatra* (*entrechats-quatre*), and various beating steps (*battements*). Outstanding among musical examples is Ravel's sensational *Bolero* (1928) for large orchestra. (L. Ht.)

BOLESLAV, the name of three Premyslid princes of Bohemia.

Boleslav I (d. 967), prince of Bohemia 929 to 967, was the second son of Prince Vratislav. He became ruler of Bohemia, by the murder of his elder brother Vaclav (St. Wenceslas), in 929. Boleslav was the real creator of the medieval Czech state in that he made Prague its effective administrative centre, fostered Christianity in western and central Bohemia and established royal castellanies to control tribal areas. The emperor Otto I invaded Bohemia in 950 and forced Boleslav to recognize his suzerainty, but this did not affect Bohemia's autonomy. Boleslav seems to have imposed his authority also on Silesia and Moravia.

Boleslav II (d. 999), prince of Bohemia 967 to 999, son and successor of Boleslav I, successfully continued his father's work by further consolidating the supremacy of the Czechs over the other Bohemian tribes and by the foundation of monasteries, nunneries and capitular churches. He secured the establishment of the bishopric of Prague in 973 or 974, under the metropolitan authority of the archbishops of Mainz. He treacherously but completely destroyed the Slavnikovci, the only princely rivals of the Premyslid dynasty in Bohemia, in 995. He was usually loyal to his suzerains, the emperors Otto I, II and III, whom he helped in their conflicts with the Polish princes, though his support of the rebellious duke of Bavaria, Henry the Wrangler, caused Otto II to lead punitive expeditions against him in 975 and 977–978.

Boleslav III the Red (d. 1037), prince of Bohemia 999 to 1002 and again in 1003, was the eldest son and successor of Boleslav II. Troubles in Bohemia drove him to flee in 1002 first to Germany and then to Poland. He made a brief return in 1003 with Polish help, murdered his enemies and was again expelled. Falling into the hands of Boleslaw I (*q.v.*) of Poland, he was blinded and kept in prison until his death in 1037.

See Cosmas of Prague, *Chronica,* ed. by B. Bretholz in *Monumenta Germaniae historica: Scriptores,* new series, vol. ii (1923).

(R. R. Bs.)

BOLESLAVSKY (Boleslawski), **RICHARD** (1889–1937), motion-picture and stage director, was born in Warsaw, Pol., on Feb. 4, 1889. From 1906 until 1915 he appeared with the Moscow Art theatre, and in 1920 he went to New York city, becoming stage director for the American Laboratory theatre (1924–29). In 1929 he began a film career that included the direction of *Rasputin and the Empress* (1933), *Clive of India* (1935) and *Les Misérables* (1935). He died in Los Angeles, Calif., Jan. 17, 1937.

Boleslavsky described his experiences in World War I in his two autobiographical books, *Way of the Lancer* and *Lances Down* (both 1932). In 1933 he published an important book on acting, *Acting: the First Six Lessons.* (M. S. By.)

BOLESLAW I the Brave or the Great (966 or 967–1025), the first king of Poland, was the son of Mieszko, the first Christian prince of Poland, and the Czech princess Dobrawa. After his

father's death in 992 he expelled his stepmother and brothers from the country and began, by energetic political and military action, to develop and to expand the Polish state. He gave a magnificent entertainment to the Holy Roman emperor Otto III at Gniezno, the capital of Poland, at the grave of St. Wojciech (Adalbert), in March 1000 and considerably strengthened his position in relation to the empire, throwing off a tribute that had been paid since his father's time for part of the Polish state's territory. He obtained from the emperor and from Pope Silvester II the erection of Gniezno into an archbishopric and reorganized the church in Poland, directing its missionary activity toward Prussia and the land of the Pechenegs. On Otto's death he seized Lusatia and Misnia (Meissen) and took the opportunity of intervening in Bohemia on behalf of Boleslav the Red, though afterward he had him blinded and took the throne in Prague for himself (1003). He refused to accept Bohemia as a fief of the empire and began war against the German king Henry II. In 1005 he lost all his western conquests, but in a second war (1010–13) he regained Lusatia and Misnia, and a third war ended in Jan. 1018 by the peace of Budysin (Bautzen), whereby he retained the conquered lands. Boleslaw then warred against Yaroslav, grand prince of Kiev, defeated him on the banks of the Bug river, placed his son-in-law Svyatopolk on the Kiev throne and occupied the disputed territory on the upper Bug (Czerwien and other castles) —also in 1018. His exertions to win recognition as king ended successfully with his coronation at Gniezno in 1025, but in the same year he died.

Boleslaw left Poland one of the mightiest states of Europe with a good administration and an independent church. His dominions comprised the basins of the Vistula and the Oder rivers, Lusatia, Misnia and also Moravia. Contemporaries appreciated his diplomatic abilities and his military talents.

See POLAND: *The Piast Kingdom.*

See *Cambridge History of Poland,* vol. i (1950); *Historia Polski,* vol. i, part 1 (1957). (A. GI.)

BOLESLAW II THE GENEROUS OR THE BOLD (1039–1081), king of Poland from 1058 to 1079, the eldest son of Casimir I and the Russian princess Dobronega Maria, began his rule in 1058, after his father's death. The contemporary struggle between the German kings and the papacy enabled him to pursue a relatively free foreign policy and to restore the international position of Poland. He helped Bela I to obtain the Hungarian crown (1060) against the Germans and their protégé and refused to pay the tribute for Silesia that his father had paid to the Czechs. Intervening on behalf of Izyaslav in Kiev, he occupied that city in 1069 and recovered Czerwien and other castles. He and Pope Gregory VII had common interests both in Hungary and against the German king Henry IV, and it was because of these interests that Boleslaw was crowned in the presence of papal legates in 1076. A second intervention in Kiev (1077), again in order to help Izyaslav, was followed by catastrophe: Polish nobles, supported by the Germans and the Czechs, began a rebellion in the name of Boleslaw's brother, Wladyslaw Herman. Among the rebels was the bishop of Cracow, Stanislaw (St. Stanislas), whom Boleslaw put to death in 1079. General rebellion compelled the king to leave Poland, taking his son with him. They fled first to Hungary, but the place of Boleslaw's death in exile is unknown; tradition says that it was Ossiach in Carinthia or Wilten in Tirol.

See POLAND: *The Piast Kingdom.*

See T. Grudziński, *Boleslaw Szczodry* (1953 *et seq.*). (A. GI.)

BOLESLAW III THE WRY-MOUTHED (1086–1138), prince of Poland, was the son of Boleslaw II's brother Wladyslaw Herman and Judith of Bohemia. During his father's lifetime he and his elder half-brother Zbigniew were both given provinces of their own, and both were used by the nobles in their struggle against the old prince and his palatine, Sieciech. Wladyslaw Herman died in 1102, and Boleslaw in 1104 began to fight for the restoration of Polish sovereignty over western Pomorze (Pomerania). This secured him the support of the Polish knights against Zbigniew, who in 1106 acknowledged Boleslaw's suzerainty. In 1107, however, Zbigniew was banished; and after his return in 1112 he was blinded. In 1109 Boleslaw repelled the armed intervention of the emperor Henry V and the Czechs in Silesia, whose invasion was broken by the successful Polish defense of Glogow and in battle near Wroclaw. Boleslaw's many expeditions to Pomorze, which extended over ten years, secured for Poland the Baltic coast from the mouth of the Vistula to the mouth of the Oder. The local prince Warcislaw, who ruled western Pomorze from his seat at Szczecin, became Boleslaw's vassal; and the union of the country with Poland was to be strengthened by converting the inhabitants to Christianity. This was begun by the Spanish hermit Bernard and continued by Otto, bishop of Bamberg. In 1135 Boleslaw paid homage to the emperor Lothair II for Pomorze and the island of Rügen (though Rügen was never conquered by Poland). Boleslaw died in 1138, leaving a statute governing the inheritance of the throne. This statute was an attempt at a compromise with the growing centrifugal tendencies manifested by the Polish nobles. Poland was divided between Boleslaw's four sons, the eldest son being accorded the overlordship of the whole.

See POLAND: *The Piast Kingdom.*

See K. Maleczyński, *Boleslaw Krzywousty* (1946). (A. GI.)

BOLETUS, a very common genus of mushrooms. Nearly all the species grow on the ground, in woods or under trees in the early autumn. They are brown, red or yellow in colour; the pores also vary in colour from pure white to brown, red, yellow or green and are from a fraction of an inch to nearly an inch long. A few are poisonous; several are good for eating. One of the greatest favourites for the table is *Boletus edulis,* recognized by its brown cap and white pores, which become green when old. *See* also MUSHROOM.

COURTESY OF THE DOMINION BOTANIST, DEPARTMENT OF AGRICULTURE, OTTAWA

BOLETUS ELEGANS

BOLEYN, ANNE: *see* ANNE (Anne Boleyn or Bullen).

BOLINGBROKE, HENRY ST. JOHN, 1ST VISCOUNT (1678–1751), English politician, who, endowed with the talent but not the strength of character requisite in a great political leader, exercised considerable influence in British politics during the first half of the 18th century, was born in London on Oct. 1, 1678, the son of Sir Henry St. John, Bart. (afterward 1st Viscount St. John). He was educated at Eton and perhaps at Christ Church, Oxford. He traveled abroad in 1698 and 1699 and in 1700 married Frances Winchcombe.

Notorious already for his libertinism, St. John won early renown as an orator when he entered parliament for the family seat of Wootton Bassett in 1701. St. John associated himself with the aggressive forces of high Toryism, and was given charge of the Bill of Settlement (1701) which gave statutory sanction to the Hanoverian succession. With the prospect of Anne's reign ahead, the high Tories were never less Jacobite, and St. John considered promoting his fortunes by paying court at Hanover in person. That he opposed the oath of abjuration of James, the Old Pretender, in 1702 indicated that he was already becoming attached to the moderate Robert Harley (*see* OXFORD, ROBERT HARLEY), with whom he had been hitherto politically unconnected. In 1702 he was elected to the commission on the public accounts, and after Anne's accession he assisted William Bromley to introduce bills against occasional conformity (the practice of receiving communion according to the rites of the Church of England, in order to qualify for public office, and then attending dissenting meetings for worship); but being connected with Harley, he voted against the motion to tack the Occasional Conformity bill to the Land-tax bill (1704). Through Harley he became secretary at war (1704); through him he began already to de-

velop his idea that party was obsolescent; and through him he was put in direct touch with the duke of Marlborough, the most important influence in his life thereafter. And it was this connection with Harley, not an alleged conspiracy to secure ministerial defeat in the commons, which compelled his resignation in 1708. He then urged Harley strongly to ally himself with the Tories.

On Harley's return to power in 1710, St. John, who insisted on high office, became northern secretary of state and privy councilor and soon began to lead the high church party and the October club of extremist high Tories against his chief, intending to establish a Tory monopoly of office fatal to Harley's hopes of nonpartisan government. In 1711 friction between them increased as St. John promoted an unsuccessful expedition to take Quebec, partly to exemplify the high Tory doctrine that England should direct its war effort in the maritime and colonial sphere, partly to win the queen's favourite Abigail Masham by providing a command for her incompetent brother "Jack" Hill and partly, according to Harley, to relieve his distressed private finances by illicit commissions on war contracts. This expedition failed, but St. John maintained his prominence by negotiating peace in Europe.

Between Aug. 1710 and April 1711 peace terms had been secretly discussed in outline between Harley, the earl of Jersey and the duke of Shrewsbury, and the French minister, the marquis de Torcy; agreements on the Spanish and commercial questions and the disposal of the barrier fortresses had been substantially settled before St. John was admitted to the secret. He accepted the proposals, however, and from April 1711 took charge of the negotiations. By October he had secretly arranged with France the precise advantages which England was to obtain and left the allied gains to be settled in detail at a general conference of the powers in 1712; then England and France could enforce the agreements they had concluded. Viscount Bolingbroke (as he became in 1712) fought for peace at home by priming Jonathan Swift with anti-Whig propaganda, by introducing the stamp duty to restrict the press campaigns of his enemies and by accusing Sir Robert Walpole and Marlborough of receiving illicit commissions, but he laboured chiefly to impose his terms upon the angry allies without allowing France to exploit their discords. He secured a peace with France by further private bargaining but incensed the allies both by withdrawing British military effort before an agreement had been concluded and by accepting terms which openly contravened previous British undertakings, especially to the Dutch and Catalans. The treaty of Utrecht, however, was a cardinal settlement and was Bolingbroke's one great political achievement.

For the government, however, the peace created a further problem, for among the disillusioned allies was George, the Hanoverian heir to the British crown, who naturally turned to the English Whigs, the avowed war party. Bolingbroke's negotiations with France were redolent of undertakings to restore the Old Pretender; the failure of the ministers to remove the Old Pretender from France only thickened the atmosphere of suspicion. The struggle between Harley, now earl of Oxford, and Bolingbroke was intensified by the knowledge of George's hostility, and in its turn exacerbated fears of the ministers' promises to the Old Pretender. Bolingbroke had been chagrined that he had received only a viscountcy when Oxford had become an earl; he won over Lady Masham through whom Oxford had pulled wires with the queen and removed his fellow secretary, Lord Dartmouth, Oxford's friend; still worse, the Schism act (1714) that forbade any nonconformist to keep a school both infringed the revolution settlement and aroused exaggerated fears that its promoters contemplated open treason.

In truth Oxford had maintained contacts with the Jacobites since the autumn of 1710, but merely ensured against a restoration he would not promote; Bolingbroke entered the correspondence much later. Until the peace was signed neither would risk the treaty by taking positive steps. When in March 1714 the conspiracy foundered on the Old Pretender's refusal to change or dissemble his religion, Bolingbroke still occupied second place in the ministry, and a very subordinate place in Jacobite hopes. Neither minister committed himself, and just before Oxford's fall, Bolingbroke was convinced that a Stuart restoration could not succeed on a purely Catholic basis, nor by Scottish and Irish support alone. Bolingbroke did not shrink from civil war but in the summer of 1714 was too clear-sighted to risk his party by disputing the succession on which he knew them to be irremediably divided.

The issue between Oxford, now physically and mentally degenerate, and Bolingbroke culminated in a dreadful scene in the queen's presence, and in Oxford's dismissal on July 27, 1714; on Aug. 1, Anne died and Bolingbroke's power was broken. A negotiation with the Whigs proved futile, and he was dismissed from office. The Tories' hopes that George I might employ them in a mixed ministry were wrecked upon the Hanoverians' exclusive association with the Whigs and Oxford's determination to seek his own security at Bolingbroke's expense. For himself Bolingbroke expected nothing, and even in autumn 1714 was planning, after parliament adjourned, to go abroad for treatment for a neglected disease. By March 1715 the ministry, perhaps under Dutch and imperial pressure, clearly intended Bolingbroke's execution, and on the advice of Marlborough he fled to France. He did not at first join the Old Pretender, and his claim may be true that he did so only when urged by his friends in England who had become exasperated with the new government. By July 1715, however, the Old Pretender had appointed him secretary of state, and in the following month an act of attainder was passed against him in England.

Bolingbroke urged James to be cautious, especially after the impeachment and flight of the duke of Ormonde (*q.v.*), of whose influence in England much had been hoped, and the death of Louis XIV who had helped the Jacobites. But without Bolingbroke's knowledge, the Old Pretender ordered the earl of Mar to anticipate his arrival by rising in Scotland.

Already irritated by clerical influence at James's court, Bolingbroke had to draft him a declaration for presentation to the English people and was incensed when his guarantees to the Church of England were removed by the Old Pretender's priests. Early in 1716, soon after the failure of the rising, he was dismissed as the result of petty intrigues and jealousies.

At once Bolingbroke sought to ingratiate himself with the English government. In March 1716 he was in touch with James (afterward Earl) Stanhope; in September his father was created Viscount St. John, and Bolingbroke later declared that the king promised to restore him. In April 1717 he began his *Letter to Sir William Wyndham* (published only in 1753) narrating his relations with the Old Pretender and urging his old associates to abandon the Jacobites. In 1717 Bolingbroke, who had always neglected his wife, formed a liaison with the widow of the marquis de Villette, and on his wife's death in Nov. 1718 he resolved to marry her. In this marriage (1722) Bolingbroke proved happy, though perhaps not completely faithful. At the same time he bought La Source, a small estate near Orléans, and began biblical, philosophical and mathematical studies. In 1722 he complained to Lord Polwarth that his pardon was still delayed and was encouraged to apply to the English ministers. In May 1723 he received his pardon, but the restoration to his peerage and estates still required the intervention of parliament. He now worked secretly for the government in both domestic and foreign affairs, but to the end Walpole resisted any concessions to him. Finally, on a private mission to London, Lady Bolingbroke secured the king's approval by a gift of £11,000 to his mistress the duchess of Kendal, and in 1725 an act was passed to enable Bolingbroke to hold real estate but leaving him excluded from the house of lords.

Owing nothing to Walpole, Bolingbroke resumed his feud against him, and from his new residence at Dawley, near Uxbridge, with Pope, Swift and William Pulteney, he organized literary and parliamentary attacks on the government and launched the *Craftsman*, the most celebrated political journal of the day. Just before the king's death, aided by the duchess of Kendal, and with Walpole's knowledge, he secured a royal audience but altogether failed to shake Walpole's power. Under George II Bolingbroke laboured to unite the opposition Whigs under William Pulteney, and his old Tory friends under Wyndham, on the basis of the old "country"

platform. Their attacks culminated in the defeat of Walpole's Excise bill in 1733, but failing to exploit his advantage and discouraged by Walpole's success in the elections of 1734, Bolingbroke retired to France.

There he resumed his studies in history and politics but returned to England in 1738 and joined the Leicester house opposition, for whom he wrote the *Patriot King*. Early in 1739 Bolingbroke returned to France, and the death of Wyndham in 1740 completed his isolation from English politics; though in close touch with the earl of Marchmont, he secured no political advancement upon Walpole's dismissal in 1742. In 1744 he settled in England again. He had already clashed with William Warburton about the comments Pope had invited him to make on some of Bolingbroke's manuscripts. After Pope's death, Bolingbroke found that Pope had secretly printed 1,500 copies of the *Patriot King;* Bolingbroke produced a corrected edition and, attacking Pope's breach of faith, became involved in further controversy with Warburton. Though intimate with the earls of Chesterfield and Marchmont, Bolingbroke was no longer of political consequence; his distress at his wife's death on March 18, 1750, undermined his own failing health, and he died of a cancer in the face on Dec. 12, 1751 and was buried at Battersea.

Bolingbroke's supreme talent was in oratory; his rhetorical prose came soon to be neglected, though complete editions of his works were published in 1754, 1778 and 1809. Bolingbroke's most important political writings were the "Remarks on the History of England" (1730–31), and "A Dissertation Upon Parties" (1733–34) in the *Craftsman*. Bolingbroke had earlier aspired to political power through party but preached the doctrines he had learned from Harley. He claimed that since the union of parties in the revolution of 1688, party was obsolescent, and that each party had so far abandoned its original standpoint that the only significant political division lay between court and country. Here Bolingbroke gave the best contemporary analysis of the evolution of party. His opposition standpoint, however, blinded him to the truth that because party ties had so far dissolved, the government could not but seek the support essential for its parliamentary business by the ties of corruption and influence. Unable to foretell the development of the cabinet and prepossessed by his animosity against Walpole, Bolingbroke concluded that the system of influence must enslave parliament even more surely than the methods of Charles II.

Bibliography.—Walter Sichel, *Bolingbroke and His Times,* 2 vol. (1901–02); Sir Charles Petrie, *Bolingbroke* (1937). *See* also K. Feiling, *History of the Tory Party, 1640–1714* (1924), *The Second Tory Party, 1714–1832* (1938); G. M. Trevelyan, *England Under Queen Anne,* 3 vol. (1930–34). (W. R. Wd.)

BOLÍVAR, SIMÓN (1783–1830), soldier-statesman to whom six Latin-American republics owe their freedom from Spanish rule, is regarded by many as the greatest genius the Hispanic-American world has produced. A man of international renown in his own day, his reputation has steadily increased since his death. There are few figures in European history and none in the history of the United States that display the rare combination of strength and weakness, character and temperament, prophetic vision and poetic power that distinguish Simón Bolívar. His life and his work have grown to mythical dimensions among the people of his continent, but no myth is required to sustain an admiration for this extraordinary man.

Bolívar, the son of a Creole aristocrat, was born to wealth and position on July 24, 1783, in Caracas, Venez. His father died when the boy was three and his mother died six years later. His uncle, Esteban Palacios, cared for his properties and provided him with tutors. He was an unruly child, and only one of his teachers had a lasting influence on him. This was Simón Carreño Rodríguez, an eccentric disciple of Rousseau. He introduced Bolívar to the fascinating world of 18th-century thought, which produced on him a deep and lasting effect.

At the age of 16, Bolívar was sent to Europe to complete his education. For three years he lived in Spain, and in 1802 married the daughter of a Spanish nobleman, María Teresa Rodríguez del Toro, with whom he returned to Caracas. The young bride lived less than a year after her marriage, being stricken with yellow fever. Bolívar often pondered on the effect her tragic death may have had on him and believed that it was the reason for his taking up a political career while still a very young man. In 1804, when Napoleon's star was approaching its zenith, Bolívar returned to Europe. France and Italy attracted him particularly. In Paris he met his friend and tutor and under Simón Rodríguez' renewed guidance steeped himself in the writings of the European rationalists. In addition to Locke, Hobbes, Buffon, D'Alembert and Helvetius, he plunged into Voltaire, Montesquieu and Rousseau Montesquieu and Rousseau had the deepest influence on his political thinking, but Voltaire coloured his philosophy of life. In Paris he also met the German scientist, Alexander Humboldt, who had just returned from his voyage through Hispanic America, and who confessed to Bolívar that he believed the Spanish colonies to be ripe for independence. This idea took root in Bolívar's imagination and on a trip to Rome, standing on the heights of the Monte Sacro, he made a vow to liberate his country.

One other experience enriched his intellect at this time: he watched the extraordinary performance that culminated in Napoleon's coronation in 1804 as emperor of the French. Bolívar's reaction to the coronation wavered between admiration and revulsion. Napoleon had betrayed the ideas of the Revolution, but he had also shown what a single individual could achieve when driven by the desire for power and glory. The desire for glory was one of the permanent traits in Bolívar's character, and there can be little doubt that it was stimulated by Napoleon. The example of the Corsican was, nevertheless, a warning that Bolívar heeded. In his later days he always insisted that the title of Liberator was higher than any other and that he would not exchange it for that of king or emperor. In 1807 he returned to Venezuela by way of the United States, visiting the eastern cities and meeting many Americans.

Independence Movement.—The Latin-American independence movement got its start a year after Bolívar's return *(see* Latin America: *The Independence Movement*). It was touched off by Napoleon's invasion of the Iberian peninsula. In 1808 the Bourbon family had been forced to abdicate and Napoleon's brother, Joseph, had been proclaimed king. The Spanish people, however, had resisted the intruder, and a junta assumed governmental powers during the absence of the legitimate king. Napoleon failed completely in his attempt to gain the support of the Spanish colonies, who claimed the right to nominate their own officials. Following the example of the mother country, they wished to establish juntas which would rule in the name of the king. Many of the Spanish settlers, however, discerned in these events an opportunity to sever the ties that bound them to Spain. Bolívar participated in many conspiratorial meetings, and when the governor, Vicente de Emparán, reprimanded him, he answered boldly that he had declared war on Spain and could not withdraw. On April 19, 1810, Emparán was officially deprived of his powers and expelled from Venezuela, and a junta took over. To obtain help, Bolívar was sent on a mission to London, where he arrived in July. His assignment was to explain to England the plight of the revolutionary colony, to gain recognition for it and to obtain arms and support for future eventualities. Some blunder in his negotiations caused him to fail on all counts, but in spite of this, his English sojourn was a fruitful one. It gave him an opportunity to study the institutions of the United Kingdom, which remained for him models of political wisdom and stability. He fostered the cause of the revolution by getting in touch with Francisco Miranda *(q.v.)*, who in 1806 had attempted to liberate Venezuela singlehanded. Bolívar persuaded Miranda to return to Caracas and to assume command of the independence movement.

Venezuela was in ferment. In March 1811, a national congress met in Caracas to draft a constitution. Bolívar, though not a delegate, threw himself into the debate that agitated the country. In the first public speech of his career he spoke out courageously: "Let us lay the cornerstone of American freedom without fear. To hesitate is to perish." After long deliberation the national assembly declared Venezuela's independence on July 5, 1811. Bolívar now actively entered the army of the young republic, whose commander in chief was Miranda. But in the short time since their

London meeting the two men had drifted apart. Miranda called Bolívar a "dangerous youth," and Bolívar had misgivings about the ability of the aging general. When the Spaniards rallied to retain control of the colony, Bolívar was placed in charge of Puerto Cabello, a port vital to the existence of Venezuela. Treasonable action by one of Bolívar's officers opened the fortress to the Spanish forces, and Miranda, believing the loss of Puerto Cabello fatal to any future military action, entered into negotiations with the Spanish commander in chief, Juan Domingo de Monteverde. An armistice was signed which left the entire country to the mercy of Spain (July 1812). Miranda was turned over to the Spaniards—some authorities say at Bolívar's instigation—and spent the rest of his life in Spanish dungeons.

Cartagena Manifesto.—Determined to continue the struggle, Bolívar obtained a passport to leave the country and went to Cartagena in New Granada (now Colombia). There he published the first of his great political memoranda: *El manifiesto de Cartagena.* In this document we encounter a new Bolívar. "As a son of unhappy Caracas," he begins, "I have miraculously escaped from its political and material destruction, and am here to serve the banner of freedom." His reference to miraculous escape refers to the catastrophic earthquake of March 26, 1812, which took a tremendous toll of lives in Caracas and other towns. He did not hesitate to point out the underlying causes for Venezuela's downfall: "Not the Spaniards, but our own disunity had led us back into slavery. A strong government could have changed everything." Bolívar had now emerged as the champion of strong government for the nascent republics of Hispanic America.

His plea was answered by the people of New Granada, and he was named commander of an expeditionary force whose task was to liberate Venezuela. In a sweeping hard-fought campaign he vanquished the Spaniards in six pitched battles and regained control of the capital. On Aug. 6, 1813, he entered Caracas, was given the title of Liberator and assumed political dictatorship.

But the war of independence was just beginning. The majority of the people of Venezuela were hostile to the forces of independence and weary of the sacrifices imposed. Civil war broke out, cruel, anarchic, murderous, without respect for law, either human or divine. Bolívar himself resorted to extreme measures, such as the "war to extinction" and the shooting of prisoners. But his severity failed in its object. In 1814 he was once more defeated by the Spanish. Spain now drew into the war the *llaneros,* the cowboys of the Orinoco valley, led by José Tomás Boves, and converted them into an undisciplined but savagely effective cavalry that Bolívar was unable to repulse. Boves captured Caracas in 1814 and subjected the city to terrible atrocities. Thus ended the second Venezuelan republic. Bolívar narrowly escaped Miranda's fate. He managed to reach Cartagena, where he was commissioned to oust the Spaniards from Bogotá and succeeded in doing so. He then laid siege to Santa Marta but when royal replacements arrived he fled to Jamaica.

Letter From Jamaica.—In exile he turned his mind toward gaining support from Great Britain, and in an effort to convince the British people of their stake in the freedom of the Spanish colonies, he wrote the greatest document of his career: *La Carta de Jamaica* ("The Letter From Jamaica"). "The bonds," wrote Bolívar, "that united us to Spain have been severed." He was not dismayed that the Spaniards had in certain instances won the upper hand. "A people that love freedom will in the end be free." Bolívar outlined a grandiose panorama from Chile and Argentina to Mexico. "We are," he said proudly, "a microcosm of the human race. We are a world apart, confined within two oceans, young in arts and sciences, but old as a human society. We are neither Indians nor Europeans, yet we are a part of each." What kind of government should emerge from the cataclysm of the independence movement? "The American states need the efforts of paternal governments to heal the wounds and scars made by despotism and war." He proposed constitutional republics, modeled on the government of Great Britain, with a hereditary upper house, an elected lower house and a president chosen for life. The last provision, to which Bolívar clung throughout his career, constituted the most dubious feature of his political thinking.

In the *Letter From Jamaica* Bolívar showed himself as a great internationalist. Looking forward to the day when the representatives of all Hispanic-American nations would gather in a central location such as Panamá, he wrote, "How ineffable it would be if the Isthmus of Panamá should become for America what the Straits of Corinth were for the Greeks. May God grant that we can some day enjoy the good fortune of opening a congress of representatives of the republics, kingdoms, and empires that would discuss peace and war with the rest of the nations of the world."

But Great Britain did not respond to his overtures. By 1815 Spain had sent to its seditious colonies the strongest expeditionary force that had ever crossed the Atlantic. Its commander was Pablo Morillo. Since neither Great Britain nor the United States would promise aid, Bolívar turned to Haiti, a small republic that had freed itself from French rule. Pres. Alexandre Pétion gave Bolívar a friendly reception, and granted him money and weapons.

Campaign Against New Granada.—Three years of indecisive defeats and victories followed. Bolívar landed on the mainland, came to grief and took refuge in Haiti for the second time. In 1817 he decided to set up headquarters in the Orinoco region, which had not been devastated by war and from which the Spaniards could not easily oust him. He engaged the services of several thousand foreign soldiers and officers, mostly British and Irish, established his capital at Angostura (Ciudad Bolívar), began to publish a newspaper and established liaison with the revolutionary forces of the plains. Their leader, José Antonio Páez, recognized Bolívar's authority, and by 1819 the latter was firmly in command. In the spring of that year he conceived his master plan of attacking the Spanish position on its western flank. He had previously centred his hopes on the liberation of Caracas, but he now concentrated on the bolder project of an attack on the Spanish viceroyalty of New Granada. In the plains of Casanare a force of patriots had withstood all Spanish attempts to destroy them. Their leader, Francisco de Paula Santander, made contact with Bolívar, who operated in the eastern part of the plains, and on June 11, 1819, the armies of Bolívar and Santander met and merged.

Bolívar's attack on New Granada will always be considered one of the most daring in military history. The route of the small army (about 2,500 men including the British legion) led through the plains, but it was the rainy season and the rivers had become lakes. For seven days, said one of Bolívar's aides, they marched in water up to their waists. Ten navigable rivers were crossed, most of them in cowhide boats. But the journey through the plains seemed child's play in comparison with their ascent of the Andean mountains that stood between Bolívar and the city of Bogotá. Bolívar had chosen to cross the pass of Pisba, which the Spanish considered an inconceivable approach. An icy wind blew across the heights of the pass, and many of the scantily clad troops died of cold and exposure. But fatigue and loss were more than outweighed by the advantage gained in descending unopposed into New Granada. When the Spaniards recovered from their surprise, it was too late to throw Bolívar back. A series of skirmishes followed, culminating in the crucial battle of Boyacá on Aug. 7, 1819, when the bulk of the royalist army surrendered to Bolívar. Three days later he entered Bogotá. It was the turning point in the history of northern South America.

Independence Gained.—Indefatigably Bolívar set out to complete his task. He appointed Santander vice-president in charge of the administration, and in Dec. 1819 made his appearance before the congress that had assembled in Angostura. Bolívar was made president and military dictator. As he said, the union of New Granada and Venezuela had been his determined goal since his earliest fighting days. He urged the legislators to proclaim the creation of a new state: the republic of Great Colombia, and three days later *La República de Colombia* was established. It was a federation and, since two of its three departments, Venezuela and Quito (Ecuador), were still under royalist control, it was only a paper achievement. Bolívar knew, however, that victory was finally within his reach, and for the first time in his long struggle fortune did not retract its smile. A revolution had forced the Spanish king to recognize the ideals of liberalism on the home front and his action quite naturally discouraged the Spanish forces in

South America. Bolívar persuaded Morillo to open armistice negotiations, and the two warriors met in a memorable encounter at Santa Ana, signing in Nov. 1820, a treaty that ended hostilities for a six months period. When fighting was resumed, Bolívar found it easy, with his superior manpower, to defeat the Spanish forces in Venezuela. The battle of Carabobo, June 1821, opened the gates of Caracas, and Bolívar's homeland was at last free. In the autumn of the same year a congress convened in Cúcuta to draft a constitution for Colombia. Its provisions disappointed Bolívar. Although he had been elected president, he thought the constitution too liberal in character to guarantee the survival of his creation. However, as long as more urgent assignments claimed his attention, he was willing to put up with its weak structure. Leaving the administration to Santander, he asked permission to continue his military campaign.

At the end of a year, Ecuador was liberated. In this campaign Bolívar was assisted by the most brilliant of his officers, Antonio José de Sucre. While Bolívar engaged the Spaniards in the mountains that defended the northern access to Quito, capital of modern Ecuador, Sucre marched from the Pacific coast to the interior. At Pichincha on May 24, 1822, he won a victory which freed Ecuador from the Spanish yoke. On the following day the capital fell and Bolívar joined forces with Sucre on June 16.

It was in Quito that the Liberator met the great passion of his life, the vivacious and beautiful Manuela Sáenz (*q.v.*). Manuela was the ideal woman for a gallant soldier like Bolívar, the perfect mixture of Amazon and hetaera. An ardent revolutionary, she freely admitted her passion for the Liberator and followed him from camp to battlefield and even to the presidential palace.

Bolívar and San Martín.—The territory of Colombia had now been completely recovered from Spain and its new government recognized by the United States. Only Peru remained in the hands of the foreign masters. It was the Peruvian problem that brought Bolívar and San Martín together. San Martín had done for the southern part of the continent what Bolívar had accomplished for the north. On July 22, 1822, the two men met in Guayaquil, and their conference has been a source of controversy ever since. From Bolívar's side there are ample, though not unbiased, reports about the conversations that took place. From San Martín only fragmentary information is obtainable. It has been said that San Martín came to request military aid from Bolívar, and that in addition he wanted to reach an understanding on problems of boundaries and the political future of Latin America. There was scant sympathy between the two. Bolívar, brilliant, ambitious, self-centred, was convinced that he was the "chosen son," singled out by providence to complete the independence of his people. San Martín was stoic, taciturn, self-effacing and moderate. His failure to influence Bolívar was almost a foregone conclusion. On his return from Guayaquil he resigned his office in Lima and went into exile (Sept. 1822).

Peru.—The avenue leading to Bolívar's ultimate ambition was now open. In Sept. 1823 he arrived in Lima. The Spanish army occupied the Sierra east of Lima and its position was considered unassailable. But for Bolívar, after the trials he had successfully passed, this was no deterrent. Men, horses, mules, and ammunition were systematically assembled to form an army, and in the southern winter of 1824 he moved out of the temporary capital in Trujillo and ascended into the high cordillera country. Once more, as chief of staff, Sucre was his able assistant. The first major battle, at Junín, was easily won by Bolívar, who then left the successful termination of the campaign to Sucre. On Dec. 9, 1824, the Spanish viceroy, La Serna, lost the battle of Ayacucho and surrendered with his entire army.

Bolivia.—Bolívar was now president of Colombia and Peru. Only a small section of the continent—Upper Peru—was still defended by royalist forces. The liberation of this region fell to Sucre, and in April of 1825 he reported that the task had been terminated. The new nation selected Aug. 6, the anniversary of the battle of Junín, as its birthday and chose to be called Bolivia after the name of the Liberator. For this child of his genius, Bolívar drafted a constitution which showed once more his authoritarian inclinations: a lifetime president, a legislative body without power, and a highly restricted suffrage. Bolívar was devoted to his own creation, but as the instrument of social reform which he had envisaged, it was a failure.

Treaties of Alliance.—Bolívar was now at the high point of his life. His power extended from the Caribbean to the Argentine-Bolivian border. He had conquered severe illness, which during his sojourn in Peru had made him practically an invalid for months at a time. Another of his favourite projects, a league of Hispanic-American states, came to fruition in 1826. He had long advocated treaties of alliance between the American republics, whose weakness he correctly apprehended. By 1824 such treaties had been signed and ratified by Colombia, Peru, Mexico, Central America, and the united Provinces of Río de la Plata. In 1826 a general American congress convened in Panamá. Compared with Bolívar's original proposals, it was a fragmentary affair, since only Colombia, Peru, Central America, and Mexico sent representatives. The delegation from the United States never reached Panamá. These four nations signed a treaty of alliance and invited all other nations to adhere to it. A common army and navy were planned, and a biannual assembly representing the federated states was projected. All controversies among the states were to be solved by arbitration. Despite its meagre results, the congress of Panamá laid the cornerstone for future hemispheric solidarity and understanding. The Organization of the American States and the United Nations can look to Bolívar as one of the first statesmen in the world sincerely interested in advocating and implementing international co-operation. (*See* PAN-AMERICAN CONFERENCES.)

But Bolívar was aware that his plans for hemispheric organization had met with only a limited degree of acceptance. His contemporaries thought in terms of individual nation-states; Bolívar in continents. In the field of domestic policy he continued to be an authoritarian republican. Many of his followers offered him the crown, but the Liberator preferred his old title to that of "Simon the First." He thought of himself as a rallying point, and anticipated civil war as soon as his words should no longer be heeded. Such a prophecy, made in 1824, was fulfilled in 1826.

Civil War.—Venezuela and New Granada began to chafe at the bonds of their union. The protagonists in each country, Páez and Santander, opposed each other, and at length civil war broke out. Bolívar left Lima in haste and most authorities agree that Peru was glad to see the end of his three-year reign and its liberation from Colombian influence. In Bogotá, Bolívar found Santander advocating the constitution of Cúcuta and arguing that Páez be punished as a rebel. But Bolívar was determined to preserve the unity of Colombia and was therefore willing to appease Páez, with whom he became reconciled early in 1827. Páez bowed to the supreme authority of the Liberator, and in turn Bolívar promised a new constitution which would do justice to Venezuela's desire for regional independence. He took over the presidency and called for a national convention that met at Ocaña on April 2, 1828. Bolívar refused to influence the elections with the result that the liberals under the leadership of Santander gained the majority. Bolívar had hoped that the constitution of Cúcuta would be revised and presidential authority strengthened, but the liberals blocked any such attempts. A stalemate developed. Arguing that the old constitution was no longer valid and that no new one had taken its place, Bolívar assumed dictatorial powers. He flattered himself when he said that "the whole nation recognizes my authority," but he soon learned the bitter truth. A group of liberal conspirators invaded the presidential palace on the night of Sept. 25, and Bolívar was saved from the daggers of the assassins only by the quick-wittedness of Manuela Sáenz. But though this attempt on his life had failed, the storm signals increased. Bolívar's precarious health began to fail. Peru invaded Colombia with the intention of annexing Guayaquil. Once more Sucre saved Colombia and defeated the Peruvians at Tarqui (1829). A few months later one of Bolívar's most honoured generals, José María Córdoba, staged a revolt. It was crushed, but Bolívar was disheartened by the continued ingratitude. France, England, even the United States, tried to intervene in the domestic affairs of the country. In the fall of 1829, Venezuela seceded from Colombia. Reluctantly

Bolívar realized that his very existence presented a danger to the internal and external peace of the nations that owed their independence to him, and on May 8, 1830, he left Bogotá planning to take refuge in Europe.

But Bolívar was a broken man and his health became worse en route. Reaching the Atlantic coast, he learned that Sucre, whom he had trained as his successor, had been assassinated. Bolívar's grief was boundless: "They have slain Abel." It was the final blow. In vain a military uprising in Bogotá called him back. "Believe me," he wrote, "I have never looked upon uprisings with friendly eyes, and during these last days I have even repented of those we undertook against the Spaniards." Even more disillusioned was his comment on his own lifework: "We have ploughed the sea." The projected trip to Europe was canceled, and at the invitation of a Spanish admirer, Bolívar journeyed to the estate of San Pedro Alejandrino, near Santa Marta in the delta of the Magdalena. It seemed ironical that his life should end in the house of a Spaniard. On Dec. 17, 1830, he died of tuberculosis. One of his last proclamations, dated Dec. 10, 1830, said: "My last wishes are for the happiness of my country. If my death can contribute anything toward the reconciliation of the parties or the unification of the country, I shall go to my grave in peace."

Bolívar remains the towering genius of the Hispanic-American world. His deeds as warrior, his acumen as political thinker and sociologist, his brilliance as writer and prophet are unsurpassed among his people. As a human being, he had, like most heroes, certain frailties, but they are more than balanced by his "passion for friendship," his generosity, and his complete disregard of monetary considerations. His international outlook is as fresh as it was in 1824 when he wrote before the battle of Junín: "The freedom of America is the hope of the universe." *See* also references under "Bolívar, Simón" in the Index.

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BOLÍVAR, a department of Colombia whose limits are the Caribbean sea on the north and west, the department of Atlántico and the Magdalena river on the east, and the departments of Antioquia on the south and Córdoba on the southwest. Pop. (1962 est.) 797,760. It has an area of 13,386 sq.mi., the department of Córdoba having been carved from it in 1951. Bolívar is mostly a low, hot, humid, forested region. Livestock, sugar cane, tobacco, cotton, cereals, coffee and forest products are included in its rural produce, and its mineral resources include gold, coal and oil. Its main industries (textiles, petroleum refining and beverages) and foreign commerce are centred in or operate from the capital, Cartagena (*q.v.*). Communications were once very inadequate, depending principally on the Magdalena river, but roads now link Bolívar with its neighbouring departments and other areas to the south, and by air it is in contact with all parts of Colombia and the world. (T. E. N.)

BOLÍVAR, a province in highland Ecuador, bounded west by Los Ríos, north by Cotopaxi and east by Chimborazo. Its triangular-shaped area is 1,242 sq.mi., and its population (1962) 137,998. The capital city is Guaranda. The province lies between the Cordillera de Guaranda on the west and Mt. Chimborazo on the east. It is drained by the Río Chimbo. From its forests come valuable timber and cinchona. Its crops include barley, potatoes, wheat, maize, sugar cane, bananas, tobacco, oranges, coffee and vegetables. Much land is used for beef cattle, and, at higher altitudes, for the grazing of sheep. There is very little mining. In 1884 this province was separated from Los Ríos to which it had belonged previously. (P. E. J.)

BOLÍVAR, a state of Venezuela, is its largest (area 91,892 sq.mi., pop. [1961] 213,543) and potentially one of its richest. Most of it is drained by the Orinoco river. The northern part consists of savanna or llanos (*q.v.*), which to the south gives way gradually to rising ground intersected by forest-covered hills. The southern portion of the state is mountainous; in the southeastern corner of Bolívar, arising steeply out of the forest, is the Gran Sabana, a high plateau. The climate is generally tropical with a rainy season from May to October. Life in the northern part of the state was quickened by discovery and development of high-grade iron ores on either side of the Río Caroní near its confluence with the Orinoco.

There are millions of tons of iron ore shipped annually from Puerto Ordaz and Palua (at the mouth of the Río Caroní) to the United States. A national steel plant for processing domestic ore was constructed near Puerto Ordaz, a city which holds great industrial promise because it has excellent transport facilities, with many raw materials nearby and cheap power (generated at falls on the lower Caroní). New mineral deposits are discovered annually. In addition to iron ore, the state has some of the world's richest bauxite and manganese deposits located east of El Pao and near Upata. Gold is mined at El Callao, 112 mi. S. by road from the Orinoco port of San Félix; diamonds along the Caroní, the Río Paragua and at Icabarú (town). Some farming is done in the more populous northern part, where about one-third of the population is agricultural.

Ciudad Bolívar (*q.v.*), the capital, is the agricultural, cattle and minerai centre of the state and the hub of the river transport system. (L. We.)

BOLIVAR, the unit of currency of Venezuela, named after the liberator, Simón Bolívar. The bolivar is subdivided into 100 centimos.

The silver bolivar was introduced into Venezuela in 1879 to remedy a chaotic monetary situation resulting from the fact that, after 1848, various foreign coins had appeared in the country. They circulated freely and by 1879 Spanish pesetas, pesos of other Latin-American countries, U.S. and British silver coins, and French five-franc pieces were all in circulation. With the introduction of the bolivar, however, a national currency came into being. It was defined as equal in value to one franc of the Latin Monetary union formed in 1865 (*see* MONETARY AGREEMENT). Spanish and French silver coins, which continued to circulate in Venezuela, were gradually replaced by bolivares until in 1886 all foreign currencies were declared commodities and only the national currency was permitted to circulate as money.

In 1918 Venezuela changed from a silver to a gold standard. By a law of June 24, 1918, the monetary unit of the country was declared to be the gold bolivar with a content of .290323 g. of fine gold, or .32258 g. of gold .900 fine. This established a gold parity with the U.S. dollar of 5.18 bolivares per dollar which in 1934, as a result of the depreciation of the dollar, was changed to 3.06 bolivares per dollar. Exchange control was introduced in 1936 and official buying and selling rates for the bolivar were established. From 1935 to 1937 the official rate undervalued the bolivar considerably and stood at 3.93 bolivares per dollar. In 1937 the official rate was changed to 3.19 bolivares per dollar, whereas the free rate fluctuated between 3.21 and 3.74 in the period up to 1942.

In 1943 a new official rate of 3.35 bolivares per dollar was established. In addition to this general rate, special buying and selling rates were set. The International Monetary Fund par value in Jan. 1965 was 4.50 bolivares per dollar. For petroleum exports the rate was 4.40, and other exports 4.48; whereas the rate for imports was 4.50. (B. F. H.; Jo. M. L.)

BOLIVIA, an inland republic of South America, once a part of the Inca empire and later of the Spanish viceroyalty of Peru and known as the province of Charcas, or Upper Peru. Its legal capital is Sucre, but the actual seat of government is La Paz. It is the fifth largest political division of the continent and extends approximately from 9° 44′ to 23° S., and from 58° to 70° W. It is bounded north and east by Brazil, southeast by Paraguay, south by Argentina, and west by Chile and Peru. The area is 424,162 sq.mi. Pop. (1961 est.) 3,509,000.

This article is organized according to the following outline:

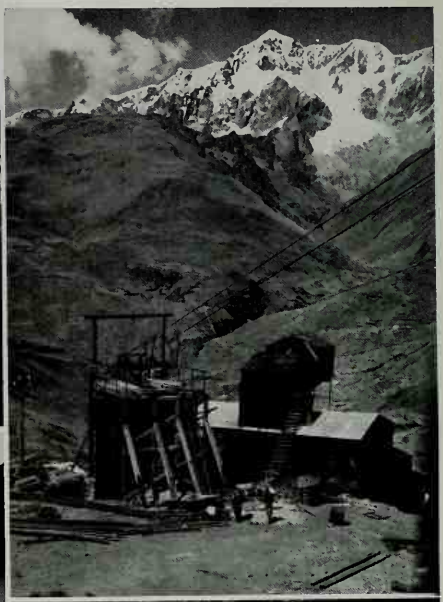
I. Physical Geography
  1. Geology and Structure
  2. Physiography

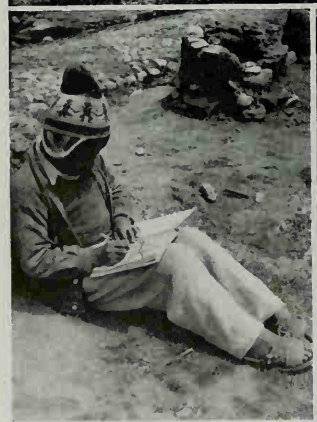
BY COURTESY OF (TOP LEFT, CENTRE RIGHT) BRANIFF INTERNATIONAL AIRWAYS, (TOP RIGHT) UNITED NATIONS; PHOTOGRAPHS, (CENTRE LEFT) ALBERTO TARDIO M., (BOTTOM LEFT, BOTTOM RIGHT) THREE LIONS

SCENES OF BOLIVIA

Top left: Devil's mask, worn by carnival dancers
Top right: Avenida 16 del Julio, centre of the city of La Paz
Centre left: Ruins at Tiahuanaco, the centre of a highly-developed pre-Inca civilization
Centre right: Spanish church at Laja, near La Paz
Bottom left: Adobe Indian houses of the Altiplano, plateau of about 12,000 ft. elevation
Bottom right: Indian women sorting ore at tin mine

BOLIVIA





PHOTOGRAPHS, (TOP LEFT) LINARES FROM MONKMEYER, (TOP RIGHT, CENTRE LEFT, BOTTOM CENTRE, BOTTOM RIGHT) HANS MANN, (BOTTOM LEFT) ALBERTO TARCIO M.

VIEWS OF BOLIVIA

Top left: Plaze Colón at Cochabamba, the second largest city in Bolivia
Top right: A wolfram mine high in the Andes with the snow-capped peak of Illimani (21,184 ft.) in the background. Income from mining is the principal basis of the Bolivian economy
Centre left: Lake Titicaca, the highest navigable body of water in the world, viewed from the island of the Sun
Bottom left: An Indian boy from the Altiplano area doing his homework. More than half of the population of Bolivia is Indian
Bottom centre: Iron gate of La Compania church in Sucre
Bottom right: Government palace in Sucre, the official capital of Bolivia

3. Climate
4. Vegetation
5. Animal Life

II. Geographical Regions
1. The Highlands or Altiplano
2. The Valles (Montaña)
3. The Oriente

III. The People
1. Racial Types
2. Languages
3. Religion
4. Customs and Culture
5. Development and Change

IV. History
1. Spanish Era
2. 19th-Century Instability
3. War of the Pacific
4. Relative Prosperity and Stability
5. Chaco War
6. The 1952 Revolution

V. Population

VI. Administration and Social Conditions
1. Government
2. Living and Working Conditions
3. Welfare Services
4. Justice
5. Education
6. Defense

VII. The Economy
1. Mining Industry
2. Economic Diversification
3. Inflation and U.S. Aid
4. Communications

There are separate articles on all the Bolivian departments and the more important towns.

I. PHYSICAL GEOGRAPHY

1. Geology and Structure.—Knowledge of the geological structure of Bolivia is incomplete, for few qualified geologists have worked there for an extended period of time. In fact, vast areas are still virtually unexplored, particularly the northeastern part of the Oriente, the monadnocks along the Paraguayan border and the northern subandean zone in the Andes.

Bolivia shows a simple geological structure. From east to west one distinguishes old crystalline rocks of the Brazilian shield (largely covered by alluvium of the lowlands of the Beni and the northern Chaco rivers); the subandean zone, adjacent to the Andean system on the east; the Eastern and Central Cordilleras, forming a uniform Paleozoic block; the Altiplano or *altiplanicie* depression, which is covered along its western border by the Quaternary volcanic Cordillera Occidental.

Rocks of the Basement complex crop out over long stretches of the Oriente, separating the alluvial troughs of the Beni and the Chaco rivers. Because of recent uplift the area is dissected into blocks that descend like steps toward the Paraguay river. The Cordillera Oriental is a group of massifs of shales or slates, sandstones or quartzites of the Paleozoic Age which rest on a granitic core. Little is known as yet regarding these much-folded complex structures. The Altiplano is essentially a long structural depression—a broken synclinal structure—occupied in its deepest hollow by Lake Titicaca. The Altiplano lies between the border of the western plateau (the Cordillera Occidental) and the Putina Synclinorium. The rocks of the Altiplano have been much deformed and modified by compression. The Cordillera Occidental is really the western plateau covered largely by somewhat dissected volcanoes. The rocks consist of vast accumulations of lavas of rhyolitic, trachytic and andesitic composition. The peaks are those of dormant and extinct volcanoes.

2. Physiography.—Although three-fifths of Bolivia's area consists of vast low plains, the western part is one of the highest inhabited areas in the world and constitutes the real Bolivia. The Andes there attain the greatest breadth and are divided into two great parallel ranges enclosing a plateau whose surface lies but a few thousand feet below the summits of the mountains themselves. Between these ranges lies the monotonous, bleak Altiplano. This is a relatively flat-floored depression 500 mi. long and 80 mi. wide, with an elevation of from 12,000 to 12,500 ft. The floor of this great depression, mostly composed of water-laid deposits from the bordering mountains, and appearing quite level, slopes gently southward. Its evenness is broken by occasional hills and ridges. The margins of the basin are marked by numerous interlocking alluvial fans that have built up an almost continuous piedmont plain of fairly gentle grade.

The northern and eastern sections of the country, the Oriente, comprise three-fifths of Bolivia. They are composed of low alluvial plains, great swamps, flooded bottom lands and gently undulating forest regions. In the extreme south is the Bolivian Chaco, a fairly level and low area that varies strikingly with the seasons of rain. It is a veritable swamp during the rainy season and a hot semidesert during the remaining eight or nine months of the year. Northward from the Chaco, but still comprising a portion of the Oriente, is the Santa Cruz area. It is generally level, with a downward slope to the north. Drainage is not the problem there that it is in the Chaco, as several small north-flowing streams interlace the area. The northernmost segment of the Oriente is the upper Beni, a low, wet plain covered in large part by heavy tropical rain forest. Much of it is subject to severe inundation during the rainy season—Nov. to May inclusive.

Extremely high mountains (some exceeding 21,000 ft.) rise northeast of the Titicaca basin, and the descent from them to the eastern plains is exceedingly precipitous. This rainy and heavily forested belt of rugged terrain (deep valleys and gorges separated by high ridges), known as the Yungas, is situated on the northeast slope of the Cordillera Oriental and extends southward as far as a line drawn from Santa Cruz to Cochabamba. The Yungas, a distinct natural division, is the southern portion of an unbroken region that extends along the eastern Andes of Colombia, Ecuador, Peru and Bolivia as far south as Santa Cruz.

Hydrography.—The rivers fall into three distinct systems: Amazon, Río de la Plata and Lake Titicaca. The eastern lowlands of Bolivia have many lakes, most of them little known. The great swampy plains along the Beni and Mamoré rivers contains several lakes and lagoons, some of them large, such as Lake Rogoaguado. Along the Paraguay river there are several lakes, partly produced by obstructed outlets, such as Bahía Negra, Cáceres, Mandioré, Gaiba and Uberaba, some of them navigable by small craft. Above these are the great Zarayes swamps. This region, like that of the north, is subject to inundations during the summer (Nov. to May). Traffic is then possible only by boat.

BY COURTESY OF THE GEOGRAPHICAL REVIEW

FIG. 1.—PHYSIOGRAPHY OF BOLIVIA

The third drainage system is that of the great central plateau. One of the most elevated of all inland basins, it comprises Lake Titicaca near the north end; the Desaguadero, its outlet; Lake Poopó into which the Desaguadero river flows; the Lake or Salt marsh (Salar) of Coipasa (connected with Poopó by the Lacajahuira, the small outlet of the latter); and the great Salar de Uyuni, independent of the rest of the system but receiving the waters of an extensive, though very arid area at the south end. Into this system enter many short streams from the neighbouring heights. Having no outlet to the sea, the water of this extensive basin is wholly absorbed by the dry soil and by excessive evaporation. Lake Titicaca, at an elevation of 12,497 ft., is the highest large navigable lake in the world. It lies on the Bolivia-Peru border and is about 110 mi. long and 46 mi. wide, with a total area of 3,141 sq.mi. The indented shore offers much topographic variety, sometimes rising abruptly, sometimes running back in low gentle slopes. The water level fluctuates seasonally, summer rains and melting snows accounting for a rise of five or six feet. Many islands dot the surface. The largest, the Isla de Titicaca, is generally considered to have been the refuge of survivors from the earlier civilization that apparently centred about the ancient metropolis of Tiahuanaco, southeast of the lake, where there are extensive ruins of admirable stone constructions. On the smaller Isla de la Luna impressive ruins also exist. Having an outlet and a fairly constant inflow, largely of melted snow, the water of Lake Titicaca is fresh, except in the shallower parts where rapid evaporation leaves it slightly brackish. The temperature of the water is low, being little above freezing during much of the year, but never low enough to form ice. Strong winds are often encountered and squalls are frequent during the summer thunderstorms. Where the margins of the lake are shallow the shore is fringed with a border of bulrush (totora) that supplies material for building reed boats known as balsas. Lake Titicaca belongs partly to Bolivia and partly to Peru, the boundary crossing near the middle from the northeast to southwest.

Lake Poopó is quite different in character from Lake Titicaca. It occupies a very shallow depression in the plateau only a few feet below the general level of the surrounding land and is nowhere more than 15 ft. deep at normal stage. However, it covers 977 sq.mi. at low stage, and the surrounding land is so flat that the lake reaches sometimes almost to Oruro, fully 30 mi. from the low-water shore. The Lacajahuira, the only visible outlet of Lake Poopó, moves underneath the sand and empties into the Salar de Coipasa which, at high water, covers about the same area as Lake Poopó at low water, but usually consists only of wide, marshy, salt-encrusted wastes, with a small permanent body of water in the lowest part. There is no outlet. The Salar de Uyuni is of a similar character but much larger than Coipasa. It covers about 3,500 sq.mi. and consists wholly of a great totally arid, windswept salt flat.

3. Climate.—Bolivia lies wholly within the tropics but it possesses every gradation of temperature from that of equatorial lowlands to arctic cold. The Yungas climatic zone comprises all the lowlands and the mountain valleys up to an elevation of approximately 6,000 ft. The atmosphere is humid. The mean temperature is about 77° F., with no great departures from this figure, and the rainfall, occurring throughout the year, is heavy (30–50 in. at least). The valley zone, which includes the deep valleys from 6,000 to 9,500 ft., has a warm climate with moderate variations in temperature and no cold weather, and is semitropical in character and products. The zone which includes the heads of the deep valleys above the valley zone, with elevations ranging from 9,500 to 11,000 ft., is temperate, though subject to an occasional frost in winter, and is favourable to the production of hardy cereals and vegetables. Both in the valley and the heads of the deep valleys zones there is likely to be a scarcity of rain but in most cases there is an abundant supply of water for irrigation. The Puna (or Altiplano), which lies mostly between 11,000 and 14,000 ft., includes the great central plateau. Always cool, it varies little from summer to winter, except in the matter of rainfall; the former season brings only rain while occasional snow falls in winter. The air is too cold for growing crops other than potatoes, barley and quinoa. The mean temperature is estimated at 50.4° F. (La Paz). The Puna Brava extends from 13,000 ft. up to the snow limit (about 18,000 ft.) and covers a bleak, inhospitable territory, inhabited only by shepherds and miners. Above this is an arctic zone within the tropics.

In general, the tropical and temperate regions are healthful and agreeable, and have varied and abundant products. It is in these two zones that most of the white people live, as well as many of the Indians. On the Puna, however, particularly around the borders of Lake Titicaca, there are districts of dense Indian population, of which some have more than 125 persons per square mile. Most of the distinctly Indian settlements are now found above 11,000 ft. It was at such elevations that the great cities of the Inca and pre-Inca period, such as Cuzco and Tiahuanaco, were situated. The high rate of mortality among the natives of this region (life expectancy is estimated at 35 years) is due in large part to unsanitary living conditions and diet rather than to climate. Nevertheless, doctors believe that the high altitude is an important contributing factor in the contraction of respiratory diseases.

Precipitation is as varied as the temperature. East of the Cordillera Oriental rains fall throughout the year. On the west side of this Cordillera, the elevated plateaus have a limited rainfall in the north (21 in. at La Paz), which comes only during the summer months and diminishes toward the south until the surface becomes absolutely barren. Brief and furious thunderstorms sometimes sweep the northern plateau and Lake Titicaca in summer.

(G. M. McB.; L. We.)

4. Vegetation.—Because of diversities in altitude the flora of Bolivia represent every climatic zone, from the scanty arctic vegetation of the lofty Cordilleras to the luxuriant tropical forests of the Amazon basin. Between these extremes the diversity in vegetation is as great as that of climate and soil. The plateau is primarily a grassland. Above 10,000 ft. few trees are found, but where there is even a light rainfall the hillsides and the high plains support a scant growth of coarse bunch grass (*Stipa ichu*), which is the principal pasture of domestic stock. This grass grows up to the snow line. Two other plants are the *tola* and the yareta; the former is a low shrub, the latter a highly resinous mosslike bush that grows in a compact fibrous mass. Both of these are used extensively for fuel. Vegetation in the Altiplano changes little in summer and winter. The vegetation of the valley is varied. Below the grass meadows at the top of the Cordillera Real is the dense Ceja de la Montaña forest. It cloaks most of the steep ridges and valleys in the belt of clouds and is composed of trees of many varieties. A major tree in this zone is the cinchona, whose bark is the source of quinine. The coca shrub, from whose leaves cocaine is obtained, also is native to this area, and orchids, mosses and lichens are common. Below, on the lowest slopes and flat valley bottoms, is the Montaña (tropical lowland) forest. It separates from the Ceja at about the 4,000-ft. contour. The forest of the foothills in this area is true tropical rain forest, the crowns of the trees forming a canopy beneath which there is but thin undergrowth. Many of the trees are huge with high trunks often buttressed at the base. The flora of the Oriente varies according to subregion. The Beni subregion is characterized by some of the heaviest forest in the Amazon basin. This forest lacks pure stands of trees and hence has been little exploited, but the Para rubber tree (*Hevea brasiliensis*), mahogany, cedar and others are important to man. The Santa Cruz area to the south is transitional (40% grass and 60% forest) between the forest area to the north and the scrub forest and grass of the Chaco to the south. Trees and palms are scattered through the dense growing grass. In the northern and western parts of the area many trees grow to great height and size. Among the principal useful trees are the *Cuchi*, a hard, durable wood used for construction; the *Almendrillo*, a hardwood tree, and the *Mara*, a mahogany that is easy to work and is widely used for doors and furniture. The Chaco subregion, south of the Santa Cruz area, is a plain. During the rainy season part of it is converted into swamps, but during the dry season it literally burns up. It is covered with tropical scrub forest interspersed with patches of grassy savanna, the grass apparently de-

veloping under conditions of flooding. There are areas where the thorny deciduous trees, mimosas and acacias, grow close together in veritable thickets; there are other places, particularly along rivers, where taller trees form bands of dense semideciduous forest; there are places where scrub trees dot the grass cover like apple trees in an orchard; and there are extensive areas of savanna. It is not unusual for trees to grow in salt-impregnated soils and in swampy associations.

5. Animal Life.—The native animal life closely resembles that of the neighbouring areas of Argentina, Brazil and Peru. In the rain forest of the north, the fauna is distinguished by a wide range of species none of which becomes very numerous, however, because competition is too great to permit it. Among the more important snakes are the anaconda, or water boa, and the bushmaster. Crocodiles, technically known as caymans, are common, as are lizards. The forest, with its constantly saturated warm air, provides a favourable habitat for salamanders, frogs and toads. Birds are present in large numbers. Among the birds that seldom descend to the ground are the fruit pigeons, parakeets, many toucans, hornbills and touracos. Seen high in the sky gliding in search of carrion are king and black vultures. Conspicuous among the mammals are the sloth, monkey, jaguar (largest of the American cats), ocelot, opossum, tapir, capybara (so-called water pig, largest of the rodents), peccary, armadillo and anteater. Insects are particularly abundant since there is no winter and they can breed throughout the year. Among those of greatest concern to man are mosquitoes, flies, leaf-cutting ants and termites.

Southward of the rain forest are the grasslands, scrub steppe and scrub forest. The fauna there include the jaguar, puma and deer (among the mammals), the cayman and some snakes; *e.g.*, the bushmaster and the fer-de-lance. Conspicuous among the birds are the rhea (a large flightless South American ostrich), a species of large stork and the common vulture. Waterfowl are abundant. There are myriad forms of insect life. Since much of the country is swampy for an extended period, mosquitoes of all kinds are present in enormous numbers. Flies, gnats and ants are also abundant. Insects are a major source of discomfort to human beings in the Chaco.

In the Montaña the fauna differs from that of the Altiplano and occurs in zones. Mammals are more abundant on the lower slopes and in the valleys than higher up. There are to be found two kinds of deer, the armadillo, various opossums, the spectacled bear, peccary, jaguar, capybara and the tayra—a huge weasel, described as ugly and vicious.

Particularly interesting and certainly most distinctive are the animals of the highlands, for the climate and fauna of the far south (Patagonia) are extended northward along the western fringe of the continent by the height of the Andes and the presence of the cold Humboldt current. Accordingly, the fauna differ notably from that of the adjacent rain forest. The most striking animals of the Puna are the guanaco and the vicuña—American representatives of the Camelidae. Their altitudinal limits are from about 8,200 to 18,000 ft. The guanaco, which is regarded as the wild progenitor of the llama, is found there at about its northern limit. The vicuña, which is particularly inured to extreme cold, thin air and little water, grazes on small alpine shrubs and plants. Rodents are well represented in the highlands, the most specialized and best known being the large chinchilla, viscacha, mara and cavy. The cavy occupies the more deserted parts of the Altiplano.

Bird life is abundant, particularly on Lakes Poopó and Titicaca, and includes geese, ducks, grebes, coots, cormorants and gulls. In the swamps there are curlews, plovers and snipes. In this region dwells the condor, which in Peru roosts and breeds from heights of 10,000 to 16,000 ft. In Bolivia the condor descends to sea level in search of food on the west side of the Andes but not to low altitudes on the east side of the mountains. Insect life, though abundant and varied at lower levels, is largely absent above 10,000 ft.

Of the five animals definitely domesticated in the western hemisphere, four were tamed in Bolivia and Peru—the llama, alpaca, guinea pig and muscovy duck. The llama is the beast of burden in the bleak, barren wastes of the Puna but is seldom observed at elevations below 7,500 ft. It is not only a beast of burden but also supplies meat, wool, leather, tallow, hair and fuel (dung). The alpaca is best adapted to high altitudes and does well in the wet, marshy ground of high elevations. It is not a pack animal but is reared for wool. The cavy, or guinea pig, a small tailless rodent, is raised by almost every Indian family in the highlands as a source of meat and as a pet, from 5 to 15 being kept in the average house. The muscovy duck is raised for food and is the only bird that has been domesticated in the Central Andes.

II. GEOGRAPHICAL REGIONS

To understand Bolivia one must divide it into regions, for there are profound differences among the various parts of the country. For example, agriculture, the dominant economic activity, is sharply differentiated by topographic and climatic variations. The almost impenetrable mountain ranges have made Bolivia, from the standpoint of terrain, a nation divided against itself. The term region as employed here refers to large areas that are uniform in certain respects and distinct from adjacent areas.

Bolivia is divisible into three major regions: (1) the highlands or Altiplano; (2) the Valles or Montañas; and (3) the Oriente. The Valles region in turn is divisible into two subregions and Oriente into three. The agriculture in each major region differs so markedly from that in the others that one might suppose the country would have a varied and balanced output. This is regarded as the potential agricultural strength of Bolivia and the goal to be achieved. Such, however, is not yet the case. Both volume of production and interchange of products that would make this potential strength an actuality are lacking because of a combination of circumstances but dominantly because of transport deficiencies.

The major bases for regional division are the great differences that exist in altitude, terrain and soils. In Bolivia variations in climate are closely related to differences in altitude, and differences in natural vegetation are closely related to differences in climate and soil.

1. The Highlands or Altiplano.—This highland region is composed of three distinct parts—the Cordillera Occidental, the Altiplano, and the Cordillera Real. It comprises about one-seventh of the total land area of Bolivia. It is a high, bleak, windswept, cold and barren region. From season to season it changes very little but experiences sharp daily variations in temperature. The days may be warm and agreeable but the nights are invariably cold and uncomfortable. The northern part receives so little precipitation—about 21 in.—that it can scarcely support agriculture. The southern portion receives even less and is virtually a desert. Rising above the Altiplano are volcanic peaks some of which exceed 21,000 ft. with passes exceeding 13,000 ft. Drought, frost and hail are hazards even during summer.

Strangely enough, this hostile region is not only one of the highest inhabited areas on earth but is also Bolivia's most densely populated region: about 60% of the total population dwells there. Most of the important cities such as La Paz and Oruro, many small towns, and most of the mines are in the Altiplano. This concentration results from continuity of historical tradition, presence of large mineral deposits and relative proximity to Chilean and Peruvian ports. It was there that the Inca and pre-Inca institutions had their beginnings. Despite almost continued cold, a paucity of rainfall, a short growing season and strong winds throughout the area, these early Indians developed one of the world's most important independent scientific agricultures. It was in the Altiplano, too, that the Spaniards became established in the early colonial period. They came seeking precious metals but many soon abandoned the quest and settled down on large agricultural estates.

Altiplano agriculture is limited to the production of potatoes, barley and quinoa, a variety of lamb's quarters. These crops are rotated in a three-year cycle after which the plot of land is not cultivated for a period of from 12 to 14 years, though pastured by llamas and alpacas, by some sheep, and in favoured spots even by cattle. Unfortunately, the Altiplano does not produce adequate food for its own population: more than 50% of the country's food

is imported. Nearly all the farm work is performed by Indians. Until 1952 most of the land was held by *hacendados* in very large estates of from 1,000 to more than 10,000 ac., most of which dated back to the days of the Spanish conquistadors when large grants of land (encomiendas), together with the Indians who worked them, were given to loyal followers of the crown. Out of this practice grew the feudalistic systems that prevailed down to the 20th century. The rest of the land was held communally by the Indians.

This semifeudal system of land tenure prevailed until 1952 when Víctor Paz Estenssoro broke up the large estates and gave plots of land to the Indians—the land to be paid for within 25 years. Thus by 1956 Bolivian landowners totaled 800,000 as compared with only 50,000 three years earlier. It was believed that Indian landownership would ultimately be good for the country, but at the start of the 1960s there was much confusion and the once productive large estates were little more than kitchen gardens for the new owners. The dense population requires a relatively high intensity of land use and there is little potentially productive land in the Altiplano under 14,000-ft. altitude that is not in use.

The Altiplano is the mining region of Bolivia. In fact a mining complex has put its stamp on the nation. In the eyes of the outside world mining is regarded as the principal activity of the country, for minerals furnish most of the foreign exchange needed to pay for the large imports of food and manufactured products required for domestic consumption. Actually only about 2% of the population is employed by the mining industry.

Mining is most important in the eastern portion of the Altiplano. While gold, silver, copper, antimony, bismuth, tungsten, lead and zinc all are mined, it is tin that is most important. Bolivia is the only nation in the western hemisphere that mines tin commercially. However, the ores are complex and occur in veins difficult to locate. Some of the deposits are nearly mined out; there is almost no fuel for smelting within the country; and the mines lie at such great elevations that only Indians can perform sustained physical labour in them. Moreover, transportation is unsatisfactory, though it is better than elsewhere in the country. This combination of adverse factors makes Bolivia a high cost producer of tin. The leading tin mining area is the Cordillera Real from north of La Paz to the southern portion of the department of Potosí, with the principal fields in the Cordillera de las Cruces in the department of La Paz: in the triangle formed by Oruro, Avicaya and Uncia: in the Potosí area; and in the province of Sud Chichas. The two outstanding mines are Llallagua and Huanuni.

Everywhere in the Altiplano the life of the miner is hard but as elsewhere in the world, it is much worse in some mines than in others. In one area the ore-bearing rock is so hot that the Indian miners wear only a breechcloth and rubber boots; the temperatures vary from 120° to 125° F. and the humidity ranges from 90% to 95%. Rock dust fills the air, getting into the lungs of the miners (60% of whom are reported to have tuberculosis). At the end of the working day, the miners leave the sweltering mine shafts, entering the cold air of the Altiplano and of their unheated homes.

Population in the Altiplano does not increase much because of the appalling infant mortality rate—one of the highest in the world. This results from exposure to cold, malnutrition and lack of hygienic child care. Life expectancy in the region is about 35 years. The Altiplano is a hard land—hard for man to grow crops and to raise most livestock, hard to find fuel to cook with or to keep warm by. The clothing and blankets are made from the wool of sheep and llamas. Most Indians chew coca and a major reason is that it numbs their senses to the cold. A cud of dried coca leaves bulges from the cheek of almost every Altiplano Indian. Life there is an endless struggle to wrest from a stubborn nature enough food, fuel and wool to live by.

The Altiplano has been Indian for centuries and promises to remain so. Most Indians there are illiterate, though some progress has been made in education. The Indians follow time-honoured customs. Centuries of bitter experience with the white population have taught the Indians to have as little as possible to do with white men if they are to protect their tiny plots of land or what remains of the previous year's harvest.

2. The Valles (Montaña).—Eastward of the highland region lies a complex area of deep valleys and high mountain spurs. The most important part of this region is a subregion known as the Yungas. Actually the term Yungas is not clearly defined by geographers and economists. Some apply the term to the entire eastern slope of the Cordillera Real, while others restrict it to the narrow subtropical valleys in the Andes east of the Cordillera Real. There the Yungas is considered to be those river valleys on the eastern slope of the Andes where the elevation is 6,000 ft. or less—essentially the area northeast of La Paz but extending southward almost to Cochabamba. With its softer, milder temperatures, the Spaniards found that not only they but also their livestock and crops became more easily acclimated.

Because of poor transport facilities, the area must produce such subsistence crops as alfalfa, barley, cacao, coffee, corn, rice, yuca, wheat and fruits (avocados, bananas, grapefruit, oranges and tangerines). Where climatic conditions are favourable but transport difficult, such cash crops as coca, sugar cane and coffee are produced. These have high value per unit of weight or bulk and thus can pay the costly transportation to the Altiplano. However, only by exploiting the Indian has it been possible to make a profit on these crops. Most important of the three is coca, which is restricted to the lower Yungas, north and east of La Paz, where it is grown by Indians on terraces of steep slopes of valley walls at grades up to 30° or more from the horizontal. Since the chewing of coca is almost universal among the highland Indians and its purchase constitutes one of the principal items of family expenditure, coca production provides the principal source of cash income for the entire populace and the Yungas has become Bolivia's richest subregion. Only within the past two decades have roads into the Yungas been sufficiently improved to enable trucks to enter and leave safely. It should be noted that the Yungas is one of the most densely populated areas of Bolivia and with the Altiplano is reported to have 80% of the total population of the country.

3. The Oriente.—This region, the largest, least productive, most sparsely populated, and possibly the least known, comprises the vast semicircular territory to the north and east of the Valles. Despite the many physical and cultural characteristics making for identity, there is sufficient diversity to justify division into subregions: the northern rain forest: the humid subtropical central zone (comprising the northern and southern parts respectively of the departments of Santa Cruz and Beni); and the semiarid Chaco. Through the centuries this region has been effectively separated from the Yungas and the Altiplano by poor communications.

The Northern Rain Forest or Upper Beni Subregion.—This subregion begins at Bolivia's northern border and extends southward through the department of Pando and includes about half the department of Beni. Isolated from the effective national territory by the lofty Andes, the Beni subregion is economically closer to Brazil than to Bolivia. The land is for the most part covered by heavy, tropical rain forest like that of the Amazon basin of which it is a part. There grows the *Hevea brasiliensis*, the best source of natural rubber. The precipitation is heavy, some rain falling throughout the year. The wet season extends from November to April and the dry season from May to October. It is hot throughout the year. So flat and low is much of this subregion that serious floods often inundate thousands of square miles. In the southern portion are some small clearings where cattle are raised. Some wild rubber is still collected and though the subregion is Bolivia's leading cattle raising area, there are no all-weather roads connecting it with the Altiplano. Accordingly, beef is flown to La Paz. However, cattle from Beni show a high incidence of internal parasites and mature slowly. Even the hides bring a discounted price because of scars from cattle ticks. Native wild grasses comprise most of the pastures through plantings of Para grass (*Panicum purpurascens*) made in low-lying areas; guinea and elephant grass have been planted in some fenced pastures.

Humid Subtropical Central Subregion. This subregion comprises roughly the northern two-thirds of the department of Santa

Cruz. Its geographic centre lies approximately 75 mi. N. of the city of Santa Cruz but its heart is the city and its immediate tributary area. The area is semitropical in climate—a transition between the wet Beni and the semiarid Chaco—and is reasonably free from both disease and parasites. For centuries this area was almost unknown and it still is among the most isolated areas in South America. Topographically, it varies from flat to rolling and lacks the heavy floods of the Beni to the north and of the Chaco to the south. The vegetation includes ribbons of tropical forests and strips of chaco. Low, scrubby thornbush dominates the drier sandy ridges.

This subregion was not important in the past. Its big disadvantage over the centuries was remoteness: it was worlds away from the Altiplano and, though potentially productive, its lands produced only for subsistence and for the single market of Santa Cruz. The Cochabamba-Santa Cruz highway completed in 1954 reaches into the Yungas and Altiplano from Santa Cruz and for the first time in Bolivian history the potentially productive surplus agricultural lands in the lowlands were connected with the population centres in the Altiplano by year-round motor traffic.

United States missions sent to help Bolivia produce more food have operated in all regions, but they have been most successful in the Santa Cruz area where the production of rice, corn and sugar cane has been increased. U.S. technicians introduced mechanized farming. However, it must be realized that most Bolivians are highlanders and it is not yet known whether mountain people can be brought down safely into the lowlands. Generally, when transferred to the Oriente, with its extremely hot weather, insects and stagnant water, they become ill and must return to the Altiplano to recuperate. A number of these people have migrated into an area 25 mi. E. of Santa Cruz and near the railway connecting this city with Corumbá and São Paulo. However, mountain folk prefer to remain in the Altiplano. Many experts believe that the area can contribute what is expected of it only if settlers are brought in from other countries. Italians, Okinawans and others have been introduced. While most colonies have failed, several, including that of Okinawans, showed some progress after difficult starts. The principal reason for failure has been lack of markets.

Chaco.—The Chaco is a huge area shared by Bolivia, Argentina and Paraguay. Much of it has not yet been explored. It is a low, level plain that slopes almost imperceptibly toward the east. The subsoil is impermeable. The streams that cross it are sluggish, as is indicated by such names as Río Salado ("salty river"), Río Confuso ("confused river") and Río Perdido ("lost river"). The waters are generally brackish. In fact, the acquisition of a potable water supply is a major problem. The Chaco is an area of striking contrast between seasons, being one of the hottest parts of South America during the rainy period when temperatures of 100° F. are common. The vegetation consists of great stretches of savanna interspersed with frequent islands of forest. Most wooded tracts consist of jungle, though large clumps of palm trees are common. The grasslands, which are often covered with water during the rainy season, become withered and nearly valueless for grazing during the dry season.

The Chaco has practically no roads other than the few that penetrate into the petroleum section. Bolivia's potential petroleum zone is a 150-mile band paralleling the Cordillera Real. Actual production is restricted to the Chaco. The most active field, the Camiri in southeastern Bolivia, produces light-grade oils and is connected with Sucre, Cochabamba and La Paz by the world's highest pipeline. For heavy oil, Bolivia depends upon the Bermejo field near the Argentine border. There are several additional fields. Bolivia not only meets its own requirements (except for lubricants and high octane aviation gasoline) but has considerable oil for export.

Population is sparse in the Chaco. There are a few villages and a negligible amount of farming. The population consists mostly of small tribes of nomadic Indians. The raising of cattle is the chief activity and, in spite of floods and droughts, large herds, usually unattended, roam the territory. Most of these cattle are marketed in Argentina.

The Oriente is thus an enormous region, the central portion of which is believed to have promising possibilities for crops and cattle. It is handicapped by transport deficiencies, though it is better off in this respect than ever before because of the Cochabamba-Santa Cruz highway. By 1956 arteries connecting with this highway had been completed. Cut off by the mountain barrier, except for the new highway, the low-lying Oriente has had little to do with the rest of the country, and its few agricultural and livestock products have trickled into Brazil and Argentina rather than into the Altiplano. Railways from both Argentina and Brazil now reach the city of Santa Cruz. (L. WE.)

III. THE PEOPLE

The people of Bolivia are mainly concentrated in the numerous valleys and plateaus of the Andean mountains, about 60% at altitudes of more than 12,000 ft. and 86% at more than 6,000 ft. Fear of the many pests and diseases common to the tropical lowlands drove first the Indian and later the Spanish immigrants to the higher altitudes. The result was early overcrowding in certain areas of the highlands and valleys, while the lowlands remained largely unoccupied with the exception of a few scattered settlements founded by the Spaniards during colonial days and many small groups of Indians widely dispersed over the forested northeast. Efforts of the government to move people from the crowded highlands to the fertile, eastern lowlands were strongly resisted until the late 1950s. Within the past decade, however, approximately 12,000 highland families have been induced to move and thousands of others are waiting their turn as land is cleared and communication facilities established.

1. Racial Types.—Bolivia is a country of diversity, not only in its geography but in its people. Racially, the population is mixed although the national census classifies everyone as either white, cholo (mixed) or Indian. The term white refers to people of European extraction and to those born locally whose parentage, history, education or achievements have resulted in an upper-class placement. The cholo group includes an Indian-white mixture plus the more or less racially pure Indians who have learned to speak Spanish well, have mastered a skilled trade, and have abandoned their indigenous dress. The Indians usually are dark-skinned, illiterate, speak only a native language, and provide the unskilled labour in the economy. The more numerous Indian groupings include the Aymaras of the highlands, who constitute about 25%, and the Quechuas of the valleys, who form about 37% of the total population. The remaining Indians, concentrated in the forested areas of the lowlands and constituting a variety of language groups, total about 2% of the population.

Within the predominant Aymara- and Quechua-speaking groups, there is little uniformity other than language. Customs, habits, beliefs and dress vary from one community to another. Any person familiar with a given geographic area can identify an Indian with his community of residence by his dress. The variety of hats, skirts, shawls and large blanketlike garments called ponchos that are to be found in any large gathering of Indians is a never-ending source of wonder to the tourist.

2. Languages.—Bolivia is a country of many languages. According to the 1950 census, only 36% of the population could speak Spanish while about 64% spoke an Indian language or dialect. As a result of a colonial policy followed by the republic in its early years, denying the Indian the right to speak Spanish, whites were required to learn the languages of the Indians. Therefore, today, most of the white population speaks one or more Indian language, generally Aymara or Quechua.

3. Religion.—Despite the freedom that all churches have enjoyed in Bolivia since its independence, the population has remained predominantly Roman Catholic. Protestant churches are located largely in the cities, and their membership is mostly white. Few Indians have been converted from Catholicism although their religious practices, especially in the rural areas, contain numerous elements of pre-Columbian rituals; many of the Indians confuse the Catholic saints with their pagan gods.

4. Customs and Culture.—Contemporary Bolivian culture has evolved from a mixture of imported European customs and those

of the indigenous people of the area. The Inca (Quechua) civilization was highly developed at the time of the Spanish conquest and much of it is still in evidence in native dress, type of house, agriculture, food, belief and custom. It is largely the influence of the Indian that makes Bolivian culture different from that of many other Latin-American countries.

The basic unit of social organization in Bolivia is the family. Strong and extensive, it includes, in addition to parents and children, a wide range of relatives bound together by close ties of visiting, work and mutual aid. The rural Bolivian divides the world into two groups—his own family and all that lies outside it. Individual roles within the family are well defined. In middle- and upper-class families boys are allowed extensive freedom while women and girls are restricted largely to the home. In lower-class families, especially in rural areas, the women are expected not only to perform the duties of homemaker but also to participate in certain field activities. Indian and cholo women usually are the bankers in the family and have the responsibility of marketing most of the farm products.

Marriage usually takes place at an early age. Although many unions are not formally legitimized, the family is a stable unit seldom broken by divorce or separation. Trial marriage is common in rural areas. When formal marriage does take place, there is often a dual ceremony since neither the state nor the church recognizes marriages performed by the other.

The diet of the rural people is simple, consisting of potatoes, a cereal called quinoa (pigweed) and bread. The more prosperous farmers consume some meat from llamas and sheep. Potatoes are preserved for long periods by freezing, trampling out the water with bare feet and drying in the strong winter sun.

Most forms of commercial recreation and amusement are available to the residents of the cities. Futbol (soccer) is the national sport. Even local games are well attended and emotions run high in closely contested matches. Major diversions of the rural people are the frequent religious festivals at which people visit, dance, exchange their wares and consume large quantities of cane alcohol and *chicha*, a fermented corn beer. Weddings, birthdays, christenings and the numerous saints' days are also celebrated by dancing and liberal drinking.

5. Development and Change.—Change is an outstanding characteristic of the Bolivian people of today. In 1953 the government initiated a revolutionary program of reform that has been heavily subsidized by the U.S. government and extensively aided by the United Nations. Roads, education and land reform have been the major targets of the program. About 12,000,000 acres of land from large estates have been distributed to approximately 158,000 families with the result that today most of the peasants farm land that they own. This change has had a profound effect on the way of life of every Bolivian. (O. E. L.)

IV. HISTORY

1. Spanish Era.—Several centuries before the arrival of the Spaniards in the 1530s on the highlands of present-day Bolivia, this area had been incorporated into the far-flung empire of the Incas. Perhaps even more advanced civilizations, at least judging from the massive architectural remains at Tiahuanaco on Lake Titicaca's southern shore, preceded the Inca rule. As happened with other relatively advanced Indian cultures of the Americas controlled by highly centralized political or military systems, the Inca empire and its territories quickly succumbed to Spanish dominion. The Aymara and Quechua natives thus changed masters, to serve the crown of Spain rather than the Incas at Cuzco. Politically this region became, in 1559, the *audiencia* of Charcas, an administrative subdivision of the viceroyalty of Peru. Until 1776, when this *audiencia* was transferred to the control of the newly established viceroyalty of the Río de la Plata at Buenos Aires, it was administered from Lima. The *audiencia* itself was located at Chuquisaca, founded in 1538 in a valley on the eastern side of the Andes—the City of Four Names, also known as Charcas and La Plata and now called Sucre and still technically the legal capital of Bolivia. Economically the region, generally referred to as Upper Peru, gained fame as the world's richest silver-mining area in the 16th and 17th centuries. The high quality silver mines at Potosí, discovered in 1545, underwrote the development of what was in the mid-17th century the most populous city in the Americas with more than 160,000 inhabitants. Commerce and trade, stimulated by the flow of silver bullion down to the coast at Lima and eventually to Spain and the subsequent return of foodstuffs, textiles and European manufactures, built other Spanish outposts into flourishing cities: La Paz, established in 1548 in the central highlands and on the main route to the coast; Villa de Oropeza, now Cochabamba, founded in 1574 in a fertile valley on the eastern side of the Andes; Oruro, settled in 1601 in the southern highlands and a mining centre in its own right.

During the 18th century the *audiencia* of Charcas enjoyed considerable autonomy and the area developed its own regional traditions and customs. Although silver production from the mines of Potosí began to decline by 1700, the cities and commerce of Upper Peru continued to flourish. Artistic and religious activity, spawned during the area's mining boom, centred at Chuquisaca and spread the renown of that city's churches, academies and university far beyond the confines of the *audiencia*. Cochabamba thrived as the breadbasket for the higher and less fertile zones while La Paz prospered from its central location on the trade routes.

Such economic growth, along with the ferment of ideas and creativity and the relative autonomy of the area within the Spanish empire, doubtless explains the early movements for independence in Upper Peru, though it hardly forecast that Bolivia would be the last of the South American republics to gain its freedom or that it would face a 19th century wracked by anarchy, despotism and international wars. The first significant uprising sprang from Indian roots. The efforts of Spain's new Bourbon dynasty in the 18th century to centralize administration and efficiently collect revenues in its overseas empire weighed on the servile Indian peasantry in the Andean regions. Aggravated by the abuses of local Spanish officials, several chieftains in Upper Peru led their people in a revolt—generally known by the name of one of the principal leaders, a descendant of the Royal Incas, Túpac Amaru II—that had overtones of a restoration of Inca sovereignty. From 1780 to 1783 a cruel and bitter war raged in the highlands of Upper Peru, finally resulting in the complete defeat of the Indians and the execution of their leaders. It was an exemplary punishment, and indeed the Indians never rebelled again. But Spain's efforts to centralize administration soon encountered a far stronger resistance in its own sons, born and nurtured in America—creoles who valued local autonomy and resented the fiscal demands of the peninsular motherland. The intellectual, political and cultural centre of Upper Peru, the city of Chuquisaca, thus witnessed on May 25, 1809, a first break with Spain's absolutism, a declaration of local autonomy albeit in terms of loyalty to Spain's temporarily deposed monarch, Ferdinand VII. Two months later at La Paz a more daring proclamation revealed desires for outright independence. This trend from local autonomy to independence, soon to be emulated by creoles throughout the Spanish empire, was premature. An expedition from the loyal heartland of Spain's empire, Peru, silenced the cries for freedom, and the principal rebel leader, Pedro Murillo, was hanged in La Paz at the beginning of 1810. The creole autonomist or independence movement, however, now began to prosper beyond Upper Peru's borders. For the next 15 years this region became the unhappy pawn in civil strife between royalists and creoles and between armies sent from independence-oriented Buenos Aires and loyalist Lima.

Guerrilla operations spread across the face of Upper Peru as local leaders, often no more than bandits, advanced their own positions with little regard or interest in either the cause of independence or the Spanish crown. At the same time as this chaotic, irregular war, more organized military operations took place. Four times creole troops from Buenos Aires invaded Upper Peru, attempting to replace the authority of Spain with that of Buenos Aires. Each time royalist forces from Peru turned the creoles back, only to be defeated themselves when they advanced into the northwestern provinces of Argentina. Even after the libera-

tion—from 1818 to 1822—of Venezuela, Colombia and Ecuador by Simón Bolívar and of Chile and Peru by José de San Martín, Spanish forces still controlled most of Upper Peru, harassed only by guerrillas from the semitropical mountain valleys of the Yungas northeast of La Paz. In 1823 a major patriot expedition from Lima under Andrés Santa Cruz, a mestizo general from Upper Peru who was later to become one of Bolivia's great statesmen, occupied the area between La Paz and Oruro for several months but was forced to retire before Spanish forces. At the end of 1824 Bolívar dispatched the Colombian general Antonio José de Sucre, the victor of Ayacucho, into Upper Peru, and his appearance caused a general uprising for the patriot cause. Further royalist resistance ended at the battle of Tumusla on April 2, 1825.

2. 19th-Century Instability.—The prolonged anarchy of the independence struggle contributed to the formation of an independent Bolivia which soon became a byword for despotism and violent revolution. In mid-1825, Sucre, as supreme commander and victorious general, summoned a congress of provincial delegates at Chuquisaca to determine the area's future. Bolívar, now dictator of Peru, wished to see the former *audiencia* of Charcas incorporated within his dream for a union of northern South America, while from Buenos Aires came equally pressing invitations to join the United Provinces of the Río de la Plata. But the spirit of autonomy and independence, effectively encouraged by Sucre, dominated congress. In Aug. 1825 Upper Peru became an independent republic, named Bolivia in honour of the great liberator. Bolívar, himself, drafted a constitution for his namesake country, and a new congress installed at Chuquisaca ratified this document in 1826. Sucre was chosen president for life, although he accepted for only two years and on condition that his Colombian troops remain with him.

At the same time though, Santa Cruz, commander of the ill-fated patriot expedition in 1823 and Sucre's second-in-command in the subsequent campaigns and organization of the republic, worked stubbornly for a union of Peru and Bolivia. First from Lima, until he was defeated in the Peruvian presidential elections of 1827 by Gen. Agustín Gamarra, and then in Bolivia, where he was chosen president in 1828 after Sucre had been driven out of the country, Santa Cruz pursued the vision of a Peru-Bolivia confederation. In 1836 the vision became reality, but only after Santa Cruz had regained power after a coup against his regime in 1829, had established some order in Bolivia's legal and fiscal structure, and had invaded Peru to overthrow and defeat his long-time rival, General Gamarra. But such a confederation could not last: it threatened South America's unstable balance of power and was strongly opposed by Argentina and Chile. Argentina limited itself to a declaration of war, but Chile sent troops into Peru to support Gamarra. Three years of war (1836–39) ended with the defeat and exile of Santa Cruz, with Gamarra restored to the presidency of Peru, and with another general, José Velasco, in provisional control of Bolivia.

With the collapse of Santa Cruz's confederation, Bolivia for the next 40 years became a land of constant strife, insurrection, repression and brutality; foreign intervention and local dictators alternately ravaged the economy and despoiled the people. Gamarra, taking advantage of new disturbances in Bolivia, attempted to annex the country in 1841, only to lose his life in battle against the forces of the new strong man, Gen. José Ballivián. A self-educated but enlightened despot, Ballivián voluntarily retired to exile in 1848, but he was succeeded by Gen. Manuel Isidoro Belzu, leader of another successful military revolution. Despite some measures to promote trade and agriculture, Belzu, before he resigned in 1855 with the words that Bolivia was incapable of being ruled, built lasting fame as a demagogue, a man of the masses and an opportunist. After several more coups the aristocratic José María Linares seized the government, ferociously crushed the opposition, and established an autocratic but honest regime (1857–61). After a vacillating interregnum under the leadership of Gen. José María de Achá, a new revolt in 1864 brought to power one of South America's most notorious military tyrants, Mariano Melgarejo. A rough, courageous soldier but a habitual drunkard and a totally amoral individual, in the eyes of many historians he literally ruined Bolivia before he fled to Peru in 1871. Both Chile and Brazil took advantage of his character to gain treaty concessions, while foreign capitalists and large landowners profited enormously. His successors provided some slight improvement but prolonged the tradition of cruel, irresponsible military dictators for another decade: Col. Agustín Morales (1871–72); Col. Adolfo Ballivián, son of the former president (1873–74); an exception to the military succession in the capable and honest civilian administration of Tomás Frías (1874–76); and Gen. Hilarión Daza (1876–79).

3. War of the Pacific.—Relations with Peru and Chile, which had already played an important role in Bolivia's early national history, brought disaster to the republic in 1879–84 when Chile seized Bolivia's western seacoast and turned the country into one of South America's two landlocked nations.

The discovery in the 1840s of rich beds of nitrates and guano along the Pacific coast had revived boundary questions between Peru, Bolivia and Chile. Frontiers that had been agreed upon during the breakup of the Spanish empire began to receive closer scrutiny. The almost uninhabited Atacama desert and its lonely port of Antofagasta, which previously had merely provided Bolivia a theoretical access to the Pacific, began to attract investment, commerce and the covetous glances of Chile. By South American standards Chile's army and navy were powerful and efficient, and the country enjoyed stable government and a prosperous economy. The war against the Santa Cruz confederation had already demonstrated Chilean determination to maintain the balance of power on the west coast and to protect, aggressively if necessary, its national interests.

In response to the nitrate and guano opportunities, Great Britain, quickly followed by the U.S., Brazil and Chile, began to invest in Atacama mining, port and railroad ventures, with Chilean citizens outnumbering other foreigners and often even Bolivians at the mining outposts as well as the ports of Antofagasta and Arica. On several occasions in the 1840s and 1850s Chilean marines were landed to protect their nationals, actually illegally exploiting mineral resources on Bolivian territory. The gap between Bolivia's chaotic and often bankrupt and irresponsible administration and Chile's prosperity and stability led to still further friction, and Chile brought increasing pressure to win economic and territorial concessions from Bolivia. It was not until Melgarejo, however, that foreign capital and Chilean influence really took over the area of Atacama. Under the threat of war Chile secured a treaty in Aug. 1866 which not only gave Chile the relatively poor territory between latitude 24° and 25° S., but also extended to it important commercial privileges in the richer region between latitude 23° and 24° S. Further blandishments to Melgarejo strengthened Chile's financial stake in this coastal desert, but ensuing Bolivian administrations in the 1870s began to resent the amount of wealth that was passing into Chilean hands. Peru also became disturbed by the hold that Chilean capital had established in Tarapacá, the nitrate-rich southern province of Peru. In Feb. 1873 Bolivia and Peru entered into a secret agreement, the ostensible purpose of which was the preservation of their territorial integrity and their mutual defense against external aggression. It was evident that the object of this treaty was to halt further Chilean encroachment. Yet Chilean pressures continued. Shortly after conclusion of the secret treaty with Peru, Bolivia signed, although it did not ratify, another commercial agreement with Chile. Four years later General Daza demanded that, as the price of Bolivia's consent to this agreement, a tax be paid on all nitrates exported from Bolivia and that unless this levy was paid nitrates in the hand of exporters would be seized by the Bolivian government. The Chilean answer was immediately forthcoming—a fleet was sent to blockade the Bolivian ports and Chilean forces occupied Antofagasta in Feb. 1879. On March 1, 1879, the Bolivian government declared war.

Chile, aware of the secret treaty between Peru and Bolivia, rejected a gratuitous Peruvian mediation offer and demanded assurances of Peruvian neutrality as well as annulment of the secret treaty. Upon Peru's refusal to meet these demands, Chile declared war. The Bolivian ports were already in Chilean hands. Chilean sea superiority soon permitted the landing of sufficient troops to

threaten the Peruvian-Bolivian forces concentrated at Arica and other coastal cities of southern Peru. The Peruvian forces were routed after a surprise sea attack at Pisagua, and General Daza withdrew to Tacna with his Bolivian troops. The fall of Patillos and the evacuation of Iquique followed in quick order, and by the end of 1879 Chile completely controlled the province of Tarapacá. Meanwhile, revolutions had overthrown the presidents of both Peru and Bolivia, and the fortunes of the two allies continued to decline. During 1880 the war was largely limited to naval engagements between Chile and Peru. In early 1881 Lima and its port of Callao were surrendered to the Chileans, although resistance lingered on in the interior. At last, in Oct. 1883 a provisional Peruvian government concluded a peace treaty with Chile, followed several months later by a similar arrangement between Chile and Bolivia.

The final territorial results of this war were not decided for Bolivia for nearly 20 years. Under the initial truce in 1884 Bolivia agreed to Chilean occupation of the whole seacoast. In 1895 treaty negotiations between Bolivia and Chile held out renewed hopes for a Bolivian access to the sea, in conjunction with Chilean claims to Tacna and Arica. Chile promised that if it acquired those provinces from Peru by plebiscite it would either transfer them to Bolivia or make other arrangements to "fully satisfy the present and future requirements" of Bolivian commerce. But secret conversations between Bolivia and Argentina, the latter engaged at that time in a bitter border controversy with Chile, led to a change in Chile's conciliatory attitude. The Bolivian hope of Argentine assistance faded during the next several years with the settlement of the Chilean-Argentine boundary, and Bolivia found herself in no position to renew hostilities or to bring effective pressure to bear on Chile. In 1904 Bolivia therefore signed and ratified a treaty which definitely ceded the maritime provinces to Chile. Bolivia, although now without a seaport, did receive certain advantages. The government of Chile undertook to construct a railroad at its own cost from Arica to La Paz and to give Bolivians free transit through Chilean territory to certain Pacific ports. Chile further agreed to pay Bolivia a cash indemnity and to extend assistance in the construction of other access railroads.

4. Relative Prosperity and Stability.—The revised constitution promulgated in 1880 remained in effect for the next 50 years, marking a return to comparative political tranquility. The economy, although hampered by the War of the Pacific, likewise showed considerable growth during the next half century.

Gen. Narciso Campero came to power in La Paz in 1879 following a garrison revolt against General Daza's incompetent management of the war effort and during the following year was confirmed in office by an election. His successors, Gregorio Pacheco (1884–88), Aniceto Arce (1888–92), Mariano Baptista (1892–96) and Severo Alonso (1896–99), provided Bolivia with a new experience in the regular and orderly transition of government. The first efforts were made to develop true political parties, although the principal issue at stake between Liberals and Conservatives remained the Liberal proposals to reduce the power of the Roman Catholic Church. The Conservatives controlled the administration until the end of the 19th century and were then followed by 20 years of Liberal government, but in the last analysis both parties merely represented variations on rule by an enlightened oligarchy. The administrations of Pacheco and Arce also marked a new economic phase, the development of Bolivia's tin industry. Both men were leading tin entrepreneurs and from the presidency encouraged the foreign investment, technology and transportation necessary to the growth of this industry. In 1898 a revolt broke out in La Paz against President Alonso's regime in protest against legislation making Sucre the permanent capital of Bolivia (previously the capital had rotated among the four cities of La Paz, Sucre, Cochabamba and Oruro). The revolt soon triumphed (the legislation was never repealed so Sucre officially remained capital, although La Paz became the effective capital) and its leader, Col. José Pando, was elected president in 1899. During his administration the groundwork was laid for final settlement with Chile of questions arising from the War of the Pacific. In addition, Pando handled a difficult boundary problem with Brazil in the rich rubber-producing territory of Acre. Most of those engaged in the rubber industry were Brazilians who resented the attempts by Bolivian officials to exercise authority in the region. These Brazilians established an independent state against which, in 1900, Bolivian troops were dispatched. Bolivia, however, was in no better position to threaten Brazil than it was to coerce Chile, and in 1903 Bolivia ceded a large portion of Acre to Brazil in return for a cash indemnity.

Development of tin mining and foreign investment and the expansion of transport facilities, especially railroads, continued to be primary concerns for President Pando and the ensuing administrations of Ismael Montes (1904–09), Eliodoro Villazón (1909–13), and Montes for a second term (1913–17). World War I greatly favoured Bolivia's international trade: imports decreased while exports, mainly tin and other minerals, increased sharply in value. The national income of Bolivia increased sixfold from 1900 to 1920 and mining production nearly ninefold, with almost no inflationary tendency. Bolivia had declared its neutrality upon the outbreak of hostilities in Europe. In April 1917, when a German submarine torpedoed a ship carrying the Bolivian minister to Berlin, Bolivia broke off relations, but took no direct part in the war on the Allied side; its exports of metals, however, went entirely to the Allies. Bolivia was represented at the Versailles Peace conference and became an original member of the League of Nations.

The period of Liberal party ascendancy that began with President Pando brought a few feeble attempts to confront Bolivia's most staggering problem—an Indian peasantry comprising more than 80% of the population but totally isolated from the white and cholo Bolivians of the cities and towns. Selected Indians received an education and some ideas of land reform were aired, but the Liberals proposed no revolutionary attack on this cultural division. Government bureaucracy expanded, the army was reorganized and came under the strong influence of a German military mission after 1911, and the Liberals provided stable rule under a veneer of individual liberties and representative government. By the 1917 election 5% of Bolivia's population of 2,000,000 were qualified voters, an increase from the 2½% that voted in the 1896 election but hardly a democracy.

Although economic progress, stimulated by the promise of oil wealth in southern and eastern Bolivia, continued into the 1920s, the political situation showed signs of degenerating into confusion and anarchy. José Gutiérrez Guerra, successor to Montes in 1917, was driven from office in 1920 by public reaction to his policies of rapprochement with Chile. The leader of the coup, Juan Bautista Saavedra, became president in 1921 and formed his own political party, the Republicans, giving rise four years later to a major dispute over the selection of the next president. A revolt in July 1924, ostensibly to secure secession of the large eastern province of Santa Cruz to Brazil but actually directed against Saavedra, failed. A vigorous electoral campaign between Liberal and Republican candidates followed in 1925, with congress annulling the Republican victory. This impasse was finally resolved in 1926 with the election of Hernando Siles, a former Liberal turned Republican. His administration faced two grave crises—an increasingly tense border situation with Paraguay over control of the disputed and possibly oil-rich Chaco territory and the repercussions of the world depression on an economy almost entirely dependent on tin mining. His conservative and sound handling of both crises was unpopular and his attempts to amend the constitution and remain in power provoked a student-military revolt that swept him from power in 1930. The venerable leader of the Liberal party and defeated candidate in 1926, Daniel Salamanca, became president.

5. Chaco War.—Ever since Bolivia had lost its Pacific seaboard to Chile, it had become more interested in an Atlantic outlet via the navigable Paraguay river and consequently was concerned with the disputed territory of the Chaco (*see* CHACO WAR), claimed by both Bolivia and Paraguay. The discovery and exploitation of oil in Bolivia in the 1920s led to rumours of oil wealth in this unpopulated frontier, and each country began to

press its claims aggressively. Renewed negotiations, opened in 1927, foundered almost immediately because of border clashes. From 1928 until the outbreak of full-scale hostilities in 1932 there were repeated incidents and skirmishes. Although Bolivia had larger manpower resources, the jungle climate and guerrilla tactics claimed a heavy toll of its highland Indian recruits. By 1935 a stalemate had developed: the Bolivian forces had been pushed out of most of the Chaco, but Paraguay now began to suffer from overextended supply lines and distance from bases of operation. A truce was arranged in June 1935, and prolonged mediation by Argentina, Chile, Peru, the U.S., and Uruguay finally led to a peace settlement in 1938. Bolivia lost its claim to almost 100,000 sq.mi. of Chaco territory as well as to an Atlantic outlet. In addition the cost in casualties had been heavy (a net loss of roughly 2% of the population), and the economic impact of the world depression on the mining economy had been accentuated by the strain of three years of exhausting warfare. Paper currency increased sharply, marking the beginning of a serious inflation.

The war left other legacies as well. Nationalist, leftist and Marxist ideologies flourished among students and military officers. For the first time all Bolivians faced military conscription—frequently putting white and cholo city boys alongside Indian peasants in the front lines. As a result there developed among the youth an awareness of Bolivia's great cultural divisions and a concern with major national problems. From groups of war veterans sprang revolutionary organizations of the right and left and the seeds of Bolivia's 1952 revolution.

President Salamanca was deposed while on an inspection trip of the battle front at the end of 1934, and his weak vice-president virtually turned the executive power over to the military. In 1936 Gen. José David Toro seized power, proclaimed a socialist state and nationalized the foreign-owned oil assets; however, he was forced into exile within a year. A war hero, Col. Germán Busch, assumed the presidency and ruled for two stormy years until he committed suicide in Aug. 1939. Strongly nationalistic but untutored in politics or economics, he launched a campaign to regulate the mining industries. His suicide while leading this struggle made him the martyr of the nationalist cause. The older generation of generals returned to power in 1940 and installed one of their number, Gen. Enrique Peñaranda, as president, countering the trend of the younger, nationalistic and reform-minded intellectual, veteran and military groups.

6. The 1952 Revolution.—This major social and political movement of the mid-20th century found its roots in the ferment of ideologies and parties that took place during the preceding decade. Powerful leftist elements coalesced around the Party of the Leftist Revolution (P.I.R.), which, though Moscow-oriented, was never accepted as a full-fledged communist party. The Trotskyite elements formed a small but vocal party in 1940. Within the army the younger nationalistic officers viewed Hitler with increasing admiration, and a select number formed a secret fascist and terrorist fraternity (R.A.D.E.P.A.). The group which would finally emerge victorious, the Movement of the National Revolution (M.N.R.), officially founded in 1941, was violently nationalistic and less closely related to the international movement of fascism or communism.

The M.N.R. gained some representation in congress under the Peñaranda regime and achieved predominant influence among the mine unions with its parliamentary attacks on the government following the brutal massacre of unarmed mine workers and their families at Catavi near Oruro in Dec. 1942. Allied and particularly U.S. pressure led to a Bolivian declaration of war on the Axis in 1943; in reaction a coup in Dec. 1943 by Maj. Gualberto Villaroel brought to power an administration dominated by R.A.D.E.P.A. and M.N.R. Along with terrorist and fascist orientation, the Villaroel period brought the organization of Indian peasant movements, the strengthening of mine unions, and certain social reforms. Frictions within the administration, however, and strong opposition both inside and outside Bolivia brought about the downfall of Villaroel in 1946 in an ugly lynch scene that left his body and those of several aides hanging from lampposts in front of the presidential palace. The oligarchy and mine owners then tried to return to power, first through the provisional president and then with the election of Enrique Hertzog in 1947 (succeeded because of ill health by Vice-Pres. Mamerto Urriolagoitia in 1949); however, the tide continued to run for reform and change. Constant cabinet shifts from 1947 to 1951 reflected the problems of an administration trying to maintain middle-of-the-road policies. A revolt by the M.N.R. failed in 1949 and a general strike was crushed in 1950, but the presidential elections in 1951 apparently gave a plurality or perhaps even a majority to the exiled leader of the M.N.R., Víctor Paz Estenssoro. Urriolagoitia then turned over authority to a military junta which annulled the election and started a campaign of repression against the M.N.R. Falling tin prices and serious inflation, particularly burdensome on urban middle-class groups, added to the political crisis. Backward agricultural techniques and land tenure systems and lack of transport forced Bolivia to import nearly all major foodstuffs and further aggravated the economic situation. Dissatisfaction with these conditions culminated in a brief and bloody revolt in April 1952, supported by Indian peasants, miners, significant civilian groups and certain army officers; the successful revolutionists put Paz Estenssoro in the presidency.

The new regime immediately started to implement a social revolution. The army was greatly reduced in size and replaced in influence by a people's militia. Universal suffrage was proclaimed. The three largest mining companies (Patiño, Hochschild and Aramayo) were nationalized. Ambitious land reform measures were instituted, largely at the insistence of Indian peasants who began to take over the land in 1953. Efforts were made to decrease illiteracy and spread education. Beginning in 1953 the new government received extensive financial and technical assistance from the U.S., amounting to a total of $1,000,000,000 by 1959. But the economic problems of falling tin prices, inefficient and declining production from the mines and the land, and skyrocketing inflation continued to harass the M.N.R. government.

From 1952 to 1964 the M.N.R. remained in control of the government but in face of increasing conflict within the party. The sharp division between the right wing, composed of intellectuals and professional men, and the left, formed by trade unions under the leadership of the mine union head, Juan Lechín, caused dissension throughout the 1950s. Initially the left wing guided the policies of the government, but in 1956 Hernán Siles Zuazo, a leader of the right, was elected as Paz Estenssoro's successor, with Paz re-elected in 1960. The enthusiasm and direction of the social revolution began to fade, leading to increased conflict after 1960 between Paz Estenssoro and the vice-president, Lechín. In the election of 1964, with Paz again the M.N.R. candidate, both right and left wings seceded and Paz turned to the army for support to continue in the presidency. Although Paz was elected in July, elements within the armed forces removed him from power in Nov. 1964 and took over control of the executive. (Js. R. S.)

V. POPULATION

The population of Bolivia, according to the last census (1950) was 3,019,031; (1961 est.) 3,509,000. The population density is only about eight persons per square mile, with very uneven distribution. The high Andean plateau and the many valleys that stretch down the eastern slopes of the Andes are heavily populated, but the Oriente, the eastern lowlands that constitute two-thirds of the national territory, still has less than one person per square mile. Heaviest densities are in the valleys of Cochabamba, Sucre, Tarija and the Yungas. The largest cities (1961 est.) were: La Paz (350,142); Cochabamba (91,017); Oruro (83,689); Santa Cruz (69,560); Potosí (54,374); and Sucre (62,339). With the exception of Santa Cruz these cities are located at relatively high altitudes; La Paz, Oruro and Potosí are all above 12,000 ft.

The population of Bolivia is largely rural. Almost two-thirds of those counted in the 1950 census were classified as rural even though all persons living in villages with 1,000 or more inhabitants were considered urban. Unlike most Latin-American countries there have been no major migrations to the cities.

The population of Bolivia is relatively young; about 42% of all persons are under 15 years of age as compared with about

FIG. 2.—POPULATION DENSITY OF BOLIVIA

33% in the United States. This is largely the result of high birth rates and health hazards caused by the high altitude.

The discomforts associated with living at high altitudes have discouraged European immigration to Bolivia. The most numerous European groups in 1950 were Germans (3,207), Spaniards (1,256) and Poles (1,223), many of whom fled Europe during the politically turbulent 1930s. Most of these are concentrated in the cities of La Paz and Cochabamba. Unstable and somewhat difficult economic conditions in the country during the last two decades have resulted in a net migration loss to neighbouring countries, especially to Peru and Argentina.

Limited immigration and high infant death rates have resulted in a lower rate of population growth in Bolivia than in Latin America as a whole. The present annual rate of growth of the population is about 25 per 1,000 inhabitants as compared to about 30 per 1,000 in the rest of Latin America. In certain areas of the highlands the number of children under one year of age who die each year equals the number born. The high plateau is cold, especially at night, and sufficient and warm clothing is often lacking among the peasants. Heating is practically unknown in rural homes, and sanitary conditions are poor by any standard. Such conditions have been serious barriers to recent attempts to improve rural health.

As a rule, the whites are concentrated in the cities and the cholos and Indians in the country. Although the Agrarian Reform program initiated in 1953 made a large percentage of the Indians owners of the land they till, their holdings are generally small and their management ability still limited. Most of the businesses, professions and better paid government jobs are in the hands of the whites. The cholos are concentrated in the skilled and semiskilled jobs and services while the Indians, despite radical reform laws recently enacted to protect them, still find few work opportunities other than the most menial and ill-paid. (O. E. L.)

VI. ADMINISTRATION AND SOCIAL CONDITIONS

1. Government.—The governmental structure has executive, legislative and judicial branches, each theoretically independent. The national government is centralized on the general model of France, with the national territory divided into nine departments.

Legislative authority is in the hands of a congress, which consists of a senate and a chamber of deputies, and meets annually at La Paz for a session of 90 days. The senate has three members from each department, or 27 in all, elected by popular vote and serving terms of six years. One-third of the senate is elected every two years. The number of deputies is determined by law. They are elected by popular vote and serve terms of four years, one-half of the membership being renewed biennially.

Executive authority is in the hands of a president and a cabinet. The president and vice-president serve four years and ordinarily are ineligible for immediate re-election. However, in 1964 President Víctor Paz Estenssoro was elected to succeed himself. This departure from constitutional practice touched off a revolt which placed Gen. René Barrientos Ortuño in the presidency in December of that year. The president is required to make a tour of the country at least once during his term of office in order to study the needs of the people. The number of cabinet ministers is fixed by law. Sucre is the legal capital, but the actual seat of the government is La Paz, where legislative and executive functions are carried on.

Before July 21, 1952, only literate adult male citizens were eligible to vote in national elections. An electoral decree of that date conferred the franchise on all citizens who have reached the age of 20, regardless of either literacy or sex. As a result, the number of eligible voters rose to approximately 1,600,000, or about half the national population. In the national election of June 17, 1956, the first presidential election held after the electoral decree of 1952, ballots were cast by 955,412 Bolivians.

The pattern of regional and local government reflects the centralized character of the Bolivian system, with most of the governmental units representing the interests of the national authorities rather than the local communities. Each of the nine departments into which the country is divided is governed by a prefect, appointed for a four-year term by the national president. The departments are themselves divided into provinces, each of which is administered by a subprefect appointed by the president upon the recommendation of the appropriate prefect. Within the provinces are still smaller units called cantons; these are governed by *corregidores*, chosen by the prefects on the recommendation of the subprefects concerned. Each of the cities has a popularly elected municipal council which, in collaboration with the presidentially appointed mayor, deals with local matters.

2. Living and Working Conditions.—Approximately 1,000,000 Bolivians were gainfully employed in the 1960s. Of this figure, about 67% were occupied in agriculture, hunting and fishing; the rest were employed in mining and quarrying; manufacturing; construction; electrical, water supply and sanitary services; and in miscellaneous occupations. Working conditions, including the length of the working day, wage rates and the practice of many employers of making a portion of the wage payments in coca (a habit-forming drug) and other nonmonetary forms, have long been major and bitter economic and political issues in Bolivian national life, with the tin miners among the leading seekers of labour reforms. Labour unions were illegal in the country before 1943, but have since then become major interest groups.

3. Welfare Services.—Bolivia has a social security program providing for health and maternity benefits, compensation for workmen injured during the course of their employment, and family allowances for persons unable to find work. In the 1950s, the government expanded its response to the growing recognition of the need for new public services in the fields of health and sanitation. A significant part of the government's steps to cope with these problems has taken the form of participation in the technical assistance programs offered by the United Nations and the United States.

4. Justice.—Judicial authority in Bolivia is vested in the supreme court, superior district courts and minor tribunals. The supreme court, with headquarters at Sucre, is divided into two sections of four justices each, with the chief justice presiding over both. Justices are elected by the chamber of deputies for ten-year terms on the basis of nominations of the senate. District court judges are elected by the senate on the basis of nominations of the supreme court. In conformity with the centralized nature of the country's constitutional system, the police force is a national rather than a regional or local agency.

5. Education.—Education is, by law, vested in three administrative bodies: the ministry of education, fine arts and Indian affairs; the national council of education; and the supreme university council. The country is divided into nine school districts, corresponding to the departments. Each school district maintains primary, secondary and technical schools.

The country's seven universities are located in seven of the nine departments. The bureau of Indian and rural education, established in 1934, maintains regional schools stressing the trades and crafts. Illiteracy is estimated at about 68%.

6. Defense.—All males between 19 and 50 years of age are subject to military service. A permanent force of 15,000 men is authorized by law, but the actual standing army numbers closer to 10,000 men. There is a small air force which was reorganized by a U.S. mission. (G. I. B.)

VII. THE ECONOMY

Bolivia is a classic example of the vulnerability of an unbalanced economy. Within its boundaries are all the resources necessary to provide a sound economic foundation. But these potentialities have been neglected and it is the contrast between the actual poverty of the country and the richness of its undeveloped resources that has given currency to the picturesque description of Bolivia, originated by Alcide Dessalines d'Orbigny, a French paleontologist, in the middle of the 19th century, as "A beggar sitting on a chair of gold."

Exploitation of the natural wealth of the country is impeded by geographical, demographical and historical factors, all discussed above. Communications and surface transport, both within the country and with world markets outside, are lamentably inadequate for healthy economic development, and the natural difficulties of the terrain render them excessively expensive to construct and maintain. The meagre population, centred mainly on the high western plateau, is not economically adaptable. The Aymara and Quechua Indians, who constitute about 70% of the population, still live at bare subsistence level practically outside the monetary economy and are wedded to primitive methods of agriculture and ancient ways of life. They have not proved adaptable for development plans in the richer lowland areas.

The nation's economy has become reliant on mineral production, and successive governments built up a system for subsidizing the importation of foodstuffs, raw materials, and essential consumer goods by indirect taxation of the mining industry. During the 1930s and 1940s mineral exports supplied the government with more than half its tax receipts and also with the necessary reserve for its banking and monetary system and the means of importation. This reliance on one industry encouraged progressive neglect of other domestic resources and by the mid-20th century, although there had been a small growth of light manufactures, the country was even more dependent on imported agricultural products and raw materials than in earlier years. The Bolivian economy has for these reasons been peculiarly sensitive to fluctuations in the world markets for nonferrous metals, particularly tin. An excessive dependence on the mining industry led to a catastrophic collapse of the whole economy when this industry failed in 1953.

1. Mining Industry.—Bolivia is estimated to have 8% of the world reserves of tin and its output of this metal is about 12% of the production outside Communist countries. It also contains large reserves of zinc, copper, lead, wolfram, antimony, residual silver and some gold. Because of its difficult terrain, heavy transportation costs, high taxation and exacting labour legislation Bolivia is a high-cost producer, particularly of tin. After 1940 the grade of the ores in the larger mines deteriorated and the industry was until 1952 kept on a profitable basis only by strict attention to exploration and development and by the use of modern machinery.

In 1952 the government expropriated the assets of the three large mining firms which, in addition to other minerals, were together producing about 75% of the national output of tin. Management of the tin mines was then delegated to a semiautonomous government agency, Corporación Minera de Bolivia (Comibol), created for that purpose. Nationalization coincided with a drop in the world prices of tin and a significant decline in demand because of world overproduction and the cessation of stockpiling by the United States. Bolivian production became uneconomic and the industry continued to operate at a loss. Some of the smaller mines were forced to close, while the government's financing of the deficits of the nationalized industry was a main cause of the unprecedented inflation that followed 1952. The industry was crippled by burdensome labour legislation, strikes, absenteeism, lack of discipline and an excessive labour force, which it was not allowed to diminish. Exploration and development of the mines were sacrificed to immediate needs, and funds were not available for the essential renewal of worn-out equipment. By the early 1960s production was almost 50% lower than in 1950.

Petroleum.—The output of Bolivia's small petroleum industry reached a record level in 1957 of more than 4,000,000 bbl. Thereafter production declined but by 1963 was again approaching the peak figure. The industry supplies the greater part of the country's domestic requirements and exports small quantities under agreement to Brazil, Argentina, Paraguay, Chile and Peru. An oil pipeline from the principal oil field at Camiri in southeastern Bolivia to the Argentine frontier came into operation in 1955, and another line has been carried to Arica, Chile. Lubricating oils are manufactured at a government plant in Cochabamba.

2. Economic Diversification.—In 1953 the government announced a program of economic diversification by means of which it planned to raise domestic living standards and remedy the chronic deficit in the balance of payments. This was to be accomplished by stimulating home production of foodstuffs and raw materials, so as to reduce the demands on importation. The program envisaged reclamation of arable land by large irrigation projects on the western plateau, increased sowing of grain, revival of sugar and cotton production in the eastern territories, stimulation of the rubber and timber industries, better exploitation of the domestic cattle reserves by improvement of stock, installation of cold storage plants, and the construction of surface communications from the eastern plains to the uplands. The cost of the program, however, was far too high. An appeal was made to the United Nations technical assistance board and a team of experts advised on the problems involved. Nothing of any account was achieved and the situation of the country became more precarious than when the program was initiated. In 1953 a politically motivated law for breaking up the large estates and giving the small Indian farmers title to the land resulted in a decline even of those products which had until then survived the general decay of agriculture. However, production of rice, sugar and cotton rose in the 1960s and hydroelectric schemes to provide much needed power for Cochabamba and La Paz were under way.

3. Inflation and U.S. Aid.—In 1953 it became clear that the economy had collapsed. At the end of 1952 Bolivia's net balance of payments deficit had reached $32,600,000. The five years that followed the reforms of 1952 were characterized by violent inflation. The main and constant inflationary cause was the monetary expansion by which the government financed the deficits of the nationalized mining industry and adjusted the resultant disequilibrium of the balance of payments position. The high cost of ambitious social legislation put an added strain on an economy already bankrupt of resources, and continual forced increases of wages, despite a theoretical freeze of them during much of the period, resulted in an acute wage-price spiral. In the autumn of 1953 the United States, fearing either internal anarchy with Communist infiltration or alternatively the partition of Bolivia among neighbouring states, initiated a program of economic aid. Although this was projected as an emergency salvage operation, it had become apparent by 1956 that Bolivia was settling into the position of a permanent dependent. The International Monetary fund also granted Bolivia stand-by credits.

In Dec. 1956 measures were taken to stem inflation and to stabilize the currency. Arbitrary rates of exchange, whose chief value had been to enable the government to subsidize imports by imposing an indirect tax on the mineral industry, were abolished and the boliviano was allowed to find its own level, being made freely convertible for all purposes at an initial rate of 7,500 to

the U.S. dollar. At the same time restrictions on imports were removed along with subsidies and price controls. In order to give the experiment a chance, wages were frozen for one year and the people were warned that still further increases in the cost of living would have to be met by austerity. The U.S. government and the International Monetary fund together subscribed a loan of $25,000,000 to cushion possible weakening of the boliviano on the free exchange. A new currency was introduced in 1960 and the new peso boliviano, worth 1,000 of the old, remained stable at roughly 12 to the U.S. dollar.

4. Communications.—Bolivia has approximately 2,300 mi. (3,700 km.) of railway, concentrated mainly on the western plateau. Three routes extend from La Paz to Pacific ports, the Arica-La Paz line, the Antofagasta-La Paz line, which has a branch running to the Argentine frontier at Villazón, and the La Paz-Guaqui line, which connects with steamers across Lake Titicaca to the Peruvian port of Mollendo. This network connects the main towns of the western plateau, and there are several branches running to mining areas. There is no railway connection between the western plateau and the eastern lowlands. More recently constructed lines connect the town of Santa Cruz with Corumbá on the Brazilian frontier and with Yacuiba on the Argentine frontier.

Bolivia is said to have about 9,000 mi. (15,000 km.) of motor roads, but a high proportion of these are serviceable only in the dry season. The only surfaced roads are those connecting La Paz with the Yungas, the highway between Cochabamba and Santa Cruz, and about 40 mi. of the Bolivian section of the Pan-American highway. Some road building to the north toward the upper Beni river region progressed during the 1960s.

Because of the inadequacy of surface communications, air transport is exceptionally important to Bolivia. Various international lines link La Paz with neighbouring capitals and connect La Paz, Oruro, Cochabamba and Santa Cruz with the main world air routes. The national air line, Lloyd Aéreo Boliviano (LAB), maintains an internal passenger and freight service and is still the only link between many parts of the country and the major towns of the Altiplano. The state broadcasting station, Radio Illimani, acquired in 1964 a longwave transmitter of 23 kw. with which it could cover most of the country.

See also references under "Bolivia" in the Index.

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BOLLANDISTS, the small group of Belgian Jesuits who edit and publish the *Acta Sanctorum,* the great collection of biographies and legends of the saints, with allied documents, edited in the original languages and arranged according to their feast days in order of the calendar. The original idea was conceived by a Jesuit father, Heribert Rosweyde (*see* HAGIOLOGY). His intention was to publish in 18 volumes the lives of the saints in their authentic Latin text, from the manuscripts, adding notes. After his death (1629) another Jesuit, Jean Bolland, continued to amass material and, on the advice of Henschenius (Godefroid Henskens), who was his associate after 1635, extended the scope of the work. Publication began at Antwerp in 1643, with the two January volumes. February appeared in 1658, March in 1668, April in 1675 and so on. From 1659, Papebroch (Daniel van Papenbroeck) collaborated. This was the most brilliant period in the history of the *Acta Sanctorum.*

The freedom of Papebroch's criticism made him many enemies, and he had often to defend himself against their attacks. After the suppression of the Society of Jesus in 1773 the work was continued, with some inequalities but always in the same spirit, first at Antwerp until 1778, then at Brussels in the abbey of Caudenberg, and finally in the Premonstratensian abbey of Tongerloo, north of Louvain. Thus, vol. iv (1780) and vol. v (1786) of October bear the imprint of Brussels, vol. vi of the same month (1794) that of Tongerloo. In the last named year, the French revolutionary armies invaded Belgium for the second time, and the work had to stop. Eventually the former library and archives were partly recovered. Much of them was acquired by the Bibliothèque royale of Brussels.

After the re-establishment of the Society of Jesus in Belgium the work was taken up in 1837, with the support of the Belgian government, and the Bollandists were installed at the Collège St. Michel in Brussels. In 1845 appeared vol. vii of October, the first of the new series, which reached vol. xiii (the last) of October in 1883. A Russian Jesuit, J. Martinov, edited the *Annus ecclesiasticus Graeco-Slavicus,* at the beginning of vol. xi of October (1864).

In 1882 the activities of the Bollandists were brought more into line with the progress of historical methods. A quarterly review was established under the title of *Analecta Bollandiana* by C. De Smedt. It includes studies in preparation for the continuation and remolding of the *Acta Sanctorum,* unedited texts, dissertations and, after 1892, a *Bulletin des publications hagiographiques,* containing criticisms of recent works. In addition to this journal, the Bollandists undertook the analysis of the hagiological manuscripts in the principal libraries. Besides numerous library catalogues published in the *Analecta* (*e.g.,* those of Chartres, Namur, Ghent, Messina, Venice, Dublin, Edinburgh, etc.), separate volumes in the series *Subsidia hagiographica* were devoted to the Latin manuscripts in the Bibliothèque royale at Brussels, two volumes (1886–89), to the Latin and Greek manuscripts in the Bibliothèque nationale at Paris, five volumes (1889–96), to the Greek and Latin manuscripts in the Vatican (1899 and 1910), to the Latin manuscripts in other libraries of Rome (1909) and to the Greek manuscripts in Great Britain, Germany and neighbouring countries (1913).

The Bollandists also prepared inventories of the hagiological texts hitherto published, and of these appeared the *Bibliotheca hagiographica Graeca* (1895; 3rd ed. rev., 1957), the *Bibliotheca hagiographica Latina* (1898–1901, with later supplements), the *Bibliotheca hagiographica orientalis* (1910) and the *Miscellanea hagiographica Hibernica* of Charles Plummer (1925; in English, with a catalogue of Irish hagiography). These indispensable works delayed the publication of the principal collection, but gave it a more solid basis and a scientific stamp, besides extending the field toward east and west. The *Martyrologium Hieronymianum* occupies vol. ii of November, published in two parts: first a diplomatic edition (1894), then a critical text (1931). The *Synaxarium* of Constantinople, by H. Delehaye, forms an introductory volume to the month of November (1902), and the *Martyrologium Romanum,* with a complete commentary, an introductory volume to the month of December (1940). Vol. iii of November appeared in 1910, vol. iv (up to Nov. 10) in 1925. These publications are produced by a small group of specialists (there were six Bollandists in 1962) working in common without a superior.

The *Acta Sanctorum* in the original edition (Antwerp, 1643–1770; Brussels, 1780–86; Tongerloo, 1794; and again Brussels, 1845–) form 67 folio volumes. They should be quoted, as in the present article, by month and volume, not as a continuous series, and preferably in the original edition. There are two reprints, unrevised, to be used with caution: one at Venice (1734–70) up to vol. v for September; and one at Paris (1863–70) up to vol. xii of October, with general indexes (1875).

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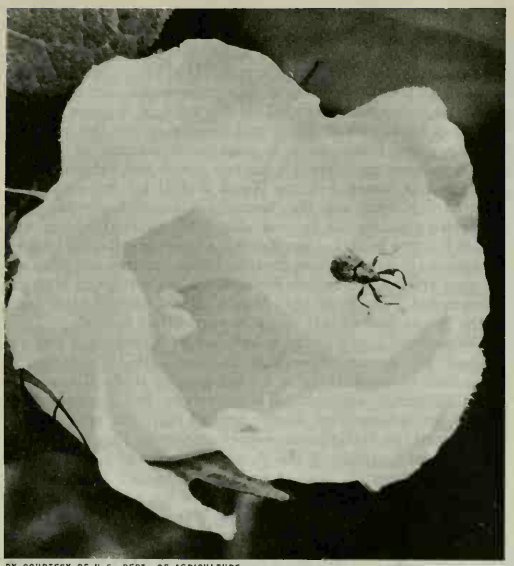
BOLL WEEVIL, a beetle (*Anthonomus grandis*) of the family Curculionidae, and the most serious pest of cotton in the United States. The estimated average annual loss of cotton and cottonseed caused by this insect is $203,000,000. Much of this loss could be economically prevented by the proper use of control measures.

The first home of the boll weevil was undoubtedly in southern



BY COURTESY OF U. S. DEPT. OF AGRICULTURE

ADULT BOLL WEEVIL (ANTHONOMUS GRANDIS) ON BLOSSOM, OR SQUARE, OF A COTTON PLANT

Mexico or Central America. Before 1892 it had spread throughout much of Mexico. It occurs southward to Guatemala, Costa Rica, Cuba and Haiti. About 1892 it entered the United States near Brownsville, Tex. By 1894 it had spread to half a dozen counties in southern Texas, and extended its range annually until, in 1922, almost all of the cotton-producing sections had become infested. Since 1922 the spread of the weevil has been more or less held to this area. Practically the only cotton-growing territory remaining uninfested is the semiarid zone including California, Arizona, New Mexico and western Texas.

The adult boll weevil is about one-fourth inch long, varying from one-eighth to one-third inch, with a breadth about one-third of its length. This measurement includes the snout, which is approximately one-half the length of the body. Variation in size is dependent upon the amount of food the insect has obtained in the larval stage. Individuals from bolls (unripe pods containing lint and seed) are therefore nearly always larger than those from squares (fruit buds). Newly emerged individuals are light yellowish in colour, but this changes to a gray or nearly black shade in a few weeks. In the field the most conspicuous indication of the presence of the boll weevil is the flaring and falling of numbers of squares or buds. Unfavourable climatic conditions and careless cultivation, however, frequently cause great shedding of the fruit, which is often mistaken for weevil damage. If excessive shedding is noted and the squares upon being cut open show a white, curved grub that has fed upon the contents, there is little doubt that the boll weevil has caused the damage.

The boll weevil passes the winter as an adult beetle. With the advent of autumn weather the adult boll weevils in cotton fields begin to seek protection against the winter. They fly in every direction, although their movements are governed partially by the prevailing winds. They may fly into hedges, woods, cornfields, haystacks, farm buildings or other places. A number of weevils also obtain hibernating quarters without leaving the cotton fields. These may crawl into cracks in the ground, under grass, weeds or other trash, and into the burrs from which the cotton has been picked. During the winter the weevils take no food, and remain practically dormant; on warm days they may move about to a certain extent. Emergence from hibernation depends primarily upon temperature and rainfall in the spring. In the southern portions of the cotton belt emergence usually begins from the first to the middle of March, but farther north it is somewhat later. Emergence has been prolonged from the middle of February to about Aug. 1. Fortunately about 95% of hibernating adults die during the winter, and others die before cotton plants produce the squares in which the eggs are laid.

In the spring and throughout the fruiting season of cotton, the eggs are deposited by the female weevils in cavities formed by eating into the buds and fruit of the plant. An egg hatches under normal conditions in about three days and the grub immediately begins to feed. In from 7 to 12 days the larva or grub passes into its pupal stage. This stage lasts from three to five days. Then the adult emerges and in about five days begins to breed. Climatic conditions cause considerable variation in the duration of the stages, but on an average it requires from two to three weeks for the weevil to develop from the egg to the adult. There may be seven or more generations per year depending on latitude.

The adult weevils feed upon the squares and bolls. The females refrain, throughout most of the season, from depositing eggs in squares visited by other females, but when most of the fruit has become infested, several eggs may be placed in a single square or boll. As many as 15 larvae have been found in a boll. The squares are preferred as food and as places for depositing eggs. As long as a large supply of squares is present the bolls are not generally damaged to any serious extent. The weevil is not known to breed in plants other than cotton except under abnormal conditions.

Although much progress has been made in developing direct control measures against the boll weevil, recommendations differ in various sections of the cotton belt. Detailed recommendations as to insecticides, etc., can be obtained from local agricultural authorities or experiment stations, and these should be followed carefully. A combination of different indirect methods is vital to a successful control program. These include: early destruction of cotton stalks; cleanup of favourable hibernating areas; frequent shallow cultivation; soil improvement and fertilization; seed treatments; early planting; etc. The development of early-maturing, rapid-fruiting, high-yielding varieties of cotton has helped greatly in enabling the farmers to produce satisfactory crops in spite of the boll weevil. *See* COTTON: *Pests and Diseases.*

See U.S. Department of Agriculture, "Insects," *1952 Yearbook of Agriculture* (1952). (R. E. BL.; J. C. DY.)

BOLOGNA, GIOVANNI DA (JEAN BOULOGNE) (1529–1608), Flemish sculptor, a most powerful and inventive artist of the time, was born at Douai in 1529. About 1555 he traveled to Italy, settling (1557) in Florence, where he spent the rest of his life. He attracted the notice of Francesco de' Medici, for whom many of his most important works were made. Among his earliest works in Florence were a bronze Bacchus, later placed on a fountain in the Borgo San Jacopo; two children fishing (now in the Museo Nazionale, Florence), cast for a fountain in the Casino Mediceo; and a bronze Venus, made for the villa of Castello and now at Petraia. The "Fountain of Neptune" at Bologna (1563–66) established his reputation. This was recognized by the commission in 1565 of a group, "Florence Triumphant Over Pisa," designed as a counterpart to Michelangelo's "Victory." The full-scale plaster model of this work (Accademia, Florence) was initially set up with the "Vic-

BY COURTESY OF VICTORIA AND ALBERT MUSEUM

"SAMSON AND A PHILISTINE," A MARBLE STATUE BY GIOVANNI DA BOLOGNA. IN THE VICTORIA AND ALBERT MUSEUM, LONDON

tory" in the Palazzo Vecchio and was later (1570) replaced by the marble version now in the Museo Nazionale. The masterpieces which followed it include the marble groups of "Samson and a Philistine" (1567; Victoria and Albert museum, London); "The Rape of the Sabines" (1579–83) and "Hercules and Nessus" (1594; both in the Loggia dei Lanzi, Florence); a famous bronze figure of Mercury (1574; Museo Nazionale, Florence); and a bronze equestrian statue of Cosimo I in the Piazza della Signoria (1587–94).

Bologna also enjoyed great popularity as a maker of garden sculpture for the Boboli gardens, Florence ("Fountain of Oceanus," 1571–76, "Venus of the Grotticella," 1573), and for the Medici villas at Pratolino (the colossal "Apennine," 1581), Petraia and Castello. The bronze birds which he cast for a grotto in the Castello garden are now in the Museo Nazionale, Florence. He was also a prolific manufacturer of bronze statuettes; the most notable collection of these is in the Kunsthistorisches Museum, Vienna. In addition to his secular commissions, Bologna was responsible for a large number of religious sculptures, which include (in marble) the fine "Altare della Libertà" in Lucca cathedral (1577–79) and (in bronze) reliefs of Passion scenes in the chapel of the University of Genoa (1579–85) and the SS. Annunziata, Florence, reliefs in the Salviati chapel in S. Marco, Florence (1579–88), and the "St. Luke" of Or San Michele (1597–1602).

He died in Florence on Aug. 13, 1608.

An Italian sculptor in all but birth, Bologna transformed the Florentine mannerism of the mid-16th century into a style of European significance. For three centuries his work was more generally admired than that of any sculptor, except Michelangelo.

See A. Desjardins, *La vie et l'oeuvre de Jean Boulogne* (1883); W. Gramberg, *Giovanni Bologna: eine Untersuchung über die Werke seiner Wanderjahre* (1936); E. Dhanens, *Jean Boulogne* (1956).

(J. W. P.-H.)

BOLOGNA (Etruscan FELSINA; Roman BONONIA), the capital of the province of that name and of the Emilia-Romagna region, Italy, lies between the Reno and Savena rivers at the foot of the Apennines, 180 ft. above sea level, about 214 km. (133 mi.) S.E. of Milan and 106 km. (66 mi.) N. of Florence by road. Pop. (1961) commune 455,848.

Description.—The central part of the city is built on the old, perfectly rectangular Roman city with narrow, right-angled streets, around which the town grew during the middle ages. By 1200 it had its first brick walls of which only a few gates are left. Most of the larger walls built in the 13th century were destroyed after 1903, but seven gates remain. The centre of Bologna still preserves a medieval atmosphere and the presence of arcades in most streets gives the town a particular aspect of its own. Many columns have artistically cut stone capitals. Of the many towers erected in the 12th–13th centuries only a few remain, among which the Asinelli (about 300 ft. high with a lean of 4 ft.) and the Garisenda (150 ft. high, about 10 ft. out of perpendicular) are typical; these were both built in 1109–19 and are two of the buildings characteristic of Bologna. In the centre of the city is a big open square formed by the Piazza Maggiore and the Piazza del Nettuno. Around it are: the Palazzo d'Accursio or Palazzo Comunale, now the town hall, begun in the 13th century and continued in different styles, with a beautiful Madonna sculptured by Niccolò dell' Arca and the statue of Pope Gregory XIII. the reformer of the calendar; the Palazzo del Podestà of the 13th century (the front is 15th century); and the Palazzo di Re Enzo, where King Enzio (*q.v.*) was kept prisoner for 23 years until his death (1249–72). Nearby there is the Fontana del Nettuno (1564) by Giovanni da Bologna (Jean Boulogne).

The Isolani, Serracchioli, and Grassi houses, and a few others, are typical examples of 13th-century dwellings with wooden columns. Other remarkable buildings are the Palazzo della Mercanzia, the old chamber of commerce (probably by Antonio di Vincenzo, the architect of San Petronio cathedral); the *palazzi* Pépoli, Bevilacqua (begun in 1477, one of the finest in Bologna), Albergati, Drappieri, Davia-Bargellini, Fantuzzi.

To St. Petronio, the city's patron saint, who in the 5th century was its first bishop, was dedicated one of the greatest churches of Christianity, begun in 1390. The base and the doors have fine marble decorations; the front is unfinished. The interior in Gothic style is admirable for its harmony and form. The emperor Charles V was crowned there by Pope Clement VII (1530). Santo Stefano is the name given to a group of four romanesque churches of the 11th to 13th centuries, erected on the ruins of a pagan temple. The so-called Cortile di Pilato and the cloister are the most impressive. San Francesco is a magnificent example of French-Gothic architecture (1236); it has two towers and a characteristic apse. It was damaged during World War II but has since been restored. Nearby are the beautiful Glossatori tombs. San Domenico contains the famous altar-tomb of St. Dominic who died in Bologna in 1221. San Pietro is a baroque cathedral built on the remains of a romanesque church. Other churches distinguished for their architecture include Santa Maria dei Servi, San Martino, l'Annunziata, San Giovanni in Monte. The beautiful brick front of the Spirito Santo (1478) may be particularly noticed.

The university, one of the oldest and most famous in Europe, attained its greatest splendour in the 12th–13th centuries. Thousands of students came to Bologna to study Roman law under celebrated scholars. The university had no fixed residence—the lectures were mostly held in the great halls of convents—until the Archiginnasio was erected under Pius IV (1563); then it moved (1803) to the Palazzo Poggi, which for about a century had been the seat of the famous Istituto delle Scienze, founded by Gen. L. F. Marsili to give a more modern impulse to scientific studies. During World War II the Archiginnasio palace was damaged and the well-known Anatomy room completely destroyed; it has since been restored. Its most eminent teachers included: Irnerius and Francesco Accursio (Accursius), noted jurists; the great naturalist Ulisse Aldrovandi (*q.v.*); Marcello Malpighi and Luigi Galvani (*qq.v.*); and Giosue Carducci (*q.v.*) who taught and lived in Bologna for nearly 50 years until

BY COURTESY OF ENTE PROVINCIALE PER IL TURISMO, BOLOGNA

THE PALAZZO COMUNALE AND THE FOUNTAIN OF NEPTUNE, BOLOGNA

his death (1907). A famous son of Bologna was Guglielmo Marconi (*q.v.*; 1874–1937). There are two great libraries, the Biblioteca Comunale dell' Archiginnasio and the Biblioteca Universitaria, and also others with special collections. The library of the Conservatorio Musicale is especially noted for its precious works. (Bologna has a great musical tradition. Wagner's operas were performed there for the first time in Italy.) The Museo Civico contains important remains of past civilizations; the material is displayed in 18 large rooms in chronological order from prehistory onward. The collections from the Umbrian (Villanova) civilization and the Etruscan necropolis in the neighbourhood of Bologna are remarkable. The art gallery (Pinacoteca Nazionale) houses a notable collection of paintings of the Bolognese school (the Carracci, Francesco Albani, Guido Reni, Domenichino, Guercino, Francia [*qq.v.*], Pellegrino Tibaldi), and possesses numerous works, including portraits, by Titian, Tintoretto and Paolo Veronese. The most famous is Raphael's "St. Cecilia." There is also a remarkable collection of drawings and engravings. The Teatro Comunale, one of the finest in the peninsula, was designed by Antonio Galli Bibiena (completed 1763).

History.—Bologna was of Etruscan origin (*see* Felsina); it was later occupied by the Gallic Boii, and in 192 B.C. became a Roman municipium (Bononia). Little was known of it in the periods which followed. It was subject to the Greek exarchate of Ravenna (6th century) and then passed, because of Pepin III's donation of the exarchate, to the papacy. It was occupied by barbarians, Huns, Goths and Visigoths; after a feudal period it became a free commune when the emperor recognized its rights (1183). Bologna later knew the tyranny of a few Signori (the Pepoli, Visconti, Bentivogli) and protracted struggles between rival families. Under Giovanni II Bentivoglio (1462–1506) fine buildings were erected. Pope Julius II incorporated it with the papal states and for more than three centuries Bologna enjoyed a peace unknown to other states. During the Napoleonic period it was annexed to the Cispadane republic, and in 1860 it became part of the kingdom of Italy. During World War II it was occupied by German troops from Sept. 1943 until it was recaptured by U.S., Italian and Polish troops (Allied 5th and 8th armies) on April 21, 1945.

Communications and Industry.—From its geographical position Bologna is important as a road and railway centre. Most traffic between northern Italy (Milan, Verona, Venice, Trieste) and the central and southern parts of the country (Florence, Rome, Naples, Bari, Sicily) passes through it. After World War II the airfield was used only by private airplanes. Bologna had several local industries (silk, veils, ropes, etc.), and the principal resource until World War I was agriculture based on the surrounding fertile plain where large quantities of wheat, grapes, rice, hemp, sugar beet and fruit were produced. There was a considerable foodstuff industry (sausage, macaroni, sugar, rice-hulling). Mechanical industries including the manufacture of electric motors, railway materials, motorcycles and agricultural machines had developed by mid-20th century. *See* also Index references under "Bologna" in the Index volume. (Lu. M.)

BOLOMETER, an instrument for measuring radiation by means of the rise in temperature of a blackened metal strip in one of the arms of a resistance bridge. In the first bolometer, invented by Samuel P. Langley, a Wheatstone bridge was used in conjunction with a galvanometer which showed a deflection proportional to the intensity of radiation (when the deflection was not great). O. Lummer and F. Kurlbaum's bolometer consists of four platinum gratings (each of which is made of a series of strips) inserted in the arms of a Callendar-Griffiths bridge; two of these gratings, in opposite arms of the bridge, are placed one behind another, so that the openings of one are opposite the strips of the other, and are exposed to the radiation, the other opposite pair being shielded; this arrangement doubles the effect on the galvanometer, and also compensates for any extraneous temperature changes. The spectrum bolometer consists of a single strip set on edge, in an arm of a bridge; it is used for exploring the distribution of intensity of radiation in a spectrum. *See* Black Body; Heat; Langley, Samuel Pierpont; Sun.

BOLSENA (anc. Volsinii), a town in the province of Viterbo, Lazio region, Italy, 18 km. (about 11 mi.) W.S.W. of Orvieto by road, stands on the northeast bank of Bolsena lake (ancient Lacus Volsiniensis) which is 1,000 ft. above sea level. Pop. (1957 est.) commune 4,330. After the Etruscan town was razed to the ground by the Romans in 280 B.C., the inhabitants migrated to the new site which they named after their former town. The castle dates from the 10th century. There is a small museum of Etruscan and Roman remains in the Palazzo Comunale. The 11th-century church of Santa Cristina, with its elegant Renaissance façade, was slightly damaged during World War II; it contains reliefs by the Della Robbia family of artists. In the adjoining catacombs is the Cappella del Mirácolo, with a 10th-century tabernacle and "St. Christina" by Andrea della Robbia. The town is famous for the miracle of 1263 when a Bohemian priest, skeptical about the doctrine of transubstantiation, was convinced of its truth by the miraculous appearance of drops of blood on the Host he was consecrating on an altar in the crypt of this church. In commemoration of this Pope Urban IV instituted the feast of Corpus Christi and built the cathedral at Orvieto. To the north of the town are the remains of a Roman amphitheatre. The inhabitants are chiefly engaged in market gardening and in the production of wine and oil; fishing is also practised.

For the Etruscan Volsinii (modern Orvieto) *see* Volsinii.

BOLSHEVIKS, the name assumed by adherents of the radical left wing of the Russian Social Democratic Labour party in 1903 and maintained as a part of the official title of the Communist party of the U.S.S.R. until 1952.

The name, a misnomer, originated in the Russian word for majority and was adopted by adherents of Nikolai Lenin (Vladimir Ilyich Ulyanov) when they won a temporary majority of places on the party's executive committee and newspaper editorial board in 1903. Subsequent shifts in loyalties passed control to their opponents, called the Mensheviks (members of the minority) because of their temporary minority status in the party councils. But the Bolsheviks, the real minority faction insofar as actual adherents among the total Social Democratic membership were concerned, retained their politically advantageous name. In 1912 they created in effect a political party independent of the Mensheviks for the elections to the fourth Russian state *duma*. Through a "military revolutionary committee" the Bolsheviks provided skilled leadership to the masses in November 1917, and although they were only a part of the left-wing revolutionary forces, they attained such notoriety that the second Russian revolution of 1917 became known in history as the "Bolshevik Revolution." When their party changed its name in March 1918 to Communist party, the factional title "Bolsheviks" was retained in parentheses to indicate continuity.

Bolshevik principles of political party organization were characterized by strongly held attitudes toward qualifications for membership and discipline. Lenin demanded that members not only accept the party program but personally participate in a party organization, which he interpreted as limiting admission to candidates willing to become active revolutionaries and not to remain mere sympathizers willing to support candidates and contribute funds. He exacted strict discipline, expecting members to accept orders from the party's executive and not to attempt to influence formulation of policy by the centre. Thus he created a foundation for what became a monolithic totalitarian organization quite different from the usual political party.

Bolshevik participation in the *duma* was dictated by a desire to propagandize revolution rather than to legislate social reform. Bolsheviks accepted Marxism as their creed and dogmatized it, arguing that parliamentary activity could never create the requisite economic base for socialism. Their attitude led to boycott of the first *duma* elections in 1906 so long as revolution seemed possible following the riots and strikes of 1905; but as calm returned the boycott was abandoned, too late for elections in industrial areas friendly to Bolsheviks. The second *duma* elections in Jan.–Feb. 1907 returned 18 Social Democrats of the Bolshevik faction, but these were a minority in the party caucus of 65. The faction was reduced to 6 of the 14 Social Democrats by the electoral reform preceding the third *duma* elections in Nov. 1907 and

held the same position in the fourth *duma* elections of 1912. Bolshevik deputies in the *duma* were selected solely from bench workmen to heighten propaganda effects on the industrial masses, but party intellectuals directed them from the background and wrote their speeches to demand a democratic republic, an eight-hour working day and confiscation of large landed estates. This program was designed to appeal to intellectuals, workmen and peasants. National minority groups were wooed by declarations in favour of self-determination, but not to the extent of upsetting party centralism by federation of national groups within the party.

Bolshevik influence grew slowly even after the March 1917 revolution, as measured by representation in the newly emerging bodies claiming to represent the interests of workers, peasants and soldiers under the name of soviets (councils) (*see* SOVIET). In the first national congress of representatives from local soviets the Bolsheviks had only 105 representatives against 248 Mensheviks and 285 Socialist Revolutionaries, the latter of whom favoured agrarian interests. At the second congress of soviets on the eve of the November revolution Bolsheviks had become a majority, but they had no control of the executive until the main body of Mensheviks and Socialist Revolutionaries withdrew in protest against the Bolshevik-led *coup d'état*. Thereafter Bolshevik supremacy was unshakable and the new government was molded in subordination to Bolshevik direction.

See COMMUNISM; MARXISM; *see* also Index references under "Bolsheviks" in the Index volume.

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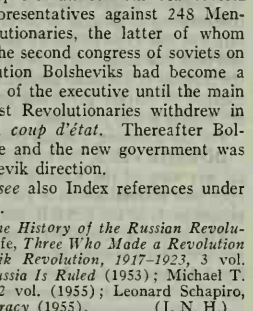
BOLSHEVISM: *see* BOLSHEVIKS; COMMUNISM.

BOLT, an old English word for a crossbow shaft or the pin that fastened a door. From the swift flight of an arrow comes the verb "to bolt," as applied to a horse, to bolting food, etc., and such expressions as "bolt upright"; also the use in the United States of "bolt" for refusing to support a candidate nominated by one's own party.



BOLTED CONNECTION SHOWING THE TENSILE LOAD *T* AND THE SHEAR LOAD *S*

From the sense of "fastening together" is derived the use of the word as a definite length (in a roll) of a fabric (40 yd. of canvas) or wallpaper (16 yd.). From crossbow terminology comes the usage that describes the part of a rifle or machine gun that is used to load a cartridge and obturate the breech of the barrel. Thus, the bolt of a rifle is used to ram or insert the round into the breech end of the barrel, to support the rear of the cartridge against the explosive forces and to extract the cartridge case after firing. (*See* MACHINE GUN; *Systems of Operation;* SMALL ARMS, MILITARY.)

Bolt as a Connector.—In construction and manufacturing, bolt describes a mechanical fastener used for connecting two or more parts. A riveted or nailed joint is a permanent connection, but a bolted joint can be readily disassembled and reassembled; for this reason bolts, or screw fasteners, are used to a greater extent than any other type of mechanical fastener and have played an important part in the development of mass production methods.

The bolt, which forms part of the connection shown in the figure, consists of a head and a cylindrical body having cut or rolled screw threads along a portion of its length. The nut is the female member of the pair, having internal threads to match those of the bolt. Hardened washers are often used to prevent crushing under the head and nut and to distribute the preload into the members. As shown in the figure, tensile loads elongate the bolt and shear loads tend to cut it apart.

Many bolted connections carry only small or nominal loads and for these the fasteners can be of any suitable material, including wood, aluminum, brass, iron and alloy steels. But certain joints in bridges, aircraft, pressure vessels and the like carry important loads, and failure of these could be dangerous to human life. For important joints the bolt should be a tough, high-strength steel and the nut a soft or ductile steel. Yielding of the relatively soft nut during wrenching distributes the load more uniformly over the threads and avoids thread stripping. The bolt should be preloaded by tightening the nut so as to utilize most of the elastic strength of the bolt. Then a tensile load on the members will reduce the compressive force between them but will have little effect on the bolt tension. This is very important because it is the variation in bolt tension that causes the nut to loosen. An additional advantage of a high bolt preload is that the high compressive forces between the members create more friction and enable the members to carry larger shear loads. A tight joint is much less likely to fail than a loose one, and there is much evidence to indicate that if a joint is made tight enough and if good material is used, then, if it did not fail during tightening, it never will fail.

Production and Classification.—Threads on bolts and screws are usually produced by cold rolling between flat dies, but they may also be cut on a lathe or with a round die. Nut, or internal, threads are cut by a rotating tool called a tap. Thus, a tapped hole in a member is a threaded hole that serves as a nut. In 1948 standardization committees from Canada, the United Kingdom and the United States agreed to use the same thread proportions, called the Unified Thread Standards. The thread shape and the number of threads per inch, called the pitch, compose the major area of agreement. Standard threads are always cut right hand, which means that a nut will advance along a fastener when turned in a clockwise direction.

The word bolt refers to a fastener that is intended to be paired with a nut, but the word screw, or screw fastener, refers to any threaded connector. Bolts and screws are classified according to the type of head, the intended use and the thread form. Square, hexagon and socket heads are examples of head types available for use when a wrench is to be used in tightening. For use with a screw driver, round, flat, fillister and oval heads are common. Carriage bolts, anchor bolts, stove bolts, etc., are so named because of their application. Screws are also manufactured with special thread shapes so as to be self-tapping; for example, wood, lag and sheet metal screws produce threads in the female member when they are driven. The drivescrew and threaded nail are other examples of self-tapping fasteners; they are driven with a hammer.

Most nuts have a square or a hexagon shape so they can be tightened with a wrench. But wing nuts and knurled nuts, for example, are designed for tightening by hand. Among the many special-purpose nuts is the castellated nut, which is slotted to permit locking by insertion of a wire or cotter pin through the bolt.

Self-Locking Nuts.—Nuts are made self-locking by employing wedging action, spring action or frictional material; many varieties are available. The Columbia nut, for example, is made in two halves, the outer one being split so that it wedges against the bolt thread as it is tightened into the inner tapered half. The Dardelet rivet-bolt has nonstandard threads that are tapered; when the nut is tightened, the surfaces wedge together to form a tight locking action. Self-locking by spring action is obtained by permitting the nut to elastically distort itself during tightening, or by distorting the threads in some manner prior to assembly. Interference nuts incorporate an unthreaded plastic or fibrous material to bear tightly against the bolt after assembly to achieve self-locking.

(J. E. SH.)

BOLTON, DUKES OF, were members of the Paulet (*q.v.*) family and held the title between 1689 and 1794. CHARLES PAULET (*c.* 1625–99), 1st duke, who became 6th marquess of Winchester on his father's death in 1675 had, from 1661, been member of parliament for Winchester and then for Hampshire. He was an ardent Whig in Charles II's reign, supported William of Orange in 1688 and was made duke of Bolton on April 9, 1689. He was an eccentric, famed for grotesque extravagances. He died at Amport,

Hampshire, on Feb. 27, 1699. His elder son, CHARLES (1661–1722), 2nd duke, who had also supported William of Orange, was lord lieutenant of Hampshire and Dorset, a commissioner (1706) to arrange the union of England and Scotland, and lord lieutenant of Ireland (1717–22). His third wife, Henrietta (d. 1730), was an illegitimate daughter of James, duke of Monmouth. According to Swift, the second duke was "a great booby"; he died on Jan. 21, 1722. His eldest son, CHARLES (1685–1754), 3rd duke, born on Sept. 3, 1685, held many public offices and attained high rank in the army. He was an early opponent of Sir Robert Walpole but was not deprived of any of his offices until 1733 because, said Lord Hervey of Ickworth, he was "such a fool." Several minor places were restored to him in 1740. He was a famous gallant and on the death of his first wife in 1751 married the actress Lavinia Fenton, his mistress since 1728. He died at Tunbridge Wells on Aug. 26, 1754, and was succeeded by his brother HARRY (1691–1759), 4th duke. Harry was succeeded by his sons CHARLES (*c.* 1718–65), 5th duke, and HARRY (1719–94), 6th duke. The latter was on three occasions (1744, 1752 and 1755) court-martialed and acquitted, and held the rank of admiral. He was governor of the Isle of Wight from 1766 to 1780. On his death at Hackwood, Hampshire, on Dec. 25, 1794, without male heirs, the dukedom became extinct.

BOLTON (BOULTON), **EDMUND** (1575?–1633?), English historian, antiquarian and poet whose lyrics are among the best in the miscellany *England's Helicon* (1600) was educated at Trinity hall, Cambridge, and the Inner Temple, London. A "poor kinsman" of the duke of Buckingham, he obtained a minor position at court but was debarred from public office because of his Catholicism and tried to support himself by writing. A friend of Camden and other scholars, he petitioned James I to form a royal academy, but the king died before giving formal sanction. Plans for official histories of England and London also failed and Bolton, after imprisonment for recusancy, seems to have died in poverty. His most considerable works are *Nero Caesar* (1624) a history of Nero's reign, and *Hypercritica*, a treatise on the writing of history in which he reviews contemporary authors. It is reprinted in J. E. Spingarn's *Critical Essays of the 17th Century*, vol. i (1908).

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BOLTON, HERBERT EUGENE (1870–1953), U.S. historian, was born near Tomah in Wilton township, Wis., July 20, 1870. He graduated from the Tomah high school in 1889, Milwaukee Normal school in 1891, and the University of Wisconsin in 1895. He went on to do graduate work at the University of Pennsylvania as Harrison fellow, 1897–99, earning a Ph.D. in history in 1899. The next two years he taught at the Milwaukee State Normal school and then was named instructor in history at the University of Texas. Bolton saw a great opportunity in the study of the southwest's complex of cultures. For several summers, 1902–06, he did research in various Mexican archives, then in 1907–11 he undertook extensive explorations in the Archives of Mexico, sponsored by the Carnegie Institution of Washington. Thus he familiarized himself with Spain's northward advance into the "Spanish borderlands," as he later called this area. Stimulated by the discovery of new materials, he began the publication of articles and books on this region. Bolton's major works numbered a score, and his total bibliography of books and articles more than a hundred. His *Guide to Materials for the History of the United States in the Principal Archives of Mexico* (1913) was a landmark. He was professor of history at Stanford, 1909–11, and at the University of California, 1911–40; concurrently, 1916–40, he was director of the Bancroft library. Bolton died Jan. 30, 1953, at Berkeley, Calif.

See Mary Ross, *The Writings and Cartography of Herbert Eugene Bolton* (1932), *Greater America: Essays in Honor of Herbert Eugene Bolton* (1945). (G. P. HD.)

BOLTON (BOLTON-LE-MOORS), municipal and county borough, divided into Bolton East and Bolton West parliamentary divisions, Lancashire, Eng., 11 mi. N.W. of Manchester. Pop. (1961) 160,887. Area 23.9 sq.mi. The town is surrounded by high moorland and is divided by the Croal, a small tributary of the Irwell, into Great and Little Bolton. It is the centre of the fine-cotton spinning area of Lancashire's textile industry; it makes textile and other machinery and has engineering, chemical, leather and other works. The town is mostly of 18th–19th century growth, the most notable public buildings being the town hall and the civic centre (1939) which includes an art gallery and museum. Hall-i'-th'-Wood, a half-timbered house dating in part from 1483, is a folk museum; there Samuel Crompton (*q.v.*) invented the spinning mule (1779). Richard Arkwright (*q.v.*) was also living in Bolton when he invented his spinning machinery (about 1768). Much of the history of the textile industry is illustrated in the Chadwick museum.

The manor was granted by William I to Roger de Poictou and passed to the Harringtons of Hornby castle, who lost it with their other estates for their adherence to Richard III. In 1485 Henry VII granted it to the 1st earl of Derby. The manor of Little Bolton seems to have been, at least from Henry III's reign, distinct from that of Great Bolton and was held until the 17th century by the Botheltons or Boltons. The site of the church of St. Peter (1870) has long been occupied by a parish church (one was there in the 12th century). In 1251 William de Ferrers obtained a charter for a weekly market and a yearly fair, but gradually this annual fair was replaced by four others chiefly for horses and cattle. The New Year and midsummer show fairs arose during the 19th century. In the Civil War Bolton sided with the parliament, and in 1643 and 1644 the royalist forces assaulted the town. Bolton was incorporated in 1838 and became a county borough in 1888. From early days it was famous for its woolen manufactures; cotton goods were not made in Lancashire until 1641, when Bolton was named as the chief seat of the manufacture of fustians, vermilions and dimities. Velvets were first made there about 1756 by Jeremiah Clarke and muslins and cotton quiltings in 1763. The first spinning factory was erected about 1780. Bleaching has been carried on since the early 18th century, and large ironworks grew up in the late 19th century. In 1791 a canal was built from Manchester to Bolton and by an act of parliament (1792) Bolton moor was enclosed. The borough owns more than 500 ac. of parks and grounds, besides the 15th-century Smithills hall and estate of more than 2,000 ac. of parkland and moorland bought in 1938. Bolton school dates from 1524.

BOLTON ABBEY, village in the West Riding administrative division of Yorkshire, Eng., is about 19 mi. N.W. of Leeds and 6 mi. from Ilkley by road. Its name was taken inexactly from the great Augustinian foundation of Bolton priory, the ruins of which are beautifully set near the right bank of the river Wharfe in a wooded valley enclosed by hills. The nave, used as the parish church since the 12th century, is Early English and Decorated. The transepts and choir are in ruins, and remains of domestic buildings are slight. With the rest of the district of Craven, the manor was granted by William the Conqueror to Robert de Romili, whose heiress, Cicely, and her husband, William de Meschines, founded and endowed a priory at Embsay, near Skipton, in 1120. In 1151 it was moved to a new establishment at Bolton Abbey which was erected by their daughter Alice, wife of William Fitz-Duncan, whose son (according to legend) was drowned in the river nearby. The manor, also called Bolton abbey, was sold in 1542 to Henry Clifford, 2nd earl of Cumberland, and descended to the dukes of Devonshire.

BOLTRAFFIO, GIOVANNI ANTONIO: *see* BELTRAFFIO, GIOVANNI ANTONIO.

BOLTZMANN, LUDWIG (1844–1906), Austrian physicist, made important contributions to many branches of physics; his greatest achievements were the development of statistical mechanics and the statistical explanation of the second law of thermodynamics.

Boltzmann was born in Vienna on Feb. 20, 1844, and studied at the university there, receiving his doctorate in 1866. He held professorships in mathematics (Vienna, 1873–76), experimental physics (Graz, 1876–89) and theoretical physics (Graz, 1869–73; Munich, 1889–93; Vienna, 1894–1900; Leipzig, 1900–02; Vienna,

1902–06), but theoretical physics was his real vocation.

When Boltzmann began his scientific work, he attacked the problem, until then unconsidered, of explaining the second law of thermodynamics on the basis of the atomic theory of matter. In a series of papers published during the 1870s Boltzmann showed that the second law could be understood by combining the laws of mechanics, applied to the motions of the atoms, with the theory of probability. In this way he made clear that the second law is an essentially statistical law and that a system will approach a state of thermodynamic equilibrium because the equilibrium state is overwhelmingly the most probable state. The entropy function of thermodynamics, whose behaviour shows the trend to equilibrium and whose maximum value characterizes the equilibrium state, is itself a measure of the probability of the macroscopic state. (The equation relating entropy and probability is engraved on the monument at Boltzmann's grave in Vienna.) In the course of these investigations Boltzmann worked out the general law for the distribution of energy among the various constituents of a system at a definite temperature, derived the theorem of equipartition of energy, derived the integro-differential equation for the change of the distribution of atoms due to collisions, and in general laid the foundations and built much of the structure of statistical mechanics, a structure later elaborated by J. W. Gibbs.

Apart from his work on statistical mechanics Boltzmann made extensive calculations in the kinetic theory of gases. He was also one of the first Europeans to recognize and to expound the importance of J. C. Maxwell's theory of electromagnetism, a subject on which he published a two-volume treatise in his own characteristic style. One must also mention Boltzmann's thermodynamic derivation of Stefan's law for black body radiation, a derivation which H. A. Lorentz called "a true pearl of theoretical physics."

Boltzmann's work in statistical mechanics was strongly attacked by W. Ostwald and the energeticists who did not believe in atoms and wanted to base all of physical science on energy considerations only. He also suffered from misunderstandings of his ideas on the nature of irreversibility on the part of others who did not fully grasp the statistical nature of his reasoning. Boltzmann was fully justified against both sets of opponents by the discoveries in atomic physics which began shortly before 1900 and by the fluctuation phenomena, such as Brownian motion, which could be understood only by statistical mechanics.

Ill and depressed, Boltzmann took his own life on Sept. 5, 1906, at Duino, near Trieste.

See STATISTICAL MECHANICS; HEAT: *Radiation: Relation Between Radiation and Temperature;* KINETIC THEORY OF MATTER: *The Equipartition of Energy;* CHEMISTRY: *Physical Chemistry: The Kinetic Theory of Gases.*

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BOLU, the chief town of an *il* of the same name in northwestern Turkey, lies 2,500 ft. above sea level in a rich plain watered by the Bolu Su, a tributary of the Filyos (*Billaeus*). Pop. (1960) 13,743. Its industries include timber, cotton and leather manufacture. Three miles east of the town, at Eskihisar, are the ruins of Bithynium, the birthplace of Antinous (*q.v.*); it was also called Antinoopolis and in Byzantine times Claudiopolis. In and around Bolu are numerous marbles with Greek inscriptions, chiefly sepulchral, and architectural fragments. At Ilica, south of the town, are warm springs well-known for their medicinal properties.

The *il* of Bolu (pop. [1960] 353,004; area 4,267 sq.mi.) includes the plain of Bolu and the mountains bordering it to north and south. The plain is fertile and its chief products are cereals, tobacco and maize (corn). In the neighbourhood are large forests of oak, beech, elm, chestnut and pine, from which some of the timber is shipped to Istanbul. The plain is one of the east-west chain of important plains in northwestern Turkey, which includes the Izmit and Adapazari plains. The other principal towns of the *il* are Akçakoca, Düzce, Gerede and Mudurnu.

(N. TU.; S. ER.; E. TU.)

BOLYAI, WOLFGANG (FARKAS) (1775–1856), Hungarian mathematician, poet and dramatist, was born at Szekler-Land, and died at Maros-Vásárhely, where he was a professor in the Reformed college, and where his son Johann was born. Bolyai studied for a few months at Jena, before proceeding in 1796 to Göttingen where he became a close friend of C. F. Gauss, a 19-year-old student at the time. The two young men discussed the foundations of mathematics, particularly those of Euclidean geometry; and on his return home in 1799, Bolyai attempted to prove Euclid's postulate of parallels. Gauss detected the error in Bolyai's attempt, but Bolyai persisted in his efforts, although he admitted that he was probably wasting his time.

BOLYAI, JOHANN (JÁNOS) (1802–1860), famous mathematician son of Wolfgang, was one of the founders of non-Euclidean geometry. Up to the age of 10, Johann knew no mathematics. By 13, under his father's teaching, he had mastered the calculus and analytic mechanics. At 15 he entered the Royal Engineering college at Vienna, to prepare for service in the army engineering corps, which he joined at the age of 20. In the army, young Bolyai divided his time between his duties, dueling, violin playing and mathematics. In 1823, in his 22nd year, he sent his father the draft of his *Absolute Science of Space*, a complete and consistent system of geometry constructed without assumption of Euclid's parallel postulate. That such a non-Euclidean geometry should be logically possible showed that the postulate of parallels is independent of Euclid's other postulates, and that attempts to prove the postulate by Euclidean geometry are necessarily futile. The new geometry was printed as an appendix to an elementary work on the foundations of mathematics (*Tentamen*, etc.) by W. Bolyai, and published in 1831. Johann's pleasure in his epochal achievement was spoiled by the discovery that he had been largely anticipated by Gauss, who, however, made no public claim to the new geometry. As early as 1826, N. I. Lobachevsky also had anticipated Johann. Bolyai and Lobachevsky were unaware of each other's existence while both were working toward the same end. The creation of non-Euclidean geometry has been compared with the Copernican revolution in astronomy for its profound influence on philosophy and science. *See* also GEOMETRY, NON-EUCLIDEAN.

(E. T. B.)

BOLZANO (Ger. BOZEN), the capital of Bolzano province, a noted tourist area in the Trentino-Alto Adige region of Italy, lies at 869 ft. on the Brenner railway, 58 mi. S. of the Brenner pass and 35 mi. N. of Trento. It lies at the confluence of the Talvera and Isarco rivers, which flow united into the Adige, about 2 mi. S.W. Pop. (1957 est.) commune 81,562, mostly German-speaking. Nothing is known of a settlement there before the dark ages. In the 7th and 8th centuries Bolzano was held by the counts of Bavaria. It was given with the rest of the diocese to the bishop of Trent by Conrad II in 1027, and was a bone of contention between the bishops of Trent and the counts of Tirol (which fell to the Habsburgs in 1363) until 1531, when it was ceded to the counts. It was ceded to Bavaria with the rest of the Tirol in 1805, but the rebellion of Andreas Hofer (*q.v.*) united it to Austria in 1809. Bolzano was part of the Napoleonic kingdom of Italy from 1810 to 1813, and from then until 1919 was under the Austrian empire. The old town, with its low-pitched Tirolean arcades, is surrounded by modern quarters, which were developed under Italian rule. In the central Piazza Walther is a statue of Drusus, which recalls his campaign against the Germanic tribes in 38 B.C., and the Duomo, a Gothic church of the 14th–15th centuries (restored in 1945). To the west is the former Dominican monastery, which has a frescoed cloister and chapels, but the church was damaged during World War II. To the north and east is the Via dei Portici, with its heavy, low arcades, and the 14th-century Franciscan church (rebuilt). There are scenic promenades along the rivers, and below the Lungotalvera Sant' Antonio is the 13th-century Castello Mareccio (with five later towers) which houses the municipal archives. There is a musical conservatory, a civic museum (of fine arts) and the Castelroncolo (Runkelstein) which contains murals of chivalric subjects of about 1400. Manufactures include steel, textiles, canned fruits and wines.

BOMA, a port of the Republic of the Congo and capital of the district of Bas-Congo, on the Congo river estuary 60 mi. from the

Atlantic coast and 175 mi. S.W. of Léopoldville. Pop. (1958 est.) 31,598 of whom 1,306 were nonindigenous. It was the second port of the former Belgian Congo and an important commercial centre. Boma is an outlet for the produce of Mayumbe (palm oil, bananas, timber especially limba), and is linked with that district by road and a narrow-gauge railway which terminates at Tshela. Industries include edible oil extraction, soapmaking and refrigeration, and there is a small naval shipyard. Boma, one of the oldest towns of the Congo, was where Capt. J. K. Tuckey landed in 1816, and where Henry Morton Stanley ended his crossing of central Africa. Formerly known as Lombi, later Embomma, it was a slave market before the middle of the 19th century. At that time, as a European trading post, it possessed factories of French, British, Dutch and Portuguese companies. In 1886 Boma became the capital of the Congo Free State and was the capital of the Belgian Congo until 1926. (He. Ni.)

BOMB, an explosive-containing device that is not hurled by either a gun, as is an artillery shell, or a self-contained propellant, as is a rocket, but is usually dropped by planes and sometimes placed by hand. The word formerly referred to an explosive shell fired by cannon.

Air bombs became important weapons with the extensive use of aircraft (dirigibles and airplanes) in World War I. At first hasty adaptations of artillery shells, they rapidly took on a streamlined, finned design of their own. By the beginning of World War II, aerial bombs had been improved to a high degree of ballistic efficiency, planes had been especially designed to carry them and drop them in successive groupings, and considerable effort had been put into the development of intricate bombsights.

The commonest type of bomb dropped in World War II was the high explosive, demolition type for use against enemy strong points, transport, ships and cities. This bomb often had a fairly thin casing. Sometimes, however, its casing was heavy and the nose section thick so that it would penetrate such cover as 24-ft.-thick concrete over submarine pens before exploding. Demolition bombs used by the British during World War II weighed as much as 22,000 lb. each, while the maximum size used by the United States was 4,000 lb. The U.S. army developed for the air force a monster 21-ton bomb, but it was not even test dropped until 1947. Another type commonly used was the fragmentation bomb, which had a casing designed to break into fragments that flew in all directions at high velocity. This type of bomb was most effective against personnel.

A third commonly used bomb is the incendiary. As its name implies, it is used against inflammable installations or buildings. On hitting the target, it spreads flaming chemicals or thermit (*see* Thermite), a mixture of powdered metals creating such intense heat that its fire is very difficult to quench. Chemicals that cause severe burns to personnel and other chemicals to poison, to signal, or otherwise to harass and incapacitate an enemy may be used in chemical bombs. Most common is napalm, a mixture forming a sort of jelly of naphtha or gasoline and a petroleum wax. Napalm was widely used by United Nations forces in Korea, but other chemical bombs, especially those containing poison gas, were held in reserve. Psychological warfare has its own bombs that carry great numbers of propaganda leaflets over the enemy territory.

Lightning-like expansion of gases resulting from the simple reaction of chemicals, or oxidation, bursts conventional bombs apart violently and causes damage by both the concussion or blast effect and by flying fragments. Late in World War II a revolutionary new type—the atomic bomb—was completed and used for the first time. One A-bomb, as it was called, destroyed most of the city of Hiroshima, Japan, in Aug. 1945. This bomb derived its power—the equivalent of 20,000 tons of T.N.T.—from disintegration of the nucleus of a radioactive atom. In the early 1950s the first hydrogen or H-bomb (fusion or thermonuclear bomb) was tested. The power of the H-bomb—many times that of the A-bomb—prompted efforts to outlaw its use in war (*see* Disarmament), while its lethal after-effects, especially radioactive fallout, caused world-wide concern. Meanwhile, the development of long-range missiles tended to reduce the importance of aerial bombs.

See Air Warfare; Ammunition, Artillery; Atomic Energy.

For the products of volcanic activity called bombs, *see* Volcano; Volcanism. (F. D. McH.)

BOMBACACEAE, the bombax or kapok family, dicotyledonous plants, all trees, and often deciduous. It is allied to the mallow family (Malvaceae), to which the cotton plant belongs, and is characteristic of the tropics. The flowers are often large and showy. Included in the family are: *Adansonia,* the African baobab (*q.v.*); *Bombax* with about 30 species in tropical America; and the closely allied *Gossampinus* with 12 species in southeast Asia.

Ceiba, with 10 or more species, is largely American, and its fruits produce the kapok (*q.v.*) of commerce. *Ochroma lagopus* is the South American balsa (*q.v.*), noted for its very light wood, while the Malayan *Durio zibethinus* bears the noted durian (*q.v.*), a fruit remarkable for its distinctive odour.

BOMBARDE, a wind instrument, the name derived from a piece of artillery in the 14th century to denote a tenor shawm (*q.v.*), with German forms *Pumhart* and *Pommer.* The name survives in Brittany to denote a small shawm played in duet with a bagpipe. (A. C. Ba.)

BOMBARDON, an old name for the contrabass brass instrument used in military and brass bands, now called simply "bass." It is a tuba (*q.v.*) built in two sizes: E flat bass, and BB flat (double B flat) bass, the latter pitched a fourth below the first. The term *bombardone* had occasionally, in Italy up to the 18th century, denoted a bass shawm or bombarde. In the 1820s the Viennese maker K. Riedl reintroduced the name, first for a kind of ophicleide, next for a large valved trombone. The connotation "tuba" in Germany and England dates from the mid-19th century. (A. C. Ba.)

BOMBAY, until May 1, 1960, a state of the Republic of India, was on that date split into two separate states: Gujarat and Maharashtra. The history of the Bombay state and of the Bombay presidency which preceded it forms the subject of the greater part of this article. For the geography and the earlier history of the area *see* Gujarat and Maharashtra. *See* also the article on the city of Bombay.

The first Europeans in modern times to appear on the western coast of India were the Portuguese. Vasco da Gama arrived at Calicut (now Kozhikode) in 1498, and the Portuguese made their capital at Goa in 1510 and established trading stations along the coast at Bombay, Bassein, Diu and Damão. In 1613 the English East India company obtained permission from the emperor Jahangir to establish a factory at Surat. The company's headquarters were transferred from Surat to Bombay in 1672.

The territory of the British presidency was confined at first to the narrow limits of the island of Bombay. In 1775, hoping to acquire Salsette and Bassein, the British championed the cause of Raghoba, a pretender to the peshwaship of the Maratha confederacy. The Bombay forces proved no match for the more mobile Marathas and were forced to capitulate. The situation was retrieved by Warren Hastings who dispatched reinforcements across the peninsula from Bengal. The treaty of Salbai (1782) secured peace with the Marathas for 20 years. Lord Wellesley (1797–1805) was the first governor-general to realize that the time had come for the British to stand forth as the paramount power in India. By the treaty of Bassein (1802) the peshwa, Baji Rao II, who had been attacked by Holkar, was reinstated at Poona as a British puppet in return for which he agreed to receive a British subsidiary force and to accept British arbitration in all disputes with his neighbours. This led to war with the Maratha chiefs. Wellesley was recalled before he was able completely to crush their power. Their final defeat and the establishment of British paramountcy was the work of the marquess of Hastings (1818–23).

The first lieutenant governor of the enlarged Bombay presidency was Mountstuart Elphinstone (1819–27), whose aims were to pacify the country, avoiding violent changes, to establish law courts, to codify the law and to encourage vernacular education. Aden was added to the presidency's jurisdiction in 1839; and after its conquest by a Bombay army under Sir Charles Napier in 1843 Sind became a subordinate province under a commissioner, with its capital at Karachi. Interspersed with British territory were a

number of Indian states, the debris of the Maratha empire, the chief being Baroda, Kolhapur and the short-lived kingdom of Satara. A land revenue system for the whole presidency was laid down in 1847, and a commission to investigate awards, instituted by Lord Elphinstone (governor 1853–60), disclosed the fact that many estates were being held rent-free without titles. In spite of this and the annexation of Satara by Lord Dalhousie, the mutiny of 1857 produced few repercussions in Bombay and the Deccan. In 1858, together with the other provinces of British India, the Bombay presidency came under the control of the crown.

Of the later governors of Bombay in the Victorian period, the most distinguished was Sir Bartle Frere (1862–67). The period up to World War I was one of regular progress, with occasional setbacks such as the outbreak of plague in 1898 and the disastrous famine in Gujarat, 1899–1902. Serious efforts to prevent a recurrence of this catastrophe were made by Sir George (afterward Lord) Lloyd (1918–23) who undertook the construction of a series of tanks designed to irrigate parts of the presidency most exposed to a failure of the monsoon. His crowning achievement was the great Sukkur barrage on the Indus, opened after his retirement in 1932. During the early decades of the 20th century Bombay's advance toward political independence followed the same pattern as in the other provinces of India (*see* INDIA-PAKISTAN, SUBCONTINENT OF). Sind became a separate province and Aden was placed under the British colonial office in 1937. On Aug. 15, 1947, British rule came to an end. The first Indian governor was Raja Maharaj Singh. On Nov. 1, 1956, when the reorganization of the states took place, the boundaries of Bombay were altered, the state gaining eight predominantly Marathi-speaking districts from Madhya Pradesh and losing the greater part of four Kanarese-speaking districts to Mysore. The dissolution of the Bombay state on May 1, 1960, and its replacement by the states of Gujarat and Maharashtra was the result of separatist agitation by the Gujarati-speaking peoples in the northern part of the state and by the Marathi-speaking peoples in the south. Bombay city fell to the share of Maharashtra. (C. C. D.; X.)

BOMBAY, capital of the former Bombay presidency and Bombay state and since May 1, 1960, capital of the new state of Maharashtra, Republic of India, is the principal seaport of western India. Bombay Island, on which the older part of the city lies, consists of a low-lying flat plain, one-fourth of which is actually below sea level. This plain is flanked by two parallel ridges of low hills which intersect beyond the southern extremity of the island where they form a dangerous reef, on which the Prongs lighthouse stands. The western line of low hills stands out in bold relief, with Malabar hill, 180 ft. above sea level, as its highest point. The eastern hills have an irregular outline with knolls and low hills about 100 ft. high: Mazagon hill, Sewri hill, Parel hill and others. The island is about 11½ mi. long by 3 to 4 mi. broad and covers an area of about 25 sq.mi. From north to south it is more or less a rectangle, toward the southern end of which extend two wide-open crablike claws of unequal length, with a broad expanse of water, the Back bay, between them.

The city was commonly called Bombay Island long after the name had become a misnomer; before 1810 the construction of causeways and breakwaters across a tidal creek had united the island with the longer island of Salsette on the north and so continuously with the mainland. Neither did the name entirely drop out of use after the rise of Greater Bombay, a term in official use since 1950, when the city expanded northward by the inclusion of Salsette. Between 1950 and 1957 a number of old municipal boroughs, including Bandra, Kurla, Parle-Andheri, Juhu, Ghatkopar-Kirol, Malad and Mulund, were incorporated in Greater Bombay. The city extends to the southern outskirts of Thana, on the Central railway, 21 mi. N. of the Victoria terminus.

The creation of Greater Bombay was a much belated measure, for by 1940 the island city was dangerously overcrowded, and people continued to flock there in thousands, mostly in search of employment. The old industries were all located in the island, and new industries sprang up within the same confined area. The only solution was to establish factories and workshops outside the city; this required roads, transport facilities and essential amenities, all

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GATEWAY OF INDIA, BOMBAY, ON THE WATER FRONT OF THE ARABIAN SEA

of which was achieved successfully and on a vast scale. The area of Greater Bombay in 1961 was 186 sq.mi. Pop. (1961) 4,152,056.

Bombay owes most of its prosperity to the great waterway constituting the harbour, 7 mi. wide at the opening and narrowing as it runs north to the creek. There are few more scenic and impressive sights than the approach up this waterway studded with hilly islands, with a view of the stately buildings of the city, and to the right the palm-fringed shore of the mainland rising gradually to the peaks of the Western Ghats in the distance. Bombay's position as the gateway of India, its fine natural harbour and the enterprise of its inhabitants, made it one of the first cities of the world. Public and commercial buildings especially notable are the municipal corporation building, the Victoria railway terminus, the general post office, the museum, the Institute of Science, the Reserve bank, the head offices of the Western railway, the town hall, the Gateway of India (a large arch in 16th-century Gujarat style built to commemorate the visit of King George V and Queen Mary in 1911), and the clock tower of the university.

The climate of Bombay is hot and humid, the mean temperature ranging from 91° F. in May to 67° F. in January. Annual rainfall is 88.7 in.

History.—It is now generally admitted that the Norwegian orientalist Christian Lassen (1800–76) was right in identifying the Heptanesia of Ptolemy (A.D. 150) with the seven islands which in course of time made up Bombay Island: Bombay (the central island) and, clockwise from west to east, Worli, Mahim, Parel-Sewri-Sion, Mazagon, Old Woman's Island and Colaba; the seven were separated by creeks often broad and deep. The name Bombay is probably derived from Mumba Bai or Mumba Devi, a Hindu goddess; from the 9th century A.D. until 1348 Bombay was under Hindu rule. It then changed hands and became part of the sultanate of Gujarat. Sultan Bahadur Shah of Gujarat ceded it to the Portuguese in 1534; and in 1661 the Portuguese gave it to Charles II of England as part of the dowry of Catherine of Braganza, sister of the king of Portugal. On April 6, 1662, an expeditionary force with Sir Abraham Shipman in command sailed for Bombay in a squadron of the Royal Navy under the earl of Marlborough. They were not allowed to land. Viceroy Antonio de Mello de Castro would not give up Bombay and persisted in his refusal for two years and four months. Finally, Humphrey Cooke, who had succeeded Shipman, took possession of Bombay in the king's name. During the years of waiting Shipman and over 300 men had perished on the island of Angediva, about 51 mi. S.E. of Goa. The articles of surrender, drawn up by de Castro and signed by Cooke, stipulated that only Bombay, and no other island, was to be ceded. On March 27, 1668, Bombay was leased to the East India company by the crown for the nominal rental of £10 a year. In 1672 Gerald Aungier, the president of Surat, transferred his seat of government to Bombay and became the city's real founder.

Bombay was then one of the most unhealthy places in the east.

The islands were covered with palm trees manured with rotting fish, and the creeks at low tide became putrid swamps. It was a common proverb that "two monsoons were the age of a man." Aungier started work on filling in the creeks, opened a hospital and established a high court. Above all, he proclaimed complete religious toleration, and this brought in the Parsee merchants from Gujarat, who were destined to play a prominent part in the development of the city (*see* PARSEES). He fortified the town so effectively that it was able to repel raids by the Sidis of Janjira and a formidable attack by the Dutch fleet in 1673. When he died in 1677 the city had a population of 60,000 and was already able to claim the proud title of "Urbs prima in Indis." There was friction, however, between the king's officers and the company's government, and in 1683 an abortive rebellion was raised by Richard Keigwin, a naval officer. The 18th century was a period of constant expansion. The city, whose growing prosperity made it a tempting prize, was surrounded by elaborate fortifications. Work went on steadily at the reclamation of the breaches between the islands, particularly that between Worli and Mahim which was finally closed by William Hornby, governor from 1771 to 84, who constructed the great causeway known as the Hornby Vellard.

Among the many who have contributed to Bombay's rise to eminence from the 18th century none are deserving of greater praise than members of the Parsee community. Among the first was Lavji Naserwanji Wadia, a shipbuilder or *wadia,* who added the name of his craft to the family name. A native of Surat, he came to Bombay in 1736, superintended the extension of the docks and started a shipyard which turned out many fine vessels, including ships of the line for the Royal Navy. His enterprise also called for men skilled in many trades and thus were sown the seeds of an extensive industry. The trade of the island increased steadily with the elimination of foreign competition: the Maratha pirates' nest at Gheria or Vijayadurg, 170 mi. down the coast, was destroyed by Robert Clive and Charles Watson in 1756, and Portuguese power was waning. French rivalry ceased with the capture of their settlements. Most important of all, the island of Salsette and the port of Bassein were ceded to Bombay by the Marathas under the treaty of Salbai in 1782.

With the fall of the Maratha empire, Bombay, as the capital of the new presidency, entered into a fresh era of prosperity and importance under its first lieutenant governor, Mountstuart Elphinstone (1819–27). In 1838 regular monthly communication between Bombay and England by way of Suez and Alexandria, Egy., was established, the duration of the journey being 45 days. This was shortened to 30 days with the opening of the Suez canal in 1869. Meanwhile, railways were being built and were bringing into the city the raw cotton destined to provide its staple industry. The first section of the Great Indian Peninsular line from Bombay to Thana was opened in 1853, and the Bombay, Baroda and Central India railway reached the city in 1864. Two years later the Victoria terminus was built on reclaimed land. During the governorship of Sir Bartle Frere (1862–67), the walls surrounding the fort, now obsolete, were demolished and Bombay cathedral was rebuilt. Between 1861 and 1865 occurred the famous trade boom when, because of the American Civil War, Bombay held practically a monopoly of the world's cotton trade. Fortunes were made and lost in a day, but with the collapse of the Confederate states came a disastrous slump which shook the city to its foundations. Nevertheless, its financial stability was soon recovered.

Cowasji Nanabhoy Davar, another Parsee, made a notable contribution to Bombay's growing prosperity in 1884, when he started the city's first successful cotton mill. During the next five years 50 more mills were established, benefiting not only Bombay but also other states or provinces. Another notable Parsee was Jamshetji Nasarwanji Tata (1839–1904), who discovered the Gurumaishini iron deposit and was the real founder of the steel and iron industry in India; the great Tata Iron and Steel company was established by him and his sons (*see* TATA family). Jamshetji Tata was the first to think of harnessing the monsoon rains that ran to waste down the slopes of the Western Ghats; the great project was carried out by his son, Sir Dorabji Tata, and by 1915 the city had at its disposal an enormous supply of cheap hydroelectric power, on which were based many industrial enterprises. Among them are mills for paper, flour, rice, oil and timber; rope, leather, stone, cement and metal works; sugar, tobacco, tea, tile and brick factories; printing presses and many kinds of workshops. There are also electric streetcars and trains.

During the last decades of the 19th century the city changed greatly. Along the Esplanade (now Mahatma Gandhi road) arose an imposing row of buildings: the vast secretariat, high court, university library, senate house, clock tower, and public works and post offices, all designed in the florid Gothic style then popular. The Crawford market was built in 1871. The Bombay port trust was constituted in 1873. The first waterworks at Vihar and Tular, and later at Tansa, brought a supply of fresh water to replace the unsanitary wells, and a drainage system was installed in 1879.

The great increase of trade brought a corresponding rise in population, which in 1891 reached 821,000. To cope with the resulting overcrowding and squalor, the City Improvement trust was set up for the purpose of making new streets, clearing away slums, reclaiming more land from the sea and constructing on it sanitary dwellings for the millworkers. This led to the Back bay development scheme sponsored by Sir George (afterward Lord) Lloyd in 1918, an ambitious project for building a sea wall from Colaba point to Marine Lines enclosing an area of 1,300 ac. which would be reclaimed and added to the city. The scheme miscarried for technical reasons and was the subject of an inquiry in 1926. As a result it was decided to proceed for the time being only with the two end sections. Work was resumed after World War II, when the Marine drive, extending from Chowpatty Sea Face road up to the junction with Harvey road, was constructed. This was the first dual highway of its kind in India. At the same time projects for suburban development were steadily pushed on. Salsette Island was developed, and residential quarters were constructed along the railway and arterial roads at Mahim. The cotton, grain and oil depots were removed from Colaba to Sewri.

Population.—In 1901 the population of Bombay city and suburbs was 847,497; 40 years later it had doubled (1,695,168). In 1951, with a population of 2,329,020, Bombay was the second largest city in India, next only to Calcutta, and its growth has continued. The cosmopolitan character of the population is brought out as much by the presence of nearly 25,000 persons belonging to 49 countries other than India as by the variety of religious beliefs among the nationals themselves. While by far the largest part of the population in 1951 was Hindu (2,039,244), Muslims (412,266) and Christians (206,191) were by no means unimportant. Besides these, in 1951 there were 80,110 Jains, 68,660 Parsees, 16,265 Jews and 13,984 Sikhs. Among the nonnationals British (4,846 in 1951), Americans (494), Chinese (1,360), Portuguese (11,759), Iranians (1,626), Pakistanis (1,677), Afghans (242) and Arabs (256) are the chief. The principal languages spoken are Marathi (by 1,236,874 persons in 1951), Gujarati (523,127), Urdu (181,975), Hindi (211,313), Konkani (129,943), Telugu (78,000), Sindhi (66,714), Tamil (59,295) and Kanarese (52,011). Besides these, more than 50 other languages are spoken.

Cultural Facilities.—The city has become an important intellectual centre. The beginning of its scholarly growth dates from 1804 and the foundation of the Literary Society of Bombay, formed "for the purpose of promoting useful knowledge, particularly such as is immediately connected with India." Foremost among its founders was Jonathan Duncan, governor of Bombay. In 1830 it moved into the town hall, where it has ever since been housed, and in 1827 a union was effected with the Royal Asiatic Society of Great Britain and Ireland, established in London in 1823. Thenceforward the Literary society was known as the Bombay branch of that society. It adopted an open-door policy. In 1804 there were 17 members, all Europeans; by 1864 there were 204, of whom 160 were European and 44 Indian. In 1893 Justice K. T. Telang became the first Indian president, and many other Indians have since held this office. In 1954 membership stood at 1,036. The society has made a name for itself throughout the world by its *Quarterly Journal,* the publication of which was first resolved upon in 1841; one of its greatest local assets is its library, started in 1805, a storehouse of knowledge perhaps without equal in the east.

The University of Bombay, established in 1857 as an affiliating body for the whole presidency, gradually added to its teaching functions and after the establishment of regional universities in the state in 1948–50 its jurisdiction was confined to Greater Bombay. In 1957 there were 32 constituent colleges imparting higher education, and 9 other recognized scholarly institutions. The university maintains three postgraduate institutions, a school of economics, sociology and politics, a department of chemical technology and a department of statistics. The colleges are coeducational except for one college exclusively for women, Sophia college, founded in 1940. The number of students rose from 29,361 in 1954 to 42,396 in 1958.

The Prince of Wales Museum of Western India was founded in 1904, though only in 1921 did it begin to function as a museum. (Bombay had possessed a museum since 1840.) It has three sections, art, archaeology and natural history, and the establishment of an industrial section was being considered in 1960. In its grounds is the Jehangir Art gallery, completed in 1952.

The Bharatiya Vidya Bhavan (Palace of Indian Learning) was founded in 1938 for research and the study of Sanskrit and ancient and modern Indian languages, history and religion. The Tata Institute of Fundamental Research was founded in 1945 by the Sir Dorabji Tata trust and the government of Bombay to carry out fundamental research in physics, mathematics and allied sciences, and is the biggest centre for cosmic ray and nuclear research in India. Its school of mathematics is perhaps the largest and most active in India. The Tata Institute of Social Sciences was founded in 1936 and offers training in professional social work. The Haffkine institute was founded in 1896 and was in 1960 the largest antibacterial vaccine manufacturing concern in Asia with a potential capacity of more than 5,000,000 to 6,000,000 ml. of vaccine per month.

Primary education in the city is free and compulsory, and is the responsibility of the municipal corporation.

Local Government.—The municipal corporation of Bombay is one of the oldest and most influential local authorities in India. Besides its standing committee and improvements and education committees, the electric supply and transport committee is its important feature. The corporation consists of members elected in the several wards of the city under adult franchise. Bombay and environs developed considerably as a result of the activities of the development directorate, set up in 1920, and of the corporation improvements committee which later took over the task of development. The public health department is in charge of sanitation, registration of births and deaths, prevention and control of communicable diseases, etc. There are also inspectors controlling food sanitation in all its aspects. Bombay has an abundant supply of drinking water and a city-wide drainage system.

Hospitals.—The Bombay municipality provides medical care for its citizens in three major general hospitals and a number of other institutions including a group of hospitals for tuberculosis, free dispensaries, maternity homes, maternity and child welfare clinics, an eye hospital, a quasi-municipal institution for the treatment of leprosy, etc. The largest is the K.E.M. (King Edward VII Memorial) hospital, which is reputed one of the best in India. It can accommodate 550 in-patients and has over 1,000 outpatients daily.

Economy.—Bombay is the principal port for imports into India. Import and export trade in tons rose to 5,807,000 and 3,333,000 respectively in 1958–59. Among imports wheat (1,355,000 tons) and machinery were predominant, and among exports manganese (295,000 tons) and other ores, oil cakes and cotton. Bombay is the centre of the cotton and textile industry of India and, after Calcutta, is the largest financial centre in the country. Wool, leather, chemicals, oil and engineering are other important industries.

The Tata electric system, originating in 1915 with three catchment lakes in Lonavla and a hydroelectric plant in Khopoli, became the principal source of power for the city and for a total area of more than 1,000 sq.mi. It is the largest power system in southeast Asia. A new thermal station has been under construction near two new oil refineries on Trombay Island. The new station was designed to burn by-product gases from the refineries as well as liquid and solid fuels.

Communications.—Bombay possesses a natural deepwater harbour about 70 sq.mi. in area. The dockyard, established in 1735, has a sea face of nearly 700 yd. and an area of about 200 ac. There are three enclosed docks with a water frontage of more than 3,000 yd. and a combined water area of 104.5 ac. Alexandra dock, completed in 1914, is entered through a lock 100 ft. wide, while the Prince's dock and the Victoria dock, completed in 1880 and 1888 respectively, have tidal working. There are two dry docks measuring 1,000 ft. by 100 ft. and 525 ft. by 65 ft. 6 in., built in 1914 and 1891 respectively. The docks are fully equipped for the rapid landing of cargo with ample accommodation for storage. Extensive works of port development and modernization, begun under the first five-year plan, have continued.

Ballard pier, the ocean passenger terminal, a few minutes from the centre of the city, is 1,500 ft. long; ships up to 750 ft. long can be brought alongside. Special trains of the Central and Western railways leave for all parts of India from the railway station adjoining the main building. Coastal passengers also embark and disembark at Ferry wharf on the Alexandra dock harbour wall.

Bulk white oils are handled at the deepwater pier at Pier Pao, about five miles from the docks, and the oils are pumped to the installations a few miles away. Black oil is discharged to the installations from the Alexandra dock harbour wall. The new marine oil terminal near Butcher Island was designed to berth large tankers carrying crude oil at any state of the tide.

The port is administered by a board of 25 trustees, some nominated by the government and others elected by various interests. The port trust has its own railway connecting with the trunk lines and with a network of sidings more than 130 mi. in total length serving the docks, the bunders (quays) and the many large depots such as those for cotton, manganese ore and grain. The land area of the estate and docks owned and administered by the board is about 2,000 ac. Bombay is the headquarters of both the Central and the Western railways. The completely electrified suburban railway system is a model of efficient, though still inadequate, communication in a highly industrialized area. The line between Bombay and Poona, passing through many tunnels in the Bhor Ghat, is also electrified. Local transport includes a fleet of over 600 buses and 250 streetcars.

Bombay (Santa Cruz) airport is one of the important international air traffic centres, connecting directly with the west and through Calcutta with the east. Daily air services are maintained to and from almost all important cities within the country.

(J. H. Ge.)

BOMBAY DUCK, the dried and salted flesh of a small fish (*Harpodon nehereus*) that inhabits the western coastal waters of India. Esteemed as a relish in curried dishes, it is sold as a gourmet item in the western world.

BOMBAZINE (Bombasine), a textile, usually black in colour, with a silk warp and worsted weft woven in either plain or twill weave. Cheaper grades of bombazine are woven with a rayon warp and worsted or cotton weft.

The word bombazine is derived from the Greek *bombycid*, meaning a moth of the silkworm genus *Bombyx*. Bombazine was originally made exclusively of silk and in a variety of colours in addition to black. But as it came to be used more and more for mourning and in the garb of religious orders, its colour became standardized as black. It was woven with silk warps and worsted wefts. Bombazine was woven in ancient China and Japan, 16th-century Elizabethan England and in Italy, France, Spain and England during the 18th and 19th centuries. In Spain and South America, women often attire themselves in black bombazine when attending church or making visits of condolence. Mantillas for winter wear in those countries also are frequently made of black bombazine.

(J. K. T.)

BOMBING AND BOMBARDMENT, the discharge of missiles, usually in large numbers, from heavy weapons—land artillery, naval guns, mortars and rocket launchers—and also the discharge of bombs from aircraft. (Up to about 1916 the term bombing indicated the employment of hand and rifle grenades by

infantry soldiers.) In land warfare it is usually employed as a prelude to an assault, to incapacitate or lower the morale of the defenders. Naval bombardments are frequently employed to cover an assault from the sea or by troops already established ashore. Aerial bombing is sometimes used in direct support of troops, but more often against rear military establishments, centres of industry and communications. Bombardment by land-based artillery reached its peak in World War I, when at the battle of Messines in May and June 1917, 3,500,000 shells were fired from British guns alone. The naval bombardments against the Dardanelles forts and other defensive works during the Gallipoli campaign of 1915 were the heaviest of their kind up to that time. In World War II many landings were supported by heavy naval bombardments, including those on Japanese-held Pacific islands and the Normandy coast in June 1944. (*See* also AIR WARFARE; ARTILLERY; BOMB.)

Since 1945 the development of nuclear weapons has vastly increased the destruction which a bombardment can cause. Missiles of obliteration with ranges of hundreds or even thousands of miles can now be fired from rocket launchers on land or sea. One such missile can cause more destruction than thousands of conventional shells or bombs. (*See* also ROCKETS AND GUIDED MISSILES.)

International law prohibits the bombing of undefended towns. Efforts were made at the Hague Conferences (*q.v.*) to prohibit all bombing from the air or at least to limit aerial bombing to military targets. Prolonged efforts during the 1950s to prohibit bombing by nuclear weapons were fruitless. *See* also DISARMAMENT; LAWS OF WAR. (C. N. B.)

BOMB SHELTER, a structure designed to offer protection to military or civilian personnel against aerial bombing attacks. Bomb shelters appeared during the first half of the 20th century as a means of passive defense against high-explosive bombs dropped from manned aircraft. During the 1950s, as long-range missiles armed with nuclear warheads approached operational use the term was loosely applied to a wide variety of protective structures.

World War I shelters, offering protection against bombs weighing up to 100 lb., were largely improvised in home basements, stronger buildings, subways, tunnels and caves. World War II, with large-scale attacks on cities by aircraft carrying bombs such as the 4,000-lb. "blockbusters," made special shelters necessary for homefront defense. Public shelters in heavily-bombed cities of Europe, such as London, Coventry, Berlin, Hamburg, were of many types: long, covered trenches in public parks, reinforced basements of larger buildings, subway stations, church vaults, tunnels, caves and earth-covered or concrete blockhouse structures above ground. Family shelters took the form of reinforced basements, steel-section backyard and indoor structures, and sandbagged groundfloor rooms.

The use of the first nuclear bombs on the Japanese cities of Hiroshima and Nagasaki during World War II emphasized the need for peacetime civilian shelter programs against future conflicts. During 1950–54, U.S. studies considered both the adaptation of existing buildings and the construction of blast-resistant shelters in principal cities. European and Scandinavian countries nearer the threat of nuclear attack constructed heavy shelters, some in solid rock, to protect up to 20,000 persons per shelter. Home shelters were required by law in Sweden, Norway and Denmark.

In 1954 the successful test of a thermonuclear bomb with force measured in millions of tons of TNT clearly showed that providing shelters close to such explosions would be impractical if not impossible. Up to that time U.S. civil defense authorities had tested, by means of actual atomic explosions, several family, public and industrial shelter types designed to protect their occupants against thermal, blast and radiological effects near the focal point of such explosions. The U.S. government also called for study of plans to evacuate large cities, such plans to be combined with provision of shelters outside the potential heavy damage areas of target cities.

In planning for the future, estimates of warning time available for evacuation were reduced in the light of new developments in rockets and missiles, particularly the intercontinental ballistic missile. With these weapons looming on the horizon, U.S. civil defense planning turned more to limited evacuation and the provision of blast-resistant shelters for metropolitan areas and lighter shelters in suburban areas. Shelters were regarded as being particularly valuable as protection against radiological fallout from distant nuclear explosions. Shelters tested by the U.S. during the 1957 atomic test series in Nevada included reinforced concrete dome shelters, an underground concrete garage-personnel shelter and earth-mounded, underground concrete family shelters.

See also CIVIL DEFENSE. (R. S. B.)

BOMBYCILLIDAE, a small family of beautiful perching birds called waxwings. The family name means "small silky ones." *See* WAXWING.

BON (BÖN); *see* TIBETAN BUDDHISM.

BONACOLSI, an Italian family that held despotic power in Mantua from 1276 to 1328 and also for a time in Modena (1312–26) and Carpi (1317–26). They first appear in the later 12th century among the consular families of Mantua, over whom and all other contenders for power they came in time to prevail by their dexterity in exploiting urban faction. Their effective lordship began in 1276, when Pinamonte di Martino Bonacolsi was created *capitano del popolo.* He was followed by Bardellone (captain general and perpetual rector, 1291–99), Guido (1299–1309) and Rinaldo, commonly called Passerino (1309–28), who in 1311 obtained imperial recognition and the office of imperial vicar. It was Passerino who won Modena and Carpi. The Bonacolsi were deposed and exterminated during a rising on Aug. 16, 1328, organized by the Gonzaga (*q.v.*), who seized power in their place.

See C. D'Arco, *Studi intorno al municipio di Mantova,* vol. ii and iii (1871–72); P. Torelli, article in *Atti Accad. Virgil.* (1923). (P. J. J.)

BONA DEA, the "good goddess," an old Roman deity of fruitfulness, both in the earth and in women. She was identified with Fauna, and by later syncretism also with Ops and Maia—the latter no doubt because the dedication day of her temple on the Aventine was on May 1. This temple was cared for, and the cult attended, by women only, and the same was the case at a second celebration, at the beginning of December, in the house of a magistrate with imperium, which became famous because of the profanation of the mysteries by Publius Clodius (*q.v.*) in 62 B.C., and the political consequences of his act. Wine and myrtle were tabooed in the cult of this deity, and myths grew up to explain these features of the cult. Herbs with healing properties were kept in her temple, and also snakes, the usual symbol of the medicinal art. Her victim was a sow (*porca*), as in the cults of other deities of fertility, and was called *damium,* and it is understood that the goddess herself was known as Damia and her priestess as *damiatrix.* These names are almost certainly Greek; Damia is found worshiped at several places in Greece, and also at Tarentum, where there was a festival called Dameia. It is thus highly probable that on the cult of the original Roman goddess was engrafted the Greek one of Damia, perhaps after the conquest of Tarentum (272 B.C.).

BONALD, LOUIS GABRIEL AMBROISE, VICOMTE DE (1754–1840), French philosopher and politician, standing with Joseph de Maistre as a leading apologist of "legitimism," was born at Le Monna, near Millau in Rouergue, on Oct. 2, 1754. Mayor of Millau from 1785 to 1789, he became president of the administration of the new *département* of Aveyron in 1790 but resigned in 1791 in protest against the Civil Constitution of the Clergy. Emigrating, he served for a time in the prince de Condé's army and then settled in Heidelberg. His extremely royalist *Théorie du pouvoir politique et religieux* (1796) was condemned by the Directory. He returned to France in 1797. To the ensuing years belong his *Essai analytique sur les lois naturelles de l'ordre social* (1800), *Du divorce* (1801) and *Législation primitive considérée . . . par les seules lumières de la raison,* 3 vol. (1802). He showed great reluctance to accept official positions under Napoleon; but after the restoration of the Bourbons, he became a member of the council of public instruction (1814), deputy for Aveyron (1815–22), minister of state (1822) and president of the censorship commission (1827), being moreover nominated to the Académie

Française (1816) and created vicomte (1821) and peer (1823). His books of this period were: *Réflexions sur l'intérêt général de l'Europe* (1815); *Pensées sur divers sujets et discours politiques*, 2 vol. (1817); *Recherches philosophiques sur les premiers objets des connaissances morales*, 2 vol. (1818); *Mélanges*, 2 vol. (1819); and *Démonstration philosophique du principe constitutif de la société* (1830). On the July Revolution of 1830 he resigned his peerage and retired to Le Monna, where he died on Nov. 23, 1840.

Bonald was a fervent legitimist, against the principles of the Enlightenment and of the French Revolution: his philosophy and his political activity went hand in hand. Arguing that man could not have invented language because language is the prerequisite of thought (*"l'homme pense sa parole avant de parler sa pensée"*), he contends that language must have come to man by divine revelation. From this metaphysical basis he proceeds to demonstrate the natural rightness of the traditional monarchy in church and state (the pope and, in France, the Most Christian king) as the structure of society: the elemental family group, father, mother and child, is paralleled in politics by the group sovereign, ministers and subjects (or king, nobility and third estate), in science by the group cause, means and effect, in revealed religion by the group God, Mediator and man.

His *Oeuvres complètes* was edited by J. P. Migne (3 vol., 1859) and the selection was edited by Paul Bourget and Michel Salomon (1905).

See H. Moulinié, *De Bonald* (1916); M. H. Quinlan, *The Historical Thought of the Vicomte de Bonald* (1953).

BONAPARTE, the name of a family made famous by Napoleon I (*q.v.*), emperor of the French. The French form Bonaparte was not commonly used, even by Napoleon, until after the spring of 1796. The original name was Buonaparte, which was borne in the early middle ages by several distinct families in Italy. One of these, which settled at Florence before the year 1100, was divided in the 13th century into the two branches of San Miniato and Sarzana. A member of this latter, Francesco Buonaparte, emigrated in the middle of the 16th century to Corsica, where his descendants continued to occupy themselves with the affairs of law and the magistracy.

Carlo Maria Buonaparte (1746–1785), the father of Napoleon I, took his degree in law at the University of Pisa and, after the French conquest of Corsica, became assessor to the royal court for Ajaccio and the neighbouring districts. In 1764 he married Letizia Ramolino (1750–1836), a beautiful and high-spirited girl descended from an old Corsican family. Joseph, her third child and the first to survive, was born in 1768, Napoleon in 1769, and nine other children, six of whom survived, subsequently (*see* table). Simple and frugal in her tastes and devout in thought, Letizia helped to bind her children to the life of Corsica while her husband, who died at Montpellier in 1785, a schemer by nature and a Voltairian by conviction, pointed the way to careers in France.

Though endowed with immense wealth and distinguished by the title of *Madame Mère* during Napoleon's years of power, Letizia continued to live mainly in retirement and always in the exercise of a strict domestic economy. After the events of 1814 she joined Napoleon in the island of Elba. In 1815 she returned with him to Paris during the Hundred Days. After Waterloo she took up her residence at Rome, under the protection of Pope Pius VII, who treated her with great kindness. In 1818 she addressed a pathetic letter to the powers at the congress of Aix-la-Chapelle, petitioning for Napoleon's release on the ground that his mortal illness had removed any possibility of his ever again threatening the world's peace. The letter remained unanswered, the powers having reason to believe that its terms had been previously concerted with Napoleon. Afterward, saddened by the death of Napoleon, of her daughters Pauline and Élisa, and of several grandchildren, she lived a life of mournful seclusion. She died in 1836.

BROTHERS AND SISTERS OF NAPOLEON I

Joseph (1768–1844), Napoleon's eldest surviving brother, was born at Corte in Corsica on Jan. 7, 1768. He was educated at the college at Autun in France, returned to Corsica in 1784, went to study law at Pisa (1787–88), then returned again to Corsica. Like his brothers, he embraced the French republican side, and on the victory of Pasquale Paoli's supporters he sought refuge in France. He settled at Marseilles and married Julie Clary, daughter of a rich merchant there. Joseph went on a mission to Genoa in 1795 in connection with plans for the recovery of Corsica. In 1796 he accompanied Napoleon in the early part of the Italian campaign and had some part in the negotiations with Sardinia which led to the armistice of Cherasco. He took part in the French expedition for the recovery of Corsica and helped the commissioner of the French republic, A. F. Miot de Melito, in the reorganization of the island. He was appointed by the Directory minister to the court of Parma in March 1797 and then to Rome. Discords arose between the Vatican and the French republic, and it is clear that Napoleon and the Directory ordered Joseph to encourage revolutionary movements in Rome. On Dec. 28, 1797, a disturbance took place opposite the French embassy which led to the death of the French general Léonard Duphot. Joseph returned to Paris and became one of the members for Corsica in the council of five hundred.

Before the *coup d'état* of 18 Brumaire, Joseph helped Napoleon in making overtures to E. J. Sieyès and J. V. Moreau, but otherwise did little. He was a member of the council of state and of the *corps législatif*. He concluded at Mortfontaine a convention with the United States (1800). He also presided over the negotiations which led to the treaty of Lunéville with Austria (1801); and he and H. B. Maret represented France in discussions with the British envoy, Lord Cornwallis, which led to the treaty of Amiens (1802). On the question of the consolidation of Napoleon's power as first consul for life (Aug. 1, 1802) with the chief voice in the selection of his successor, the brothers disagreed. As neither Joseph nor Napoleon had a male heir, Joseph as eldest brother claimed to be recognized as heir, while Napoleon wished to recognize the son of Louis Bonaparte. On the proclamation of the French empire (May 1804) the friction became acute. Joseph refused Napoleon's offer to make him king of Lombardy if he would waive all claim of succession to the French throne.

Meanwhile Joseph had striven in vain to avert a rupture with England, which came about in May 1803. In 1805 he acted as chief of the French government while Napoleon was in Germany. Early in 1806 he was sent to Naples to expel the Bourbon dynasty. By the decree of March 30, 1806, Napoleon proclaimed Joseph king of Naples, but allowed him to keep intact his claims to the throne of France. During his brief reign at Naples, Joseph abolished the relics of feudalism, reformed the monastic orders, reorganized the judicial, financial and educational systems and initiated several public works.

Joseph was suddenly called away by Napoleon to take the crown of Spain (May 1808). There his difficulties were far greater (*see* Spain: *History;* Peninsular War), and his sovereignty was little more than titular. Compelled to leave Madrid hastily in Aug. 1808 after the Spanish success at Baylen, he was reinstated by Napoleon at the close of the year. Thereafter he was kept in a subordinate position which led him on four occasions to offer to abdicate. After Joseph's flight from Spain in 1813 the emperor wrote to the minister of war (July 11, 1813): "His behaviour has never ceased bringing misfortune upon my army; it is time to make an end of it."

Napoleon was equally dissatisfied with Joseph's conduct as lieutenant general of France, while he himself was conducting the campaign of 1814. On March 30, Joseph empowered Marmont to make a truce with the assailants of Paris if they should be in overpowering strength. On the surrender of the capital Joseph at once retired. The part which he played during the Hundred Days (1815) was also insignificant. After Napoleon's surrender to the captain of H.M.S. "Bellerophon" at Rochefort, Joseph went to the United States. In 1830 he pleaded for the recognition of the claims of Napoleon's son, the duke of Reichstadt, to the French throne. He afterward visited England and for a time resided in Genoa and then in Florence, where he died on July 28, 1844. In person he somewhat resembled Napoleon, but utterly lacked his energy. He was too supine and luxurious for the tasks thrust on him by

his brother. His writings, however, prove that he retained for Napoleon warm feelings of affection.

LUCIEN (1775–1840), Napoleon's second surviving brother, was born at Ajaccio on May 21, 1775. He followed his elder brothers to the schools of Autun and Brienne but, being debarred by defective sight from the army, went to the seminary at Aix-en-Provence (1786). His excitable and volatile disposition agreed ill with the discipline of the place, and on the outbreak of the Revolution in 1789 he returned to Corsica and became the leading speaker in the Jacobin club at Ajaccio. Lucien urged his brothers to break with Paoli and headed a Corsican deputation which went to France to denounce Paoli and to solicit aid against him. In the south of France he worked hard for the Jacobin cause. In May 1794, he married Christine Boyer (1773–1800), by whom he had two daughters, Charlotte (1795–1865) and Christine Égypta (1798–1847). The *coup d'état* of Thermidor (July 1794) compelled him to accept a small post at St. Chamans. There he was arrested and imprisoned for a time until Napoleon procured his release and found him a post as commissioner in the French army in Germany. Lucien disliked the army and was sent to Corsica. In 1798 he entered the council of five hundred at Paris as deputy for Corsica. He was president of that body on 19 Brumaire (Nov. 10) 1799, when Napoleon overthrew the national councils at the palace of St. Cloud. By refusing to put the vote of outlawry, for which the majority of the council clamoured, by his opportune closing of the sitting and by appealing to the soldiers outside to disperse "the representatives of the dagger" Lucien turned the scale in favour of his brother.

This event, the chief event of Lucien's life, was fatal to the cause of democracy of which he had been the most eager exponent. In one of his earlier letters to his brother Joseph, Lucien stated that he had detected in Napoleon "an ambition not altogether egotistic but which surpassed his love for the general weal; . . . in case of a counter-revolution he would try to ride the crest of events." This suspicion became a dominant feeling, and the relations between Lucien and Napoleon became strained during the period of the consulate (1799–1804). Lucien accepted office as minister of the interior, but was soon deprived of it because of political and personal differences with the first consul. Napoleon then appointed him ambassador to the court of Madrid (Nov. 1800), where he again fell into disfavour. He returned to Paris and again opposed Napoleon's schemes. Lucien's next proceeding completed the breach. After his first wife's death he became enamoured of a Mme Jouberthou (Alexandrine de Bleschamps; 1778–1855), and despite the express prohibition of the first consul secretly married her at his residence of Plessis-Chamant on Oct. 26, 1803. At that time Napoleon was pressing Lucien to marry the Spanish infanta Luisa, the widow of Louis, king of Etruria, and he now ordered him to leave French territory. Lucien departed for Italy with his wife and infant son, after annoying Napoleon by bestowing on her publicly the name of Bonaparte.

For some years Lucien lived in Italy, chiefly in Rome. In Dec. 1807 Napoleon sought to come to an arrangement by which Lucien would be made a French prince, provided that he would annul his marriage. Lucien refused this and, after residing for some time at his estate of Canino, from which he took the papal title of principe di Canino, he left for the United States. Captured by a British ship, he was taken to Malta and thence to England, where he lived under some measure of surveillance up to the peace of 1814. Returning to Rome, he offered Napoleon his help during the Hundred Days (1815), stood by his side at the "Champ de Mai" in Paris and was the last to defend his prerogatives at the time of his second abdication. He spent the rest of his life in Italy and died at Viterbo on June 29, 1840. His publications include an epic, *Charlemagne ou l'Église délivrée*, two volumes (1814), *La Vérité sur les Cent-Jours* (1835) and *Mémoires*, of which only the first volume appeared (1836).

ÉLISA (1777–1820), Napoleon's eldest sister to survive infancy, born at Ajaccio on Jan. 3, 1777, was married on May 5, 1797, to Félix Baciocchi, a member of a Corsican noble family. Napoleon gave her the principality of Piombino in March 1805, Lucca in the following June and finally, in March 1809, made her grand duchess of Tuscany. Her pride and ability had great influence on the administration and on Italian affairs in general. Her relations with Napoleon were frequently strained; in 1813–14 she abetted Joachim Murat in his enterprises. After her brother's fall she retired, with the title of contessa di Compignano, first to Bologna and afterward to Sant'Andrea near Trieste, where she died on Aug. 7, 1820.

LOUIS (1778–1846), Napoleon's third surviving brother, was born at Ajaccio on Sept. 2, 1778. Napoleon supervised his education and in 1795 procured for him admission to the military school at Châlons. Louis went through the Italian campaign of 1796–97 with Napoleon and acted as his aide-de-camp in Egypt in 1798–99. In 1802 Napoleon as first consul married him to Hortense de Beauharnais (*see* HORTENSE), a forced union that led to deplorable results. In 1804 Louis was raised to the rank of general and entered the council of state. In 1805 he became governor of Paris and undertook various military and administrative duties.

Napoleon proclaimed Louis king of Holland on June 5, 1806. From the first the emperor reproached him with being too easy with his subjects. Their relations were embittered by a violent jealousy which Louis conceived against his wife. In 1808 the emperor offered Louis the throne of Spain, but when Louis refused it the honour went to Joseph. In 1809 Napoleon was thinking of annexing Holland in order to stop the trade which the Dutch secretly carried on with England. At the close of the year Louis went to Paris, partly to procure a divorce and partly to gain better terms for Holland. He failed in both respects. After the collapse of negotiations with Great Britain in the spring of 1810, the emperor again pressed Louis hard and finally sent French troops against the Dutch capital. On July 1, 1810, Louis abdicated and fled from his kingdom, which on July 9 Napoleon annexed to France.

Louis then took the style of comte de St. Leu. After some time in Bohemia, Austria and Switzerland, he spent his later life chiefly in Italy (in Rome or in Florence), largely occupied with literary pursuits. As well as the *Documens historiques et réflexions sur le gouvernement de la Hollande*, three volumes (1820; Eng. trans., 6 pt., 1820), he published *Marie, ou Les Peines de l'amour*, two volumes (1812), *Mémoire sur la versification*, two volumes (1819–20) and *Le Retour* (1846). He was much gratified by the devotion of his two surviving sons to Italian nationalism and was grieved by the death of the elder son, Napoléon Louis, during the Romagna rising of 1831 and by the failure of the other, Charles Louis Napoléon, in the Strasbourg and Boulogne conspiracies (1836 and 1840; *see* NAPOLEON III). Louis died at Livorno on July 25, 1846.

PAULINE (1780–1825), the second to survive, the gayest and the most beautiful of Napoleon's sisters, was born at Ajaccio on Oct. 20, 1780. She married Gen. C. V. E. Leclerc (1772–1802), a staff officer of Napoleon, in 1797 and accompanied him to San Domingo. When Leclerc died of yellow fever she returned to Paris. She then married Prince Camillo Borghese (Nov. 6, 1803) and went with him to Rome, but soon tired of him, returned to Paris, and gratified her whims in ways that caused some scandal. In 1806 she received the title of duchess of Guastalla. Her offhand treatment of Napoleon's new empress, Marie Louise, led to her removal from court in 1810. Nevertheless she went with her mother to Elba in 1814 and is said to have expressed a wish to share Napoleon's exile in St. Helena. She died of cancer in Florence on June 9, 1825. Canova's statue of her as Venus reclining on a couch is well-known.

JÉRÔME (1784–1860), Napoleon's youngest brother, was born at Ajaccio on Nov. 15, 1784; he shared the fortunes of the family in the early years of the French Revolution, was educated at Juilly, and was called to the side of his brother, then first consul, in 1800. While in the consular guard he fought a duel with the younger brother of Gen. L. N. Davout and was wounded. Soon afterward he was transferred to the navy and cruised in the West Indies, where he left his ship and went to the United States. At Baltimore on Dec. 24, 1803, he married Elizabeth Patterson (1785–1879), daughter of William Patterson, a merchant there.

When in 1805 Jérôme brought his wife to Europe, the emperor ordered her to be excluded from his states. Jérôme vainly sought to bend his brother's will in an interview at Alessandria. In May 1805 he received command of a small squadron in the Mediter-

ranean, while his wife proceeded to Camberwell, Eng., where she gave birth to a son. In November Jérôme returned to service in the navy. Napoleon made him a prince of France and gave him command of a division of South Germans in the campaign of 1806. After the battle of Jena, Jérôme received the surrender of several Prussian towns. An imperial decree having annulled the Patterson marriage, the emperor married Jérôme to the princess Catherine of Württemberg and, in pursuance of the terms of the treaty of Tilsit (1807), made him king of Westphalia. In the Russian campaign of 1812 Jérôme was entrusted with a movement which might have brought the southern Russian army into grave danger; on his failure (probably due to his lack of energy) the emperor promptly subjected him to the control of Marshal Davout, and Jérôme returned to Kassel.

In 1813, on the fall of the Napoleonic regime in Germany, Jérôme retired to France. In 1814 he spent some time in Switzerland and at Trieste. Returning to France in 1815, he commanded a division on the French left wing at Waterloo and attacked Hougoumont with great pertinacity. On Napoleon's second abdication Jérôme proceeded to Württemberg, where he lived for a time with the style of prince de Montfort. Finally he was allowed to proceed to Augsburg. Thereafter he resided at Trieste, or in Italy or Switzerland. His consort died in 1835, and in 1840 he made a morganatic marriage with Giustina Pecori, widow of the marchese L. Baldelli-Bartolini. He returned to France in 1847, and after the rise of his nephew Louis Napoléon to power, became successively governor of the Invalides, marshal of France and president of the senate. He died at Villegenis (Seine-et-Oise), on June 24, 1860.

Caroline (1782–1839), Napoleon's youngest sister, was born at Ajaccio on March 25, 1782. Early in 1800 she married Joachim Murat (*q.v.*), whose interests she afterward advanced with all the power of her ambitious and intriguing nature. He became governor of Paris, marshal of France (1804), grand duke of Berg and of Cleves (1806), lieutenant of the emperor in Spain (1808) and, early in the summer of 1808, king of Naples. The distance of this capital from Paris displeased Caroline; her relations with Napoleon became strained, and she associated herself with the equivocal movements of her husband in 1814–15. Before his tragic end at Pizzo on Oct. 13, 1815, she had retired to Austrian territory. She died in Florence on May 18, 1839.

DESCENDANTS

Of Lucien Bonaparte.—The male line of descent from Lucien Bonaparte is shown in the accompanying table. Three members of this line, however, deserve separate notice here.

Charles Lucien (1803–1857), principe di Canino and di Musignano, Lucien's eldest son, was born in Paris on May 24, 1803. He was a scientist rather than a politician and was a correspondent of many learned societies. He married his cousin Zénaïde, daughter of Joseph, in 1822. At the age of 22 he began the publication of *American Ornithology*, four volumes (1825–33), which established his scientific reputation. A series of other works in zoology followed. He took part in the political agitation in Italy, and he declared himself at Venice in favour of the independence of Italy and the expulsion of the Austrians. He entered the junto of Rome in 1848 and was elected deputy by Viterbo to the national assembly. The failure of the revolution forced him to leave Italy in July 1849. He went to Holland, then to France, where he turned again to science. He died in Paris on July 29, 1857. His principal works were *Conspectus systematis ornithologiae, mastozologiae, erpetologiae et amphibologiae, ichthyologiae* (1850), *Tableau des oiseaux-mouches* (1854) and *Ornithologie fossile* (1858). Of his 12 children (*see* Table), 3 sons and 5 daughters survived him.

Louis Lucien (1813–1891), fourth son of Lucien Bonaparte, was born at Thorngrove, Grimley, Worcestershire, Eng., on Jan. 4, 1813. He passed his youth in Italy, not going to France until 1848, when, after the revolution, he was elected deputy for Corsica (Nov. 28, 1848); his election having been invalidated, he was returned as deputy for the Seine in June 1849. He sat in the right of the legislative assembly, but had no direct part in the *coup d'état* of Dec. 2, 1851. Napoleon III named him senator and prince, but he took hardly any part in politics. Instead he spent much of his time in England, where he devoted himself to philology, in particular to the study of English dialects. He also published some notable works on the Basque language. He died at Fano, Italy, on Nov. 3, 1891, leaving no children.

Pierre Napoléon (1815–1881), fifth son of Lucien Bonaparte, was born in Rome on Oct. 11, 1815. He joined the rebels in the Romagna (1830–31), and was then in the United States, where he went to join his uncle Joseph, and in Colombia with Gen. Francisco Santander (1832). Returning to Rome, he was taken prisoner by order of the pope (1835–36). He finally took refuge in England. At the revolution of 1848 he returned to France and was elected deputy for Corsica to the constituent assembly. He declared himself an out-and-out republican and voted with the Socialists. His attitude contributed greatly to give popular confidence to his cousin Louis Napoléon (Napoleon III), of whose *coup d'état* on Dec. 2, 1851, he disapproved; but he was reconciled to the emperor and accepted the title of prince. The republicans at once abandoned him. From that time on he led a debauched life and lost all political importance. In Jan. 1870 a violent incident brought him again into prominence. As the result of a controversy with Paschal Grousset, the latter sent two journalists to provoke him to a duel. Pierre Bonaparte took them personally to account, and during a violent discussion he drew his revolver and killed one of them, Victor Noir (Yvan Salmon). The high court acquitted him of murder, and criticism then fell upon the government. Pierre Bonaparte died in obscurity at Versailles on April 7, 1881. He had married the daughter of a Paris working-man, Justine Eléonore Ruffin, after the birth of her two children by him. His *Souvenirs, traditions et révélations* appeared in 1876.

Of Louis Bonaparte.—Louis Bonaparte's two elder sons predeceased him. His third became emperor of the French as Napoleon III (*q.v.*). Napoleon III's only son by the empress Eugénie, Napoléon Eugène Louis (1856–1879), prince imperial, was born in Paris on March 16, 1856. He was a delicate boy, but when the Franco-German War of 1870 broke out his mother sent him to the army. After the first defeats he had to flee from France with the empress and settled in England at Chislehurst, completing his military education at Woolwich. On his father's death (Jan. 9, 1873) the Bonapartists proclaimed him Napoleon IV, and he became the official pretender. The Bonapartist leaders thought that he should win his crown by military prestige and he was persuaded to attach himself as a volunteer to the British expedition to Zululand in Feb. 1879. While out on reconnaissance with a few troopers he was surprised by Zulus and killed at Ulundi (June 1, 1879). His body was brought back to England and buried at Chislehurst.

Of Jérôme Bonaparte.—As shown in the table, Jérôme Bonaparte had children by both his marriages.

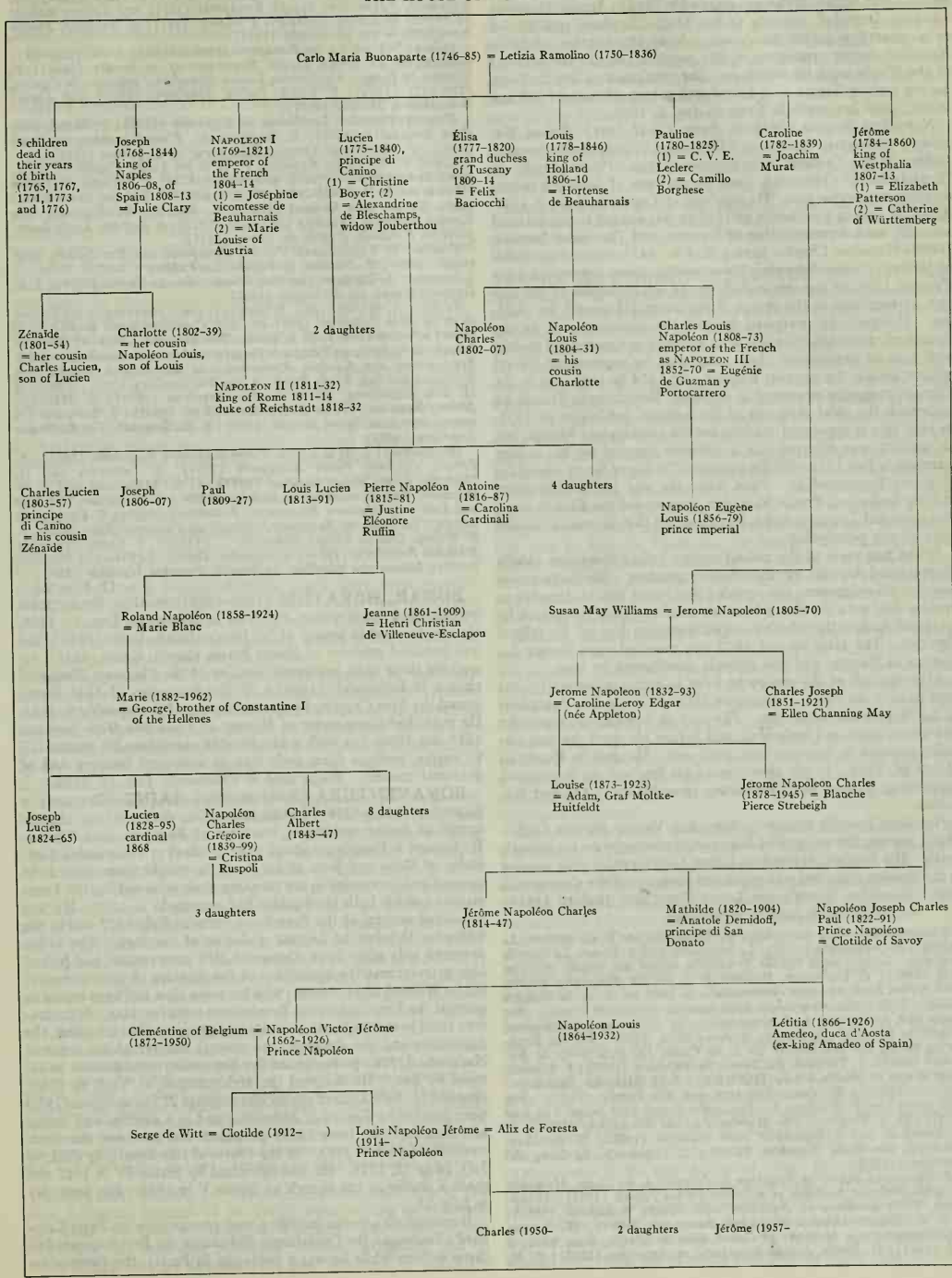
The Bonapartes of Baltimore were descended from Jérôme's marriage with Elizabeth Patterson (*see* above). Although this marriage was valid according to U.S. law and Pope Pius VII refused to declare it void, Jérôme was forced to separate from his wife, and after a stay in England she returned to Baltimore. The only child of this marriage was Jerome Napoleon Bonaparte (1805–70), who was born in England but resided chiefly in Baltimore. He was on good terms with his father, who for some time made him a large allowance, and father and son occasionally met. His elder son, also called Jerome Napoleon (1832–93), whose children are shown in the accompanying table, entered the French army, with which he served in the Crimea and in Italy.

Charles Joseph Bonaparte (1851–1921), brother of the last-named, attained a distinguished place in U.S. politics. Born in Baltimore on June 9, 1851, and educated at Harvard university, he became a lawyer in 1874, was elected president of the National Municipal league, and occupied other public positions. He was secretary of the navy in Pres. Theodore Roosevelt's cabinet from July 1905 to Dec. 1906, and then attorney general of the United States until March 1909. He died in Baltimore on June 28, 1921.

Of Jérôme's three children by Catherine of Württemberg two deserve special mention:

Mathilde (1820–1904), Jérôme's only daughter, was born at

THE HOUSE OF BONAPARTE



Trieste on May 27, 1820. After being almost betrothed to her cousin Louis Napoleon she was married in 1840 to Anatoli Demidov (Anatole Demidoff, principe di San Donato), whose conduct led to a separation within five years. After the election of Louis Napoleon to the presidency of the republic she did the honours of the Élysée until his marriage. She continued to live in Paris, having great influence as a friend and patron of men of art and letters, until her death in Paris on Jan. 2, 1904.

NAPOLÉON JOSEPH CHARLES PAUL (1822–1891), Prince Napoléon, sometimes known as "Plon Plon" (supposedly because soldiers in the Crimean War nicknamed him "Plomb-plomb" or "Craint-plomb" (Fear-lead), was the only son of Jérôme's second marriage to survive him. He was born at Trieste on Sept. 9, 1822. After the French Revolution of 1848 he was elected to the national assembly as a representative of Corsica, and (his elder brother, Jérôme Napoléon Charles, having died in 1847) assumed the name of Jérôme. Notwithstanding his ostensible opposition to the *coup d'état* of 1851, he was designated, on the establishment of the empire, as successor to the throne if Napoleon III should die childless. Privately he professed himself the representative of the Napoleonic tradition in its democratic aspect and associated mainly with men of progressive ideas. At court he represented liberal opinion against the empress Eugénie. In 1854 he took part in the Crimean campaign as general of division. Returning to France, he undertook the chief direction of the national exhibition of 1855. In 1858 he was appointed minister for the colonies and Algeria, but his activity was diverted into a different channel by his sudden marriage in Jan. 1859 with the princess Clotilde of Savoy, daughter of Victor Emmanuel II. Thus, when the war for the liberation of Italy broke out, Prince Napoléon commanded the French corps that occupied Tuscany, and it was expected that he would become ruler of the principality.

In the last years of the second empire Prince Napoléon chiefly distinguished himself by remarkable speeches. His indiscretion equalled his eloquence: one speech (1861) sent him to America to avoid a duel with the duc d'Aumale; another (1865), in which he protested against the Mexican expedition, cost him all his official dignities. The fatal war of 1870 was resolved upon during his absence in Norway and was strongly condemned by him.

After the fall of the empire he lived in comparative retirement until in 1879 the death of Napoleon III's son made him direct heir to the Napoleonic succession. His part as Bonapartist pretender was unfortunate and inglorious, and before his death he was virtually deposed in favour of his elder son. He died in Rome on March 17, 1891. In the character of his intellect, as in personal appearance, he bore an extraordinary resemblance to the first Napoleon.

Napoleon Joseph's elder son, NAPOLÉON VICTOR JÉRÔME (1862–1926), became the recognized Bonapartist pretender on his father's death. His brother, NAPOLÉON LOUIS (1864–1932), took service in the Russian army and was appointed governor of the Caucasus in 1906. Napoléon Victor's son LOUIS NAPOLÉON JÉRÔME (1914–) succeeded to his father's pretensions.

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(P. F. DE L.)

BONAR, HORATIUS (1808–1889), Scottish Presbyterian minister and hymn writer, was born in Edinburgh, Dec. 19, 1808. He was licensed to preach at St. John's church, Leith (1833), and was ordained minister of North Parish church, Kelso (1837), remaining there until appointed minister of the Chalmers Memorial church in Edinburgh (1866). At the disruption of 1843 Bonar joined the Free Church; he was moderator of its assembly in 1883. He published three series of *Hymns of Faith and Hope* between 1857 and 1866; but with a few notable exceptions his hymns fail to inspire, perhaps from their lack of scriptural imagery and of doctrinal content. Bonar died at Edinburgh, July 31, 1889.

BONAVENTURA (BONAVENTURE), **SAINT** (GIOVANNI DI FIDANZA) (1221–1274), Italian theologian, doctor of the church, known as *doctor seraphicus*, was born at Bagnorea near Viterbo. He became a Franciscan about 1243, studied in Paris under Alexander of Hales and John of La Rochelle, taught there from 1248 onward and succeeded to the teaching chair reserved for the Franciscans (which both his masters had occupied) in 1253. He was appointed general of the Franciscan order in Feb. 1257 and in the following October he became a doctor of theology. The latter occurred only after Pope Alexander IV's intervention had helped him to overcome the opposition of the masters of the university, led by William of St. Amour, who for some time had been trying to prevent the Franciscans and Dominicans from teaching. Bonaventura tried to reconcile the two extreme groups within his order, the *Spirituales* and the *Relaxati;* the general chapter of his order at Narbonne (1260) promulgated the Franciscan constitutions as revised by him. He declined the archbishopric of York in 1265; renewed his fight against the secular masters of the university, who were now led by Gerard of Abbeville; and as a cardinal and bishop of Albano (from June 1273) prepared and attended the great council of Lyons (1274). In the course of this council he died, on July 14 or 15, 1274. He was canonized by Sixtus IV in 1482 and made a doctor of the church by Sixtus V in 1588. His feast day is July 14.

Bonaventura's works include a vast commentary on Peter Lombard's *Sentences*, the *Quaestiones disputatae*, the *Breviloquium* (all three written while he was a professor in Paris), the *Itinerarium*

mentis in Deum, the various *Collationes* (*De decem praeceptis, De septem donis Spiritus Sancti, In Hexaemeron*), the *De reductione artium ad theologiam*, the *De triplici via* and the *Soliloquium*.

Bonaventura was at the same time a man of action and a philosopher, theologian and mystic. In philosophy he strongly adhered to the Augustinian tradition with its Platonic elements. While accepting Aristotle insofar as his teaching was clearly compatible with revelation, he did not try to adapt most of his doctrines to a Christian point of view.

Following his Franciscan predecessors, he ascribed to primary matter some kind of actuality: its *rationes seminales* are positive aptitudes which will develop into the several forms in the process of becoming; the principle of individuation is to be found in the union of matter and form. Every being has a plurality of forms; unity is preserved in each of them by the subordination of lower to higher forms (in man, to the rational soul). The most important of the lower forms of man is the "corporeal form," identified with light: by giving actuality to the body, it preserves the independence of the soul and ensures its spirituality and immortality. But the soul itself is a compound of some kind of matter and form. The soul's knowledge of the corporeal world is produced by interaction between the intellect (both active and passive) and objects as perceived by the senses. Divine illumination helps this knowledge to conform to the *rationes aeternae* or ideas in God's mind, which contain the fullness of sense objects. Spiritual beings are known through innate species; the soul can thus know itself and, indirectly, God, whose image it is. The existence of God can also be proved by a posteriori arguments, by the analysis of the concept of God (Anselm's argument) and from the nature of truth (Augustine's argument).

In order to complete philosophical speculation which, in its concern for all things, leads to God, we need the imperfect but certain knowledge of God given in faith; for the soul's faculties of knowing and loving, though of divine origin, have been contaminated by its union with the body. Faith is also the foundation of the mystical contemplation of God, which Bonaventura regards as the end of man and discusses at great length in the tradition of the Pseudo-Dionysius and the Victorines.

This contemplation has its origin in the discovery of God's imprint in the corporeal world and is developed through the recognition of His image in the soul and the apprehension of His being and infinite goodness. It requires prayer, meditation and the theological virtues, especially charity. The whole process is accompanied by divine grace. But contemplation itself can only be perfected in the next life.

Among the first printed editions of Bonaventura's writings may be mentioned those of the *Itinerarium* (1472), of the *Breviloquium* (1472), of the *Soliloquium* (1474), of the commentary on book i of the *Sentences* (1474–77?) and of the commentary on book ii of the same (1477). Collected editions of Bonaventura's works are: (1) the edition commissioned by Pope Sixtus V and executed by C. Boccafuoco *et al.*, seven volumes (1588–96; reissues, 1609 and 1751); (2) the edition of A. C. Peltier, 15 volumes (1864–71); and (3) the definitive edition by the Fathers of the Collegio di San Bonaventura, under Fr. I. Jeiler, O.F.M., ten volumes (1882–1902). There are English translations of the *Itinerarium* by J. E. Mahony, under the title *The Franciscan Vision* (1937); of the *De Reductione* by E. T. Healy (1939); of his life of St. Francis (1904); and of *The Mirror of the Blessed Life of Jesus Christ* (1926).

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(L. M.-Po.)

BONCOMPAGNO DA SIGNA (*c.* 1165–*c.* 1240), one of the most influential teachers of the art of letter writing in 13th-century Italy, was born at Signa near Florence. He taught mainly at Bologna and published numerous treatises on rhetoric and on letter writing (the *ars dictandi*), the most important of which are the *Boncompagnus* or *Rhetorica antiqua* (completed by 1215) and the *Rhetorica novissima*. He also wrote a historical work on the siege of Ancona (*Liber de obsidione Anconae*) and a treatise on the afflictions of old age (*Libellus de malo senectutis et senii*). His works are not only outstanding documents of the revival of rhetoric, but also important sources for contemporary life and manners. Boncompagno died in Florence *c.* 1240. There are editions of the *Rhetorica novissima* by A. Gaudenzi in *Bibliotheca iuridica medii aevi*, vol. ii (1892); of the *Liber de obsidione* by G. C. Zimolo in *Rerum Italicarum scriptores*, vol vi (1937); and of the *Libellus* by F. Novati in *Rendiconti dell' Accademia dei Lincei (classe di scienze morali)*, series 5, vol. i (1892).

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(N. R.)

BOND, SIR EDWARD AUGUSTUS (1815–1898), English librarian who was among the first to make classical paleography into a scientific discipline, was born on Dec. 31, 1815, at Hanwell, Middlesex, and educated at the Merchant Taylors' school. He entered the Public Record office in 1833, under T. D. Hardy at the Tower of London, and five years later went to the manuscript department of the British museum. In 1850 he was appointed Egerton librarian and in 1866 succeeded Sir F. Madden as keeper of manuscripts. His work in reorganizing the manuscript department was of lasting value; the classified catalogues of manuscripts are a result of his efforts. He was principal librarian and secretary from 1878 to 1888 and was created knight commander of the order of the Bath shortly before he died, Jan. 2, 1898, in London. Under Bond's supervision the White wing was built to provide accommodation for prints, manuscripts and newspapers and, in conjunction with E. Maunde Thompson, he founded the Palaeographical society. Bond edited four volumes of *Facsimiles of Ancient Charters in the British Museum* (1873–78), *Speeches of the Managers and Counsel in the Trial of Warren Hastings* (1859–61) and other interesting documents.

(J. M. WI.)

BOND, SIR ROBERT (1857–1927), leader of the Liberal party in Newfoundland, was born Feb. 25, 1857, at St. John's. He was educated at Queen's college, Taunton, Eng., and then returned to Newfoundland and entered politics. His term as prime minister (1900–09) is memorable for the concessions made to outside capital in an attempt to develop the natural resources of the colony. Most notable was the arrangement with the proprietors of the London *Daily Mail* which led to the opening in 1905 of a paper mill at Grand Falls, thus inaugurating a logging industry which was destined to replace the fishery as the chief contributor to Newfoundland's income.

Bond was repeatedly overruled by the United Kingdom in his attempts to legislate with regard to historic fishing privileges granted by Britain to French fishermen in 1783 and to U.S. fishermen in 1818. France gave up the right to use Newfoundland shores in 1904, but Bond continued to denounce Britain's continued interference with his attempts to restrict American activities.

In 1909 Bond resigned because the British governor refused his advice that the assembly should be dissolved again, the general election of 1908 having resulted in a tie. A former supporter, Sir Edward Morris, became prime minister as leader of a new People's party. Bond formed an alliance with a radical Fishermen's union but his influence continued to decline and in 1914 he went into retirement. He died at Whitbourne, Nfd., March 16, 1927, and was buried in the Anglican churchyard there.

(G. O. R.)

BOND, WILLIAM CRANCH (1789–1859), U.S. astronomer who, with his son, George Phillips Bond, discovered a new ring system and a new satellite (Hyperion) of Saturn and constructed an improved type of recording chronograph, was born at Portland, Me., on Sept. 9, 1789. Largely self-educated, Bond was attracted to astronomy by the solar eclipse of 1806. He independently discovered many comets, beginning with that of 1811, and was appointed the first astronomical observer by the corporation of Harvard college in 1840, an unsalaried position held concurrently with that of astronomical observer for the federal government. He became director of the Harvard college observatory upon its com-

pletion in 1847. He was elected associate of the Royal Astronomical society in 1849, the first American so honoured. The application of photography to astronomy was greatly advanced under his administration at the Harvard observatory. He died at Cambridge, Mass., on Jan. 29, 1859.

See E. S. Holden, *Memorials of W. C. and G. P. Bond* (1897).
(O. J. E.)

BOND: *see* Bail; Fidelity and Surety Bonds; Guarantee; Investment Paper; Real Property and Conveyancing, Laws of.

BOND (IN FINANCE), a type of promissory note issued by governments and by private corporations specifying an obligation to return borrowed funds. Bonds are usually issued in more formal fashion than promissory notes and ordinarily are under seal. This process involves a printing of some formality, including numbering and lithographing or engraving, to minimize fraud. Bonds are printed on paper that is somewhat larger than letter-size, plus coupons. Usually the debt indicated by the bonds is of substantial size and is advanced by a relatively large number of creditors known as bondholders, although it is not uncommon for all or most of the bonds represented by a debt to be held by one lender, such as an insurance company or a pension fund, under an arrangement known as a private or direct placement.

Bonds may be issued in any denomination, but in the United States they are commonly issued in denominations of $1,000. In essence, the borrower promises to pay interest when due, usually semiannually, at a stipulated percentage of the face value of the bond, and to redeem the face value of the bond at maturity in legal tender. Interest on bonds is most often collectible through the presentation of numbered coupons which the holder clips from the bond. A coupon is usually printed and attached for every interest date throughout the life of the bond.

When bonds are sold, accrued interest is added to the sales price. The purchaser advances to the seller a percentage of the next interest coupon payable computed by dividing the whole time period between interest due dates by the actual time elapsed since the previous interest due date. The money is paid in advance to obtain the partly earned coupon.

Most bonds are payable to the bearer and are thus easily negotiable, but it is usually possible to have the bond registered and thus made payable only to the named holder. The great majority of bonds are callable, meaning that the issuer can redeem them at his option, upon appropriate notice, well before maturity. Maturity or due dates for bonds are usually at least more than one year from issuance, and normally run from 10 to 30 years, although much longer periods have been used.

The four major classifications of bonds by borrowers in the United States are: (1) government bonds, issued by the United States and foreign governments; (2) municipal bonds, issued by states, cities and other such governmental bodies, usually backed by some element of taxing power; (3) revenue bonds, issued by quasi-governmental corporations to finance public conveniences such as toll roads, exhibition halls, airports, or water works, and secured only by the revenue from the projects involved; and (4) corporate bonds, issued by private, profit-seeking corporations such as those in the railroad, utility and industrial fields, or by nonprofit corporations. Technically, bonds may also be issued by proprietorships and partnerships.

Contract terms are very important to both parties and are normally found in the indenture, an agreement between the borrower and a trustee acting on behalf of the bondholders. In the United States, the minimum duties and responsibilities of the trustee, if the bonds are publicly offered, are specified in the Trust Indenture act of 1940, but not in the case of government and municipal bonds. Bonds are often referred to by a term having reference to the most distinctive feature of the loan contract. Most prevalent among these types are the following:

1. Mortgage bond, a general obligation of the borrower that is also secured by a lien against real estate or other property such as equipment owned by the borrower. The type of lien is usually indicated by additional words such as first, second, or general.

2. Debenture bond, a general obligation of the borrower with no prior lien on specified property. In Great Britain the term debenture stock is equivalent to the U.S. debenture bond. A bond of this type can be subordinated, meaning that the holder agrees to accept a junior creditor position relative to other creditor obligations such as bank loans.

3. Convertible bond, a general obligation of the borrower, plus an additional covenant to exchange ownership securities (stock) at a fixed price to the bondholder, at the holder's option, good for a specified time. The value of the bond may subsequently increase should the market value of the stock exceed the option price.

4. Special district bond, usually an issue of a subdivision of a municipality such as a board of education or park district. It is a general obligation backed by the taxing power of the district.

5. Collateral trust bond, a general obligation plus the security of a specified lien on securities or other personal property of the borrower.

6. Equipment trust certificate, a security commonly thought of as a bond having a specific lien against equipment such as railroad cars, trucks, airplanes or buses. Technically, it is an ownership and not creditor security since the equipment is commonly leased to the user.

7. Income bond, a general obligation of the borrower with a contingent promise to pay interest only if earned.

8. Sinking-fund bond, a bond containing a covenant to set aside certain amounts at specified periods to build up a redemption fund or to retire outstanding bonds.

9. Tax-exempt bond, in the United States, a bond that is not subject to the federal income tax, and may also have state tax-exemption features. Bonds issued by states, municipalities and their subdivisions fall into this category.

There are many other descriptive terms attached to bonds to denote some special feature in the indenture that the borrower thinks will be of special interest to the lender. The indenture also includes many protective provisions, promises made by the borrower that are thought to assure greater safety to the lender, such as closed-end mortgage clauses, acceleration, after-acquired property clauses, etc.

All bonds are, as we have seen, general creditor obligations of the borrower. In addition, they may contain additional covenants offering an inducement to the lender to favour the borrower with his funds such as a lien on specified property or the others mentioned above. Fundamentally, however, the source of repayment lies in the income or cash-generating power of the assets to which the funds are committed or in the income-raising ability of the governmental body.

See also references under "Bond (in Finance)" in the Index volume.

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BONDE, GUSTAF, Count (1620–1667), lord treasurer in the regency council appointed in 1660 to govern Sweden during the minority of Charles XI, was born at Esplunda on Feb. 4, 1620. In 1645 he became a member of the inland revenue board, in 1648 governor of Södermanland and in 1653 a privy councilor. In 1660 he became lord treasurer and a member of the regency council, where he advocated a policy of retrenchment at home and withdrawal abroad in opposition to the overambitious financial and foreign policy of the chancellor Magnus Gabriel de la Gardie.

From 1660 to 1662 Bonde was successful in forcing through reductions of expenditure and a careful examination of crown contracts and pensions, and stood inflexibly opposed to any renewal of a policy of donating crown lands. These policies made him bitter enemies who helped the chancellor to sabotage Bonde's reforms. His economic system was broken before the final blow of the wasteful Bremen War (1665).

Bonde withdrew from further political disputes, but his ideas were defended by a group of his treasury subordinates and by his successor Sten Bielke (d. 1684). Embodied in the report of the *Blue Book* (1668) they became the basis of much of the financial system of Charles XI. Bonde died at Hamburg on May 25, 1667.

See G. Wittrock, *Karl XI:s Formyndares Finanspolitik 1661–1667* (1914).

BONDFIELD, MARGARET GRACE (1873–1953), British trade union leader and the first woman to attain cabinet rank in Great Britain, was born on March 17, 1873, at Chard, Somerset. At the age of 14 she became an assistant in a draper's shop at Brighton, but soon afterward moved to London. She became assistant secretary of the Shop Assistants' union in 1898 and secretary of the National Federation of Women Workers in 1921.

She was made chairman of the Trades Union congress in 1923, being the first woman to hold that position, and in Nov. 1923 was elected Labour M.P. for Northampton. In the Labour government of 1924 she was parliamentary secretary to the ministry of labour. She was British government delegate on the governing body of the International Labour office, and at the sixth session of the International Labour conference (Geneva, 1924) she was particularly concerned with the project to develop by international agreement facilities for the utilization of workers' leisure. She was defeated at the general election of Oct. 1924 but she returned to parliament in 1926 as member for Wallsend. She became minister of labour in 1929 and gained her seat in the cabinet. She was generally judged to be well worth her place, for she was a competent administrator as well as a clear and forceful speaker. Defeat in the general election of 1931 terminated her parliamentary career, but she was chairman of Women's Group on Public Welfare (1939–49) and from 1941–43 lectured in the United States for the British Information services. She died on June 16, 1953, at Sanderstead, Surrey.

Margaret Bondfield possessed both practical ability and an immense warmth and idealism. She had inherited a fine tradition of religious dissent and political radicalism, and her life fully illustrated her conviction that the strength of British socialism derived from its religious foundations.

See M. Bondfield, *Life's Work* (1949); M. Hamilton, *Margaret Bondfield* (1925). (R. J.)

BONE, HENRY (1755–1834), English painter, whose miniature portraits in enamel were outstanding, was born at Truro on Feb. 6, 1755. He was employed by London jewelers for small designs in enamel, and in 1800 the beauty of his pieces attracted the notice of the Royal Academy, and he was admitted an associate in 1801; in 1811 he was made an academician. Up to 1831 he executed many beautiful miniature pieces of much larger size than had been attempted before in England; among these are 85 portraits of the time of Queen Elizabeth I, of different sizes, from 5 by 4 in. to 13 by 8 in., now at Kingston Lacey, Wimborne, Dorsetshire. These, and pieces in the Wallace collection, London, were his greatest works. He died in London on Dec. 17, 1834.

BONE, SIR MUIRHEAD (1876–1953), British artist, best known as an etcher and dry-point engraver, was born at Glasgow, Scot., on March 23, 1876, son of David Drummond Bone, a journalist. He first studied architecture and then art in the evening classes of the Glasgow School of Art. Being attracted by the picturesque aspect of buildings, he executed drawings of views in his native town. His method was generally that of dry point; as a draftsman he used pencil, charcoal and sepia. In 1899 he issued a *Portfolio* with etchings of Glasgow. He moved to London in 1901 where the exhibition of his works in 1903 established his fame. In 1904 ten of his dry points were published by Obach. His work displays a devotion for every form of intricate scaffolding; thus his famous etching "The Great Gantry" (1906) is a study of Charing Cross railway station after the accident to the roof in 1905, with a network of scaffolding set up for reconstruction. This, his "Ayr Prison" and "Liberty's Clock" are among the finest works in dry point.

During World Wars I and II he served as official artist with the British forces. He was knighted in 1937. Bone died at Ferry Hinksey, Oxford, on Oct. 21, 1953.

BÔNE, the capital of the *département* of Bône, Algeria, and a port on the gulf of Bône near the mouth of the Seybouse river, lies 260 mi. E. of Algiers near the Tunisian border. Area of commune about 42 sq.mi. Pop. (1960) 144,000 (metropolitan) comprising 100,000 Algerians (Muslim), 44,000 European French subjects. The town rises from the shore up the cork-covered slopes of the Edough foothills. The old town with its narrow streets dominates the centre of the city and is grouped round the Place d'Armes where are the earliest French houses and the mosque of Salah Bey (1787). In the 11th-century mosque of Sidi-bou-Merouan the prayer room is divided into seven naves and seven bays, with columns taken from the ruined forum of Hippo. The synagogue, close by, was built in 1852.

West of the old town is the new town, built since 1870 along both sides of the Cours Bertagna. Its straight roads cross at right angles and the chief public buildings include the town hall (1888), the municipal theatre (1954), the prefecture (1958), the cathedral of St. Augustine (1850), the basilica of St. Augustine (1881), the Protestant church (1882), the hospital (1958), schools, technical colleges and the Hippo museum near the excavations of the Roman city. There are public gardens round the town hall and others are the Randon gardens and the Jean Coggia park.

Bône, the chief exporter of minerals on the Mediterranean (iron ore and phosphates), is also a passenger, trading and fishing port and a port of call. Main roads connect Bône with Philippeville, Constantine, Guelma and Souk-Ahras. There are railways to Algiers and on to Morocco via Constantine, to Tunis via Souk-Ahras and to Biskra and Touggourt via Constantine. There is an airport at Bône-Les Salines, 6¾ mi. S.E., with service facilities to France and other towns of north Africa.

In the surrounding countryside are arable and stock-raising farms, forests and mines. The important mine of Karezas produces arsenic and tungsten. The effort to industrialize Algeria after World War II has given Bône several major industries including motor and railway workshops, aluminum and chemical works.

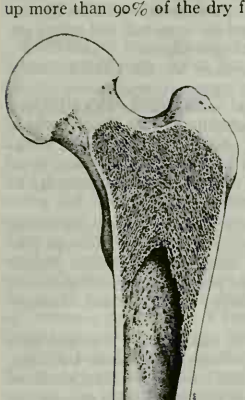
Bône's exceptional situation on a coast poorly supplied with natural harbours, on a large bay between Cape Garde and Cape Rosa and protected from the west and northwest winds, attracted the earliest sailors. It seems certain that in the 12th century the Phoenecians founded a trading port there which later became Hippo Regius, the chosen residence of the kings of Numidia. At the end of the Punic Wars the inhabitants received their independence from Rome and Hippo became a flourishing town. St. Augustine (*q.v.*), bishop of Hippo from 396 to 430, made it the centre of Christian thought. Much of the town was destroyed by the vandals in 431 but was delivered by the emperor Justinian in 533. Two centuries later it was overcome by the Arabs and the beneficial effects of Roman rule and Christianity soon disappeared. The remaining citizens, driven on to high ground nearby, built a new town, Bouna el Hadida, invisible from the sea. Surrounded by walls, it later became the headquarters of pirates and fugitives. For many centuries Bône was one of the small cities of north Africa under the domination of successive rulers. In 1535 it was occupied by the soldiers of the emperor Charles V but was retaken by the Turks in 1540 and remained in their possession until 1832 when the French captured it with a small force. In 1848 Louis Philippe made it a commune administered from Paris, and by the end of the century it had become the important Mediterranean port and city that it now is. (P. A. Se.)

BONE, a dense, highly specialized form of connective tissue, composed of branching cells in an intercellular substance, has certain characteristics which differentiate it from other forms of supporting tissue, the most striking one being that it is hard. This hardness results from the deposition, within a soft organic matrix, of a complex mineral, composed chiefly of calcium, phosphate and carbonate; this process represents one form of calcification. Bone tissue has cells peculiar to it, while for the most part the cells common to loose connective tissue are lacking. Bone, as a tissue, has important functions, largely concerned with storage and metabolism of calcium and phosphate. The individual bones are organs, characterized by the bone tissue of which they are formed; together with the joints they form the skeleton or framework of the body of most vertebrates. They serve to house a blood-forming tissue—the bone marrow (*q.v.*)—and to protect vital organs of the body, notably the brain and spinal cord.

Structure.—Most bones, and especially the long bones, are made up of two types of structure (*see* fig. 1). The shafts, or diaphyses, are formed of compact bone; the expanded ends, or epiphyses, usually include a vaulted structure of spongy or cancellous bone, with a thin cortex, or outer layer, of compact bone; this arrangement serves to transfer weight and stress from the shafts of the bones to the joints. The internal structure of compact and of spongy bone is identical.

The haversian system, or osteone, is the unit of structure of bone. This is irregularly cylindrical and branching, of microscopic

size, with thick walls and a narrow canal, carrying one or more small blood vessels, and is usually oriented in the long axis of the bone (*see* fig. 2). The walls of the osteones are made up of concentric layers or lamellae, the form and structure of the unit being given to it by the fibrous protein, collagen; this substance makes up more than 90% of the dry fat-free weight of the organic matter of bone, and yields glue or gelatin when boiled. The haversian system, in addition to being arranged around a central canal, includes large numbers of lacunae, or small spaces, housing cells and being interconnected by a network of canaliculi, or minute canals; these are the channels by means of which the fluids derived from the blood reach and nourish the bone tissue.



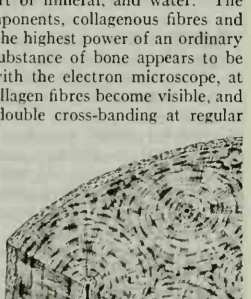
DRAWN BY E. BOHLMAN PATTERSON

FIG. 1.—DRAWING OF A LONGITUDINAL SECTION THROUGH THE NECK AND SHAFT OF A HUMAN FEMUR SHOWING THE STRUCTURE OF SPONGY AND OF COMPACT BONE. REDUCED ½

Cells.—The cellular components of bone are associated with specific functions: osteoblasts, located on bone surfaces, with the formation of bone; osteocytes, located in the lacunae, with the maintenance of bone as a living tissue; and osteoclasts, on the surfaces of bone, with its destruction or resorption. These cells, having common ancestors, are closely interrelated. The bones are surrounded by a membrane, the periosteum; their marrow cavities, which serve also to provide the bones with maximum strength at minimum weight, are lined with a similar membrane, the endosteum. The cells of these membranes have bone-forming capabilities, which are called into play during the normal growth of the skeleton and during the healing of fractures; when these cells are engaged in the formation of bone they assume the appearance, as well as the functions, of osteoblasts.

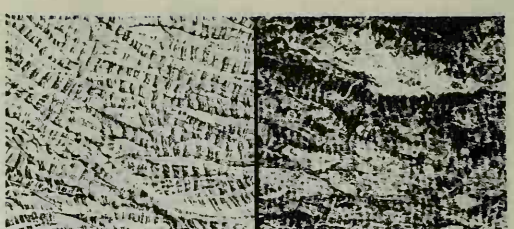
Interstitial Substance.—The intercellular or interstitial portion of bone is a calcified collagenous substance that makes up its great mass. The interstitial substance includes the organic framework or matrix, the inorganic part or mineral, and water. The organic matrix has two chief components, collagenous fibres and a ground substance. Even under the highest power of an ordinary light microscope the interstitial substance of bone appears to be homogeneous, but when viewed with the electron microscope, at much higher magnifications, the collagen fibres become visible, and are seen to be characterized by double cross-banding at regular intervals, averaging 640 angstrom units (one angstrom unit equals one ten-millionth of a millimetre) (*see* fig. 3a). The space between the fibres is filled with crystals of bone mineral, and a semifluid ground substance, also called cement substance.

The bone mineral, commonly called the bone salt, is mainly in the form of extremely minute and difficultly soluble crystals, averaging about 500 angstrom units in length. These are thin, hexagonal tablets (*see* fig. 4), and are arranged in a periodic pattern in bands around the collagen fibres, with the long axes of the crystals oriented in the direction of the fibres. The location of the bands of crystals corresponds to the cross-banding of the fibres which they surround (*see* fig. 3b); this arrangement in space suggests that certain characteristics of the collagen fibres are instrumental in determining the location, formation and growth of the crystals.



DRAWN BY E. BOHLMAN PATTERSON

FIG. 2.—THREE-DIMENSIONAL DIAGRAM OF HAVERSIAN SYSTEMS, OR OSTEONES, OF BONE. (MAGNIFIED ABOUT 90 TIMES)



A B

DRAWN BY E. BOHLMAN PATTERSON AFTER ROBINSON AND WATSON

FIG. 3.—DRAWINGS OF ELECTRON MICROGRAPHS ILLUSTRATING COLLAGEN FIBRES OF BONE: (A) FROM DECALCIFIED SECTION SHOWING CROSS-BANDING OF FIBRES; (B) FROM SECTION WITHOUT DECALCIFICATION, ILLUSTRATING RELATION OF CRYSTALS OF BONE MINERAL TO COLLAGEN FIBRES. UNDERLYING COLLAGEN IS BARELY VISIBLE, BUT CRYSTALS ARE SEEN IN BANDS CORRESPONDING TO COLLAGEN STRIATION. MAGNIFIED 20,000 TIMES

The crystal structure and chemical composition of the bone salt are approximated by the formula:

$$3Ca_3(PO_4)_2 \cdot Ca(OH)_2 \quad \text{(hydroxyapatite)}$$

The lattice of the crystal is identical in structure with that of others of the apatite series of minerals, widely distributed in nature; this structure is responsible for the characteristic pattern revealed by X-ray spectroscopy. Between the crystals, and on their surfaces, are ions not included within the lattice structure. It is as though the bone is built up of bricks and mortar, rather than as a monolith of a homogeneous substance. The bricks are the crystals of hydroxyapatite, the mortar consists chiefly of citrate and carbonate, with an admixture of other ions. The collagen fibres, also between the crystals, serve as reinforcing strands.

Osteogenesis.—Bone always arises, both in fetal and postfetal life, by a transformation of connective tissue. Formation of bone may be preceded by the laying-down of a cartilage model, or it may occur by direct transformation of fibrous tissue. When bone is formed in such a manner as to replace cartilage, itself a connective tissue, the process is intracartilaginous ossification; when the transformation is direct, without the presence of cartilage, it is intramembranous ossification. Both forms of ossification take place during growth and in the healing of fractures.

In bones which have been preformed in cartilage (*q.v.*) a portion of the cartilage persists throughout the period of growth, as a cartilage plate, the epiphyseal cartilage. This cartilage continues to grow, and is constantly replaced by bone, resulting in the growth in length of the bones. The cartilage with its surrounding tissues, also contributing to growth, has been called the growth apparatus. Increase in the diameter of the bone occurs by another process, involving continual erosion or resorption from within the marrow cavity, and formation of new bone, by apposition, on the outer or periosteal surface.

Calcification of bone tissue is effected by the deposition of bone mineral in the organic bone matrix, and ordinarily occurs simultaneously with the formation of the collagenous fibres of the matrix. For calcification to occur, certain conditions must be present, some humoral and others local. The humoral conditions embrace the supply and transport of the necessary minerals and their delivery to the locus of calcification in the concentrations required. The local conditions include whatever it is that differentiates a calcifiable from a noncalcifiable tissue. Since several interrelated factors, not well understood, appear to be involved, it is convenient to refer to a local mechanism. Calcification is best described as crystal formation and growth.

Physiology.—The fact that the bone salt is difficultly soluble is of far-reaching physiologic significance. This property not only

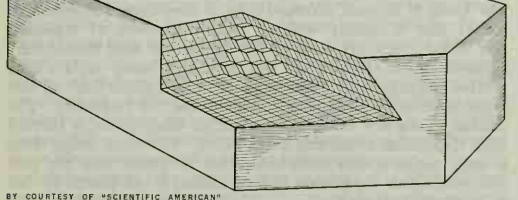
determines the deposition of the bone mineral; it also preserves the structure and rigidity of the bones. Moreover, it is of first importance in maintaining the balance of minerals between the skeleton and the fluids of the body. The adult organism as a whole is normally in a state of approximate calcium balance; *i.e.*, the output of calcium is equal to the intake. There is a constant turnover of the bone mineral, and since the bones account for by far the greater part of the body's store of calcium, an over-all calcium balance means that the rates of deposition and of solution of the bone mineral are also in balance.

The regulation of the transfer of calcium ions between the blood and the bones, in both directions, is the essential feature in the homeostatic regulation of the calcium ion concentration in the blood plasma. The maintenance of this concentration at an approximately constant level is necessary for proper functioning of the heart and of the neuromuscular system, and for the clotting of blood, and thus for life itself. This regulation is mediated by the parathyroid glands (*q.v.*), four tiny bodies embedded in the posterior surface of the thyroid gland.

Remodeling of the haversian systems, which continues throughout the life of the animal, is closely related to the regulation of the exchange of calcium between the blood and the bones. This consists in the formation of tunnels through compact bone, to be subsequently filled in by new haversian systems, by deposition of concentric lamellae on the walls of the tunnel, continuing until only the usual small haversian canal remains. During this remodeling the new bone under formation remains reactive and readily accessible to the circulation over periods of months or more. Except for this process compact bone would become fully mineralized and inert or nonreactive. Even in elderly people remodeling provides a continuous supply of new and reactive bone, able to transfer calcium to the blood as needed by the organism.

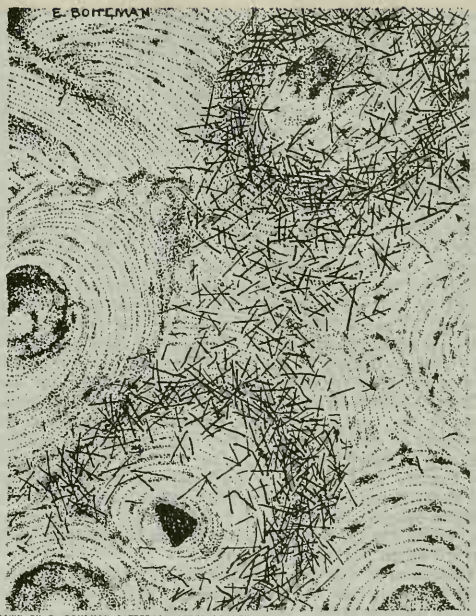
Resorption of bone is, in essence, the putting into solution of a complicated structure, in such a fashion that it disappears, its end products entering the blood stream. It always progresses inward from the surfaces of bone; it never arises within the deeper layers; there is no interstitial resorption of bone. Formation of new bone and resorption are complementary processes; they ordinarily occur in close relation to one another, and both are essential to the growth of bone and to its constant remodeling. Resorption of bone is partially under the control of the parathyroid glands, which mediate the return of calcium from the bone to the blood by destruction of mineral-containing bone tissue. The resorption of bone serves also a second function; *i.e.*, of growth and reconstruction of bone, including haversian remodeling; the resorption taking part in this function, in contrast to that responsible for the regulation of the calcium content of the blood, does not appear to be dependent upon parathyroid activity.

Radioactive Elements and Bone.—Accidental poisoning by radium had been recognized by the 1920s. Later, the introduction of artificially produced radioactive elements, including the fission products of the atom bomb, materially increased the hazards from radioactivity. The situation is made worse by the fact that many



BY COURTESY OF "SCIENTIFIC AMERICAN"

FIG. 4.—DRAWING OF A MODEL OF A CRYSTAL OF HYDROXYAPATITE. THE MODEL IS 50 CM. LONG, 25 CM. WIDE AND 8.5 CM. THICK, AND REPRESENTS A MAGNIFICATION OF 10,000,000 TIMES. CUTOUT ILLUSTRATES PATTERN OF INTERNAL STRUCTURE OF CRYSTAL



DRAWN BY E. BOHLMAN PATTERSON AFTER LOONEY AND WOODRUFF

FIG. 5.—CROSS SECTION OF BONE FROM A WOMAN GIVEN RADIUM WATER 22 YEARS BEFORE HER DEATH, ILLUSTRATING DISTRIBUTION OF RADIUM IN COMPACT BONE. SHORT RODS ARE TRACKS OF ALPHA PARTICLES, RECORDED ON PHOTOGRAPHIC FILM, FROM DISINTEGRATION OF RADIUM ATOMS. (MAGNIFIED ABOUT 170 TIMES)

of the radioactive elements, especially radium and strontium, have an affinity for the skeletal system, where they may remain fixed for long periods of time (*see* fig. 5), during which they cause damage to the bone marrow and to the bone tissue itself. One of the unfavourable results of long continued internal radiation from radium deposited in the bones has been the occurrence of bone sarcoma, a form of malignant tumour. *See* BONE, DISEASES AND INJURIES OF; BONE MARROW; CONNECTIVE AND SUPPORTING TISSUES; SKELETON, VERTEBRATE; *see* also references under "Bone" in the Index volume.

See F. C. McLean and M. R. Urist, *Bone: an Introduction to the Physiology of Skeletal Tissue* (1955); A. A. Maximow and W. Bloom, *Textbook of Histology*, 7th ed. (1957). (F. C. McL.)

BONE, DISEASES AND INJURIES OF. Diseases and injuries of bone may conveniently be discussed under five headings: congenital defects, metabolic disturbances, infections, tumours and fractures.

Congenital Defects.—Of unknown cause, congenital defects range from absence, reduplication, misplacement or deformity of a part to permanent inability to form good skeletal tissues. When the development of cartilage is affected, longitudinal growth of long bones is always abnormal and deformities, if not present at birth, appear in time. The most familiar example of this sort of disturbance is the circus dwarf with his large head, long trunk and short extremities. Defects of bone formation are seen in osteogenesis imperfecta (brittle bones), with its multitudinous fractures, in osteopetrosis (marble bones), in which bone grows dense at the expense of the blood-forming marrow, and in fibrous dysplasia, in which bone becomes replaced by soft fibrous tissue.

The osteochondroses are little-understood disorders of growth in which the bony centre of one or another epiphysis (*see* BONE: *Structure*) appears to die. This is most commonly seen in the upper femoral epiphysis (hip joint) where the condition is known as Legg-Perthe's disease. If these areas of dead bone are sufficiently protected from stress they are eventually replaced by new

living bone and good function can be expected.

Another growth disturbance, common among adolescent boys, also affects the hip joint. Sometimes the entire epiphysis migrates slowly upon the neck of the femur in the region of the epiphyseal cartilage. This condition of epiphyseolysis (slipped epiphysis) can be treated rather simply if it is seen early. If a marked deformity has already been produced, major surgical reconstruction is necessary. (*See* also ORTHOPEDIC SURGERY: *Methods and Procedures.*)

Metabolic Disturbances.—Bones are living, active organs that are constantly being destroyed and rebuilt at the same time. Under normal conditions these two processes are in equilibrium. Bones faithfully reflect the general condition of the tissues they support, and therefore anything that interferes with a person's metabolism has an effect on his skeleton. Deficiencies of vitamin C or D are followed by scurvy and rickets respectively. Dysfunction of the parathyroid gland, the kidney, the gastrointestinal tract, the adrenal glands—in fact of almost any organ or system—may produce changes in the bones. In these cases, treatment is directed toward the underlying disease and healing of the bone follows. Unless there are such specific constitutional disturbances, however, the normal physiologic processes of the skeleton are unaffected by diet. Neither are they affected by age except that the ratio of rebuilding to destruction is slowly altered so that the absolute mass of bone is eventually less. Thus, although the chemical composition of the bone remains the same, the total skeleton becomes less heavy and more delicate. This is one of the reasons why the bones of elderly persons tend to break easily but still repair themselves adequately.

Infections of bone may be caused by any infectious agent but most commonly they result from pyogenic (pus-forming) organisms or tubercle bacilli. Pyogenic osteomyelitis was one of the major orthopedic problems before the introduction about 1940 of the chemotherapeutic and antibiotic drugs (sulfonamides, penicillin, aureomycin, etc.). Thereafter acute osteomyelitis, which results from spread of organisms via the blood stream from another site (abscess, infected ear, etc.), became a relatively rare disease. Furthermore, when it does occur, it is not often a serious threat to life or limb and it is much easier to manage. Judicious surgical treatment combined with drug therapy can in most instances effect a cure while avoiding the distressing complications that once were commonplace.

The antibiotic drugs (streptomycin, etc.) also helped in the treatment of tuberculous osteomyelitis. Since this disease is always secondary to a focus elsewhere in the body, treatment of the skeletal focus must be correlated with treatment of the patient's general condition. It is imperative also to investigate the pulmonary status of both the patient and his contacts.

While solitary tuberculous abscesses of bone are seen occasionally (and often cured by surgical excision), tuberculous osteomyelitis is usually associated with infection in a neighbouring joint. Most commonly involved are spine, hip and knee, but no site is immune. Sanatorium treatment of tuberculosis of bone and joints (by diet, rest, fresh air and sunlight) used to be standard and remained popular in Europe.

About 1920 surgical removal of tuberculous lesions began to be recognized as a more certain means of arresting the disease and of hastening rehabilitation of the patient. Most authorities in the United States came to believe that the treatment of choice is definitive surgical intervention as soon as the patient's general condition permits. This may involve excision of diseased tissue together with fusion (stiffening) of the affected joint. (*See* also TUBERCULOSIS: *Non-Pulmonary Tuberculosis.*)

Tumours of bones are not common. The relatively few benign ones are amenable to surgical removal. Carcinoma (cancer) never develops originally in bone but often spreads to bone from other sites. Patients with such a spread to the bones usually have pain and disability. There is no known treatment that will effect a cure but much can be done to prolong life and make the patient comfortable. The malignancies that do arise in bone are known as sarcomas. Although any of the component tissues may give rise to a malignancy, the three main types are those that form fibrous tissue, bony tissue or cartilaginous tissue. In the treatment of these tumours, the only hope of cure is eradication of the whole process by adequate early surgical excision. This may necessitate amputation but often a limb can be saved by cutting out the involved tissues and substituting a graft from a healthy bone. Irradiation, chemotherapy, isotopes, etc., are useful for palliation or in the treatment of inaccessible lesions, but they had not proved curative by the early 1960s. (*See* also CANCER: *Symptoms and Course of Certain Common Cancers;* TUMOUR: *Clinical Manifestations.*)

Fractures (breaks) are the commonest type of injury to bone. Ordinarily they result from considerable violence, but when a bone is abnormal (softened by disease or grown fragile with age) fractures may follow trivial accidents or even occur spontaneously (pathologic fractures). If the soft tissues are damaged so that the fracture communicates with the external air, the fracture is said to be open (compound); otherwise, it is a closed (simple) fracture. The presence of a fracture is not difficult to suspect and indeed is often evident, but only the roentgenogram (X-ray) will reveal details. (*See* also FRACTURES AND DISLOCATIONS.)

The principles of treatment of any fracture are to bring the fragments back as nearly as possible to their anatomic position and to hold them in that position until bony union has occurred. Whether or not implementing these principles is easy or even possible depends upon a number of factors, such as the age and general condition of the patient, the site of the fracture, etc.

It is true that fractures heal more easily in children than in adults and, in addition, that the subsequent growth of a child tends to remodel and erase any deformity from a fracture. Therefore, in general, a less accurate reduction is acceptable in a child than in an adult and a shorter period of immobilization usually is required. Moreover, in children stiffness does not tend to develop in joints that are immobilized, so that convalescence is short. On the other hand, if the epiphyseal plate has been injured, subsequent growth in length may be unequal or even completely arrested. Occasionally, stimulation of an epiphysis near to, but not involved by, a fracture will result in overgrowth of an extremity. Such uneven growth may be corrected through appropriate surgical measures. It is seldom necessary to resort to operation to treat children's fractures.

Fracture of a major bone in an adult is another matter. Many breaks, such as the common ones of the wrist, are usually treated by simple manipulation and immobilization in plaster. When this is impossible traction may be helpful but often the quickest, safest and most economical way to handle the matter is to operate upon the patient, fix the pieces of bone together and fasten them with metal appliances. If the fracture has involved a joint surface open reduction is imperative, because a perfect fit must be obtained. This is specialized surgery, and the decision as to what to do and how to do it must be made individually for each patient. While one fracture demands a cast, another will need traction and a third will need exercises and special treatment to restore function. If, as sometimes happens under the most favourable of circumstances, the bone unites slowly or refuses to unite at all, the surgeon will probably operate again and employ some bone-grafting procedure to stimulate healing.

If there is no interference by unwise treatment, infection or other complications, fractures tend to heal in an orderly fashion. The break is at once surrounded by a hematoma (collection of blood) that is rapidly replaced by the ingrowth of organized scar tissue. Although some of the cells in the bone immediately adjacent to the fracture site will have died, many surface cells survive and proliferate. New bone, therefore, grows from all surfaces, replaces the dead bone and unites the two fragments. The calcium in the new bone, like that of all other bones, is derived from the calcium circulating in the blood. Therefore, unless there is some constitutional disturbance that interferes with the general metabolism, the process of bone healing is not altered by diet or by advancing years.

There are certain fractures that by their very nature are especially difficult. In general, fractures through compact bone heal more slowly and less satisfactorily than fractures through spongy

bone. Also, fractures that have entered joints always give more trouble, because although the bone heals with perfect bone, the cartilaginous surfaces cannot repair themselves so efficiently. Bones such as the astragalus (ankle), carpal navicular (small bone in the wrist) and neck of the femur (hip) often break in such a fashion as to interfere with the blood supply. When this occurs, the portion of bone so deprived dies, no matter how well the fracture has been reduced and fixed.

Under these circumstances union of the fracture is difficult to obtain and, even if it occurs, the dead bone must be protected for a long time in order for complete replacement by living bone to result. In the absence of such protection, complications such as painful degenerative arthritis can be expected. In such cases various surgical procedures can be performed to improve function, but the final outcome is usually less than perfect.

Fractures about the hip, which usually occur in elderly persons, are often difficult to handle even under the best circumstances. A high percentage of these breaks will heal with the ordinary methods of fixation, but for those that do not special methods of handling have been devised. Among the most commonly employed are various osteotomies (surgically cutting or removing a piece of bone) designed to change the position of the fragments, certain bone-grafting procedures and the use of metal or synthetics to replace damaged joint surfaces. None of these methods is without its own complications and none is applicable to every fractured hip. It must be emphasized again that treatment must always be individualized.

See ANEMIA; RADIOLOGY: *Bones;* BONE MARROW; *see* also references under "Bone, Diseases and Injuries of" in the Index volume.

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BONE BED, a rock stratum or deposit which contains bones. The term is applied not only to those layers occurring at definite geological horizons, but also to the brecciated and stalagmitic deposits found on the floors of caves. The stratified deposits are frequently associated with stream bedding and probably indicate a sorting out and segregation of the heavier bony material accompanying partial or complete removal of the finer sediment by the action of currents.

A well-known bed is the Agate Springs bone bed, composed of disarticulated bones and teeth of extinct mammals, especially rhinoceroses, of Lower Miocene age, in western Nebraska.

BONE MARROW, or myeloid tissue, is located in the cavities of the bones. It produces the blood platelets and all the cells of the peripheral blood (circulating outside the marrow cavities), with the exception of the lymphocytes which are normally produced by the lymphatic tissue. (*See* BLOOD: *Cells of the Blood.*) In man, at birth, the bone marrow or myeloid tissue has a volume averaging 67 c.c. or 2.3% of the total body weight. In the adult human being, bone marrow volume varies between 1,600 c.c. and 3,700 c.c., or 2.1%–4.9% of the total body weight. In general, its volume is larger in the male than in the female.

Bone marrow is of two types, red and yellow. The difference in colour is based on the preponderance of either fat tissue (yellow) or blood-forming tissue (red). In man, at birth and until about the age of seven, bone marrow is red in colour. Gradually the fat content increases at the expense of the red bone marrow. In the adult the red bone marrow is present only in the bones of the skull, breastbone, ribs, collarbone, spinal column and in the proximal portion of the thighbone and upper arm bone. Under certain conditions, as after serious blood loss or increase in temperature, yellow bone marrow may change into red bone marrow. A similar change may occur in diseases that are accompanied by an increase in the blood-forming activity of the bone marrow.

Microscopically the bone marrow consists of a three-dimensional network of special connective tissue fibres, the reticular fibres, to which adhere outstretched reticular cells. These two components constitute the stroma of the bone marrow. Two types of reticular cells are distinguished: fixed macrophages and primitive reticular cells. The fixed macrophages have the ability to phagocytose or take up particulate materials from the blood stream. The primitive reticular cells can change into macrophages or can develop into blood cells. In the stroma of the bone marrow are the fat cells which, as mentioned above, give the bone marrow a yellow colour when present in large numbers. Mature red blood cells, called erythrocytes, and granulated white blood cells, the granulocytes or granular leukocytes, as well as the immature precursors of all these cells, are present in the meshes of the network of cells and fibres. Both cell series of erythrocytes and granulocytes are derived from a common stem cell called by some a myeloblast and by others a lymphoblast. According to the dualistic theory of blood formation, the stem cell of the myeloid elements (myeloblast) of the blood is essentially different from the stem cell of the lymphocytes (lymphoblast). Since no constant morphologic or physiologic differences between the stem cell of the bone marrow and the lymphocytes have been demonstrated and since the so-called lymphoblast is not essentially different from a lymphocyte, the proponents of the unitarian or monophyletic theory of blood formation reject the names myeloblast and lymphoblast for stem cells and call the bone marrow stem cell hemocytoblast.

As the bone marrow stem cell develops into the red blood cell, hemoglobin accumulates in the cytoplasm. The erythrocyte precursors which contain hemoglobin as well as nucleic acid in the cytoplasm stain in ordinary blood preparations with a colour which is a mixture of the pink-staining hemoglobin and the blue-staining nucleic acid and are consequently called polychromatophilic erythroblasts. In them the amount of hemoglobin increases gradually at the expense of the nucleic acid. At the same time the nucleus becomes very dark and round and the resulting cell is called normoblast. From this cell the mature nonnucleated erythrocyte arises by either extrusion or dissolution of the nucleus.

The granulocytes are formed from the bone marrow stem cell by the elaboration of granules in the cytoplasm and characteristic changes in the nucleus. Depending on the properties of the cell ultimately produced, the granules become heterophile (neutrophile; staining indifferently with acidic or basic dyes), eosinophile (staining with acidic dyes; *e.g.*, eosin) or basophile (staining with basic dyes; *e.g.*, methylene blue) in their reaction to dyes. These immature forms of the granular leukocytes are called myelocytes.

Dispersed between the blood cells and fat cells are the megakaryocytes. It is generally believed that these giant cells produce the blood platelets by the process of pinching off small fractions of their protoplasm.

The peripheral blood is fed new cells via the arteries into the bone marrow and then into large thin-walled vessels, the sinusoids, which drain into the veins. (*See* BONE.) The cells which form the walls of the sinusoids are different from the ordinary endothelial lining of the blood vessels but they are similar to the macrophagic reticulum cells in that they have the ability to phagocytose. These lining cells, which are named littoral cells, can free themselves from the wall, round off and become free macrophages in the lumen of the sinusoid.

In man, after early embryonic stages, blood formation takes place extravascularly, or outside the blood stream. In birds and in reptiles erythropoiesis, or formation of red blood cells, takes place intravascularly, while the granulocytes are formed extravascularly. In the evolutionary series, bone marrow appears first in the tailless group of amphibians, familiar members of which are frogs and toads. In lower vertebrates, blood-cell formation occurs in a great variety of organs such as the spleen, kidney, liver, heart, mucous membranes of the intestine, sexual glands, etc.

The maturation of the erythrocytes is determined in part by the antianemic factor present in the liver. If this antianemic factor is absent, the production of erythrocytes is inhibited and the disease pernicious anemia results. Administration of the antianemic factor restores the maturation process. (*See* ANEMIA.) The production of erythrocytes is enhanced when the amount of oxygen in the environment is reduced, such as occurs at high altitudes. Certain chemical substances, such as cobalt, have a similar effect. Under pathologic conditions, large changes may occur in the bone

marrow. (*See* BLOOD, DISORDERS OF.) For diagnostic purposes, samples of the bone marrow can be removed by puncture of the breastbone and aspiration of the bone marrow by means of a syringe, a technique called sternal puncture.

All forms of ionizing radiation (X-rays, etc.) have a deleterious effect on the bone marrow with a consequent reduction of the number of cells in the peripheral blood. In animal experiments, it was found that administration of bone marrow cells, and also of other organs such as the spleen, after irradiation enhances the regeneration of the blood-forming organs, including the bone marrow, and in addition has a protective effect on the individual as a whole. *See also* BLOOD; LYMPH AND LYMPHATIC SYSTEM; CONNECTIVE AND SUPPORTING TISSUES; BONE, DISEASES AND INJURIES OF.

See A. A. Maximow and W. Bloom, *A Textbook of Histology*, 7th ed. (1957). (P. P. H. DE B.)

BONER (BONERIUS), **ULRICH** (fl. 1324–1349), Swiss writer and Dominican monk, whose collection of 100 fables in verse was very popular in the middle ages and was the first book to be printed in German (Bamberg, 1461). Boner is mentioned in records between 1324 and 1349 and is known to have been of Bernese family. His fables, referred to as *bîschaft* or *bîspel* ("examples"), were written in Middle High German and probably completed about 1350. They were entitled *Der Edelstein* ("The Precious Stone"), since their effect was intended to resemble that of the spell cast by precious stones. Although Boner names only two of his sources—Aesop's *Fables* and Avianus—it is clear that he also drew on other material.

The form of the *Edelstein* is of particular interest. It begins with a prologue and ends with an epilogue, the one including an opening and the other a closing prayer. The themes of the first four fables are closely linked with the ideas expressed in the prologue on the duties of youth; and the gloomy, *respice finem* mood of the epilogue is anticipated in the last nine fables. Within this framework are two groups of stories: an Aesop group (fables 5–62) and an Avianus group (fables 63–91). In the Aesop group the moral, which embodies the author's own practical wisdom, is generally loosely attached to the story, whereas in the Avianus group the moral is directly derived from the story and inculcates general moral precepts.

Der Edelstein was edited by G. F. Benecke (1816), and also by F. Pfeiffer, in *Dichtungen des deutschen Mittelalters*, vol. iv (1844). Selected fables have been translated into modern German by M. Oberbreyer (1881) and K. Pannier (1895).

See R. H. Blaser, *Ulrich Boner, un fabuliste suisse du XIVe siècle* (1949). (R. H. BL.)

BONESET (*Eupatorium perfoliatum*), a North American plant of the Compositae (*q.v.*) family. It is also called thoroughwort, agueweed and Indian sage, and is common in wet places from Nova Scotia to Manitoba and southward to Florida and Texas. It is a coarse, rough, hairy perennial, two to six feet high, with lance-shaped, toothed and wrinkled leaves, four to eight inches long, which are joined together at their bases around the stem. In August the plants bear small, tubular, white flowers in numerous heads which are arranged in a flattish much-branched cluster four to seven inches wide.

PHOTOGRAPH, J. HORACE MCFARLAND CO.

BONESET (EUPATORIUM PERFOLIATUM)

See also EUPATORIUM.

BO'NESS (BORROWSTOUNNESS), a small burgh and seaport of West Lothian, Scot., lies on the southern shore of the Firth of Forth, 18 mi. by road N.W. of Edinburgh opposite Culross. Pop. (1961) 10,194. It has an extensive harbour exporting coal and importing pit props, phosphates, etc., but its trade has been limited by the development of the port of Grangemouth. The chief industry is coal mining, some of the pits extending a long distance below the firth. Fertilizers and earthenware are manufactured. Traces of the Roman Antonine wall (*q.v.*) known as Graham's or Grime's dike lie south of the town. The estate of Kinneil house is now a public park and the house (where the mural paintings have been restored) is an "ancient monument." James Watt developed his invention of the steam engine in the park.

BONFILS, FREDERICK GILMER (1860–1933), U.S. publisher, was born in Troy, Mo., Dec. 21, 1860. He entered the U.S. military academy in 1878 but resigned in 1881. With Harry H. Tammen (1856–1924) he purchased the *Denver Post*, a daily newspaper, in 1895. They dedicated the paper to "the service of the people" and conducted spirited crusades against crime and corruption which brought them into national prominence. Their activities often involved them in lawsuits and in 1900 in an attempt upon their lives by an irate lawyer. The *Post*, above whose building door they inscribed "O Justice, when expelled from other habitations, make this thy dwelling place," became an influential and widely circulated newspaper under their direction. Bonfils died on Feb. 2, 1933, in Denver. (H. J. SG.)

BONFILS, HENRY (JOSEPH FRANÇOIS XAVIER) (1835–1897), French jurist born at Montpellier on July 31, 1835, became professor and eventually dean (1879–88) of the faculty of law at the University of Toulouse. His early work was concerned with the teaching of private law. The first edition of his book on international law, *Manuel de droit international public*, appeared in 1894. As Bonfils states in his preface, this book is not a dogmatic treatise: it is rather an investigation of precedents in the light of history, discovering the origin and the development of the customary rules from their first hesitant application to their ultimate consolidation, examining the divergent opinions of lawyers about them and determining their true significance. Written at a time when international law was regarded as being the sum of the rules governing the relations between sovereign and independent states, Bonfils' book became progressively out-of-date as the concept of interdependence grew stronger. The work of making the necessary changes in it fell to Paul Fauchille (*q.v.*). Bonfils died at Toulouse in 1897.

(ML. ST.)

BONFIRE, a large fire lit in the open air. The earliest known instance of the derivation of the word occurred as *ban fyre ignis ossium* in the *Catholicon Anglicum* (1483). Other derivations have been sought for the word. Thus some have thought it *Baal fire*, passing through *Bael*, *Baen* to *Bane*. Others have declared it to be *boon* fire, a "contribution" fire, everyone in the neighbourhood contributing a portion of the material.

Whatever its origin, the word has long had several meanings: (1) a fire of bones; (2) a fire of corpses, a funeral pyre; (3) a fire for immolation, such as that in which heretics and proscribed books were burned; (4) a large fire lit in the open air on occasions of national rejoicing or as a signal of alarm, such as the bonfires which warned England of the approach of the Armada. Throughout Europe the peasants from time immemorial have lighted bonfires on certain days of the year, and danced around or leaped over them. The earliest proof of the observance of these bonfire ceremonies in Europe is afforded by the attempts made by Christian synods in the 7th and 8th centuries to suppress them as pagan. Thus the third council of Constantinople (680), by its 65th canon, orders: "Those fires that are kindled by certaine people on new moones before their shops and houses, over which also they use ridiculously and foolishly to leape, by a certaine antient custome, we command them from henceforth to cease." Leaping over the fires is mentioned among the superstitious rites used at the Palilia (the feast of Pales, the shepherds' goddess) in Ovid's *Fasti* (*q.v.*). The lighting of the bonfires in Christian festivals was significant of the compromise made with the heathen by the early church. In Cornwall bonfires are lighted on the eve of St. John the Baptist and St. Peter's day; sometimes effigies are burned in these fires, and there are grounds for believing that in ancient times human sacrifices were actually made in the bonfires. Spring and midsummer are the usual times at which these bonfires are lighted, but in some countries they are made at Halloween (Oct. 31) and at Christmas.

BONGARS, JACQUES, Sieur de la Coudrière (1554–1612), French diplomat who was also a classical scholar and the compiler of a celebrated history of the crusades, was born at Orléans in 1554. A Huguenot, he studied in Germany before going to Italy and Constantinople in pursuit of learning. From 1586 the king of Navarre (the future Henry IV of France) sent him on missions to obtain men and money from the German princes and from Elizabeth I of England. When Fabian von Dohna blamed the Huguenots for the defeat of the German troops that he led into France in 1587, Bongars composed a violent pamphlet against him. As French minister in Germany (1593–1610), he tried to unite the Protestant princes in a league with James I of England at its head. He died in Paris on July 29, 1612.

Bongars published an edition of Justin's works in 1581 and a French translation of Aristaenetus in 1597 and prepared an edition of Quintus-Curtius (not published until 1696). He was interested, however, not only in classical writings but also in medieval chronicles. His collection of historical works on Hungary (1600) was followed, in 1611, by the far more important *Gesta Dei per Francos* ("God's Work Through the Franks"), a collection of the contemporary accounts of the crusades together with Marino Sanuto's *Secreta Fidelium Crucis*. An edition of his letters, in Latin, appeared in 1647, a French translation of them in 1668–70. His diary of his journey to Constantinople and the pamphlet against Dohna were printed in 1874.

See H. Hagen, *Jacobus Bongarsius* (1874); Roman d'Amat, article in *Dictionnaire de biographie française,* vol. vi (1954). (J. B. R.)

BONGO, a Negro people once extensive in southwestern Republic of the Sudan, now found in small, scattered settlements south and east of Wau. Lack of co-operation among sections, living separated by miles of bush, was decisive in their decimation by waves of invaders since the 18th century. Chiefs had little authority although they were consulted in important legal and social matters.

The Bongo now live along roads, subsist largely on the cultivation of sorghum, eleusine, sesame and tobacco; they domesticate dogs, chickens, and a few sheep and goats. Famed as hunters, they spend each dry season hunting and fishing. They use poisoned arrows and spears, in addition to nets, traps and snares. Wild fruits, roots and fungi are eaten. Noted for their metalwork, the Bongo supplied neighboring peoples with iron tools until imported iron stopped smelting of local ores. They are fond of music played with flutes, drums, horns and large wooden trumpets.

See P. T. W. Baxter and Audrey Butt, *The Azande and Related Peoples of the Anglo-Egyptian Sudan and Belgian Congo,* pp. 130–135 (1954). (C. C. R.)

BONGO (*Taurotragus* [subgenus *Boöcercus*] *eurycerus*), a large African antelope (*q.v.*). Both sexes bear large horns that spiral in one complete twist; the rich chestnut body is marked with narrow vertical white stripes, the chest with a white crescent. The bongo, one of Africa's wariest animals, is related to the bushbuck and lives in dense forests.

BONHEUR, ROSA (Marie Rosalie) (1822–1899), French painter of animal subjects, was born at Bordeaux on March 16, 1822, the daughter of an art teacher, Raymond Bonheur. She was taught by her father and studied in Paris under Léon Cogniet. Her animal paintings are notable for the firm handling of the subjects and the remarkable accuracy of the drawing. Toward the end of her career she developed a more highly polished surface finish reminiscent of Paul Potter. A regular *salon* exhibitor from 1841 onward, she won a first class medal for "Ploughing in the Nivernais" (Luxembourg gallery, Paris) in 1848. Her "Horse Fair," exhibited in 1853, was acquired for a record sum in 1887 by C. Vanderbilt, who presented it to the Metropolitan museum, New York (replica in National gallery, London). Rosa Bonheur was a strong, unconventional personality, and when at home used to wear trousers and smock, and smoke cigarettes. At one time she kept a lioness, and in the period immediately after the Franco-German War she would paint only wild animals such as lions, tigers and wolves. In 1894 she became the first woman to receive the Grand Cross of the Légion d'Honneur. She died at By, near Fontainbleau, on May 25, 1899.

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BONHOEFFER, DIETRICH (1906–1945), German Lutheran pastor who taught a controversial theology, was born in Breslau on Feb. 4, 1906. He studied under Adolf von Harnack in Berlin, and was influenced by Karl Barth (*q.v.*). Protesting against the anti-Jewish legislation forced upon his church in 1933, he left Germany to minister to German congregations in London but returned to become head of a theological college. Shortly before World War II he was lecturing in the United States, but returned to Germany. He became involved in the German resistance movement and in 1942 met in Stockholm his friend Bishop G. K. A. Bell (*q.v.*), to whom he revealed plans for Hitler's overthrow. He was arrested on April 5, 1943, and hanged in the concentration camp at Flossenbürg on April 9, 1945.

In his early writings Bonhoeffer is concerned with the theological and sociological implications of the church (*Sanctorum Communio,* 1930) and of Christian obedience (*Nachfolge,* 1937; Eng. trans. *The Cost of Discipleship,* 1948). In his *Ethik* (1949; Eng. trans. 1955) and his *Widerstand und Ergebung* (1951; Eng. trans. *Letters and Papers From Prison,* 1953; U.S. ed. *Prisoner for God,* 1954), he outlines a highly individual interpretation of biblical concepts in a world that has come of age, in which neither metaphysical nor psychological categories are adequate. These works show the way to a revolution in the understanding of Christian belief, not in a separate "religious" realm but in a dialectical identity with this world and with Christ as one who is, in suffering, absolutely for this world.

See E. Bethge (ed.), *Die Mündige Welt,* vol. i–iv (1956 *et seq.*); J. D. Godsey, *The Theology of Dietrich Bonhoeffer* (1961). (E. Be.)

BONIFACE (Wynfrith), **SAINT** (*c.* 672/673–754), the apostle of Germany and organizer of the Frankish church, was born of a good family near Exeter in Devonshire. At the age of seven he became a monk and studied first near Exeter, then at Nursling, near Winchester, under the abbot Winberht. He soon distinguished himself both as scholar and preacher. In 716 he followed the example of other Saxon monks and set out as missionary to Frisia. He was soon obliged to return, however, probably because of the hostility of Radbod, king of the Frisians, then at war with Charles Martel. At the end of 717 he went to Rome, where in 719 Pope Gregory II commissioned him to evangelize Germany. Crossing the Alps, Boniface visited Bavaria and Thuringia; but upon hearing of the death of Radbod he hurried again to Frisia where, under the direction of his countryman Willibrord (d. 738), the first bishop of Utrecht, he preached successfully for three years. About 722 he visited Hesse and Thuringia, won over some chieftains, and converted and baptized great numbers of the heathen. Having sent special word to Gregory of his success, he was summoned to Rome and consecrated bishop on Nov. 30, 722, after taking an oath of obedience to the pope. Then his mission was enlarged. He returned with letters of recommendation to Charles Martel, as a regionary bishop, with a general jurisdiction over Germany.

Charles's protection, as Boniface himself confessed, made possible his great career. Armed with it he passed safely into heathen Germany and began a systematic mission baptizing, overturning idols, founding churches and monasteries, and calling from England monks and nuns, some of whom have become famous: St. Lull, his successor in the see at Mainz; St. Burchard, bishop of Würzburg; Willibald, Boniface's own biographer; St. Lioba, St. Walburga, St. Thecla. In 732 Boniface was created by Gregory III metropolitan of Germany beyond the Rhine, with authority to found bishoprics wherever he thought fit. Several years later, for the third time, he went to Rome. On his return he organized the church in Bavaria into the four bishoprics of Regensburg, Freising, Salzburg and Passau. Then his power was extended still further. In 741 Pope Zacharias made him legate, and charged him with the reformation of the whole Frankish church. With the support of Carloman and Pepin, who had just succeeded Charles Martel as mayors of the palace, Boniface set to work. As he had done in Bavaria, he organized the east Frankish church

into four bishoprics, Erfurt, Würzburg, Buraburg and later Eichstädt, and set over them some of his own monks. In 743 he presided at what is generally counted as the first German council. At the same period he founded the abbey of Fulda, as a centre for German monastic culture, placing it under the Bavarian Sturmi, whose biography gives many picturesque glimpses of the time. Then came a disciplinary controversy with Fergal (latinized Virgilius), the Irish abbot of Salzburg who ruled the diocese through an Irish bishop under his authority in the Celtic fashion. Fergal, a good mathematician and interested in cosmography, was reported to Pope Zacharias by Boniface as believing "that there are another world and other men under the earth, and another sun and moon"—clearly a misrepresentation of the doctrine about the antipodes held a few years before by Bede. This matter was quietly dropped by the pope, who gave judgment for Fergal against Boniface on a few minor points. Boniface took it ill, but Fergal had the last word: under the assumed name of Aethicus Ister ("the Danube Philosopher") he produced a *Cosmographia* purporting to derive from St. Jerome, in fact an elaborate fake, which had a wide circulation in the middle ages and was not unmasked until 1951. Fergal was consecrated bishop of Salzburg after Boniface's death, and canonized in 1233.

Boniface was more successful in France. There a certain Adelbert, a Frankish bishop of Neustria, had caused great disturbance. He had been performing miracles and claimed to have received his relics not from Rome, like those of Boniface, but directly from the angels. Planting crosses in the open fields he drew the people to desert the churches, and had won a great following throughout all Neustria. At the instance of Pepin, Boniface secured Adelbert's condemnation at the synod of Soissons in 744; but he and Clement, an Irish missionary associated with him who held heretical views on predestination, continued in spite of legate, council and pope, to find followers for three or four years more.

Between 746 and 748 Boniface settled at Mainz, as metropolitan over the Rhine bishoprics and over those he had established in Germany—thus ensuring the pre-eminence of the see of Mainz. In 747 a synod of the Frankish bishops sent to Rome a formal confession of faith. It is not certain that Boniface took part in the anointing of Pepin as king of the Franks in 751–752. In 754 he resigned his archbishopric in favour of Lull, and took up again his earliest plan of a mission to Frisia; but on June 5 of the same year he and his companions were massacred by heathens near Dokkum. His remains were afterward taken to Fulda. His feast day is June 5.

St. Boniface has well been called the proconsul of the papacy. His organizing genius, even more than his missionary zeal, left its mark upon the German and French churches throughout all the middle ages.

The missionary movement, which until his day had been largely carried on by independent Irish monks, was brought under the direction of Rome. In so welding together the scattered centres and binding them to the papacy, Boniface was actuated by simple zeal for unity of the faith and not by a conscious political motive.

Though pre-eminently a man of action, Boniface left several literary remains, the chief being his letters, which are extremely important from the standpoint of history, dogma and literature. His other works include a grammar, some poems, the fragment of a penitential, and some sermons of doubtful authenticity.

See also references under "Boniface, Saint" in the Index.

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BONIFACE (Lat. BONIFATIUS), the name of nine popes.

SAINT BONIFACE I (d. 422) was pope from Dec. 28/29, 418, to Sept. 4, 422. Born at Rome, date unknown, he was a priest when elected pope by a majority of the Roman electors. Eulalius, a deacon simultaneously chosen by a clerical faction, contested the office until April 419, when he lost the support of Emperor Honorius for violating an agreement that the two claimants leave Rome pending a council's decision. His feast day is Sept. 4.

BONIFACE II (d. 532), pope from Sept. 22, 530, to Oct. 17, 532, was born at Rome, date unknown, of Gothic descent, the first Germanic pontiff. Felix IV designated him, while Boniface was still archdeacon, as his successor. When the majority of the Roman clergy elected Dioscorus, discord followed, settled within a few weeks by Dioscorus' death. (JN. F. B.)

BONIFACE III (d. 607), pope from Feb. 19 to Nov. 12, 607, is principally known for an edict he obtained from the emperor Phocas recognizing the see of Rome as the head of all the churches, which doubtless was intended as a limitation on the claims of Cyriacus, patriarch of Constantinople.

SAINT BONIFACE IV (d. 615) was pope from Aug. or Sept. 608 to May 615. He converted the Pantheon into the Church of Our Lady of the Rotunda and presided over the council of Rome in 610 attended by Mellitus, the first bishop of London, by whom Boniface sent letters and instructions to Lawrence, archbishop of Canterbury, and to King Aethelbert. Boniface was later venerated as a saint, his feast day being May 25.

BONIFACE V (d. 625), pope from Dec. 619 to Oct. 625, did much to assist the spread of Christianity in England, especially in Northumbria. According to Bede (in his *Ecclesiastical History*) he wrote encouraging letters to Mellitus, third archbishop of Canterbury; to Justus, bishop of Rochester; to Edwin, king of Northumbria; and to his wife, Aethelberga, thus assisting the work of Paulinus for the conversion of Northumbria.

BONIFACE VI (d. 896) was elected pope in April 896 but died 15 days later.

BONIFACE VII (d. 985) reigned in June and July 974 and again from Aug. 984 to July 985. Many historians dispute the legitimacy of his claim as pope and implicate him in the deaths of Benedict VI and John XIV. In 974 he was substituted by Crescentius for Benedict VI, who was strangled in prison. Exiled by Count Sicco, the envoy of Otto II, Boniface returned in 984 to throw Pope John XIV into prison and take his place. (C. P. L.)

BONIFACE VIII (Benedict Caetani) (*c.* 1235–1303) was pope from Dec. 24, 1294, to Oct. 11, 1303, when he died in Rome a little more than a month after the attempt against his person perpetrated by Guillaume de Nogaret, the emissary of King Philip IV of France, at Anagni, where, to use the words of Dante (not a friend of Boniface's), "Christ was made captive in his vicar" (*Divine Comedy* Purg. xx, 86).

The catastrophe of Boniface VIII marks the first open rejection of papal spiritual hegemony by the rising national monarchies of the west, and above all by France. Boniface's assertions of papal plenitude of power did not go beyond those of his predecessors in the 13th century. They were in fact more moderate than, for instance, those of Innocent IV (*q.v.*) and were in any case well within the range of the opinions gradually elaborated in the schools of theology and canon law in the period between the age of Gregory VII and that of Boniface. Boniface's failure was due not to any novelty of his views or claims but to changed circumstances, to his inability or unwillingness to gauge their significance adequately and last but not least to his own character: conscious of his superior intellect and at the same time tormented by illness, he was impulsive to the point of imprudence and short-tempered to the point of uncharitableness. It was his exaggerated harshness against the Colonna (*q.v.*)—whose hatred for the Caetani pope was largely due to conflicting interests of the two families in the Roman Campagna—as well as his shortsighted underestimation of the ruthlessness of Philip IV of France and his helpers that led to the coalition of these two disparate forces and to the pope's downfall. Boniface VIII's personal failings, however, can in no way exculpate Philip IV the Fair (*q.v.*) and his ministers, who used against the pope the same means of forgery, defamation, intimidation and violence (practices apparently inseparable from radical nationalism since its beginnings) which they were again to employ a few years later against the Templars.

Benedict Caetani was born in Anagni, probably between 1235 and 1240. He studied law in Bologna and then for many years held increasingly important functions in the administration of the Roman *curia*. Martin IV made him cardinal-deacon of St. Nicholas in Carcere Tulliano in 1281; under Nicholas IV he became cardinal-priest of St. Martin in Montibus in 1291. On his legation to France from 1290 to 1291 he succeeded in delaying the outbreak of renewed war between France and England and in bringing about peace between France and Aragon. It was Cardinal Benedict Caetani who confirmed the unhappy Pope Celestine V (*q.v.*) in his wish to resign and after he had succeeded him found it advisable to intern the old man in the castle of Fumone; there Celestine soon died, and though it was a death by natural causes it was open to suspicion and incriminating aspersions by Boniface's enemies. Among those who carried on the propaganda and opposition against Boniface were not a few of the Franciscan "Spirituals," for instance, the famous Jacopone da Todi (*q.v.*) some of whose poems were written during his imprisonment by Boniface from which he was released only after the pope's death.

The two principal international conflicts which existed from the onset of Boniface's pontificate were that between France and England concerning Guienne and Flanders and that between the kingdoms of Naples and Aragon concerning the island of Sicily, which had broken away from the Neapolitan Anjous after much provocation, disregarding, however, papal feudal overlordship. While Boniface finally, though unwillingly, accepted the independence of the island kingdom under Frederick of Aragon (peace of Caltabellotta, 1302), his attempts to stop hostilities between Edward I of England and Philip IV of France became enmeshed with another important problem, the increasing tendency of these warring monarchs to tax the clergy without obtaining papal consent. While the desire of the late-medieval rulers to tax the wealth of their clergy has been defended and can perhaps be understood, the practice was unquestionably contrary to the canon law of the time. That Boniface refused to look on inactively while the struggle between France and England, which he was trying to terminate, was being financed at the cost and to the prejudice of the church and the papacy is not surprising. In 1296 he issued the bull *Clericis Laicos* which forbade under the sanction of automatic excommunication any imposition of taxes on the clergy without express licence by the pope. This bull had some effect in England, owing chiefly to the steadfastness of the archbishop of Canterbury Robert de Winchelsea, but in France there was no strong defender of papal prerogative against the concerted action of the king and his civil lawyers. Philip IV countered or even forestalled the publication of *Clericis Laicos* by an order forbidding all export of money and valuables from France and by the expulsion of foreign merchants.

While this measure was a very serious threat to papal revenues, it alone probably would not have forced Boniface to those far-reaching concessions which he had to grant the French king within the year, concessions which almost amounted to revocation of *Clericis Laicos*. The necessity to come to terms was caused above all by the insurrection against Boniface of a powerful section of the Colonna family, including two cardinals, culminating in the armed robbery of a large amount of papal treasure in May 1297. A year of military action against the Colonna followed, which ended with their unconditional surrender. They were absolved from excommunication but not reinstated in their offices and possessions; they therefore rebelled again and fled; some of them went to Philip, with whom they had conspired perhaps even before the issue of *Clericis Laicos*.

Boniface's first conflict with the French king was followed by an apparent reconciliation, which was emphasized by the pope's canonization of Philip's holy ancestor Louis IX. A second conflict, which broke out in 1301 around the trumped-up charges against a southern French bishop Bernard Saisset of Pamiers and his summary trial and imprisonment, proved to be irreconcilable, because now the king threatened and meant to destroy one of the most fundamental gains which the papacy had made and maintained in the great struggles of the last two centuries: the substitution of the pope for the ruler in the control of the clergy. The pope could not compromise here, and in the bull *Ausculta Fili* he sharply rebuked Philip and demanded amends, especially the release of the bishop, who had appealed to Rome. Instead, the king's chancellor Pierre Flotte was allowed to circulate a distorted extract of that bull and thus to prepare public opinion for the great assembly of the estates-general of France in April 1302, in which nobles and burghers enthusiastically and the clergy reluctantly supported the king.

Nevertheless the pope seemed to have good reason to hope for a favourable termination of the conflict, since Philip's army was shortly afterward disastrously defeated by the Flemish townspeople and since the German king and prospective emperor Albert I of Habsburg was ready to give up his French alliance if the pope would recognize the contested legitimacy of his rule. This recognition was granted early in 1303 in terms which exalted the ideal and traditional, though none too often realized, harmonious relationship between the papacy and the Holy Roman empire. This empire now was said by the pope to possess under ultimate papal supremacy an overlordship over all other kingdoms including France. Already in Nov. 1302 Boniface had issued an even more fundamental declaration concerning the position of the papacy in the Christian world, the famous bull *Unam Sanctam*, which of all papal documents of the middle ages has become the most widely known because of its allegedly radical and extreme formulation of the content of the papal office. The bull as a whole is indeed a very strong but not a novel invocation of the supremacy of the spiritual over the temporal power. At the same time the old Gelasian doctrine that both powers are from God is clearly stated, and in the final dogmatic sentence the pope speaks no longer of the temporal power but of the human creature as the object of papal plenitude of power, submission to which in this sense only is said to be necessary to salvation.

Meanwhile in France, Guillaume de Nogaret had taken Flotte's place as the leader of a violently antipapal royal policy in which Philip was confirmed by other enemies of the pope. One of these was the legate whom Boniface had dispatched to France in these critical months and who betrayed his master, the French cardinal Jean Lemoine (Johannes Monachus). Many unjustified accusations against Boniface, ranging from unlawful entry into the papal office to heresy, were raised against him at a secret meeting of the king and his advisers held in the Louvre at Paris; these accusations were to be taken up and elaborated upon later during the posthumous trial against the pope pursued by Philip IV. Shortly after the Louvre meeting, at which Nogaret had demanded the pope's condemnation by a general council of the church, Nogaret went to Italy to stir up, if possible, rebellion against the pope. Unsuccessful in this respect and attempting to forestall publication of a new papal bull announcing Philip's excommunication, Nogaret, with the assistance of Sciarra Colonna and the connivance of some of the cardinals, decided to capture the pope at Anagni. In this he succeeded through the momentary complicity of the local leaders of the city of Anagni, who, however, changed their minds after two days, rescued the pope and thus frustrated whatever further plans Nogaret may have had. During these two days Boniface, whom Sciarra Colonna would have killed but for Nogaret's wish to drag the pope before a council, was probably physically ill-treated. He bore everything with great courage and with the patience and resignation of Job, whose pertinent words (Job i, 21) he quoted. Boniface returned to Rome physically and mentally broken and died soon thereafter. (*See* also NOGARET, GUILLAUME DE.)

Among the lasting achievements of his turbulent pontificate were the publication of the third part of the *Corpus Juris Canonici*, the so-called *Liber Sextus* (*see* CANON LAW), and the institution of the Jubilee of 1300, which was the first Holy Year. The event was commemorated in a painting by Giotto in the Lateran, a fragment of which still survives in the Basilica of San Giovanni in Laterano. Boniface VIII was a figure of some importance in the revival of the arts in the age of Dante and Giotto. His sepulchre came from the workshop of Arnolfo di Cambio; the *tumba* with his reclining statue in the Vatican grottoes and a bust in the Museo Petriano may still be seen. Of the numerous

memorial statues erected by himself or others in his honour, and later used by his enemies to brand him as an idolater, several still survive. They are visual evidence for the fact, known also from other sources, that Boniface VIII, who extended the height of the papal tiara (*q.v.*) to one ell, the scriptural unit-measure of the ark of Noah, symbol of the unity of the church, also increased the number of crowns which circle the tiara from one at least to two and perhaps to three, which is their number in modern times.

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(G. B. L.)

BONIFACE IX (Pietro Tomacelli) (1355–1404), pope from Nov. 2, 1389 to Oct. 1, 1404, was born at Naples. He viewed the schism of 1378 as a political problem and resorted to all possible means to raise money in order to win allies against the Avignon popes but failed to end the breach.

See P. Hughes, *History of the Popes,* vol. iii (1947). (J. A. Cr.)

BONIFACE OF SAVOY (d. 1270), archbishop of Canterbury, sixth son of Thomas I, count of Savoy, was one of several Savoyards who reached high office in England through the influence of Boniface's niece, Eleanor of Provence, queen of Henry III. Elected archbishop of Canterbury in 1241 while still a subdeacon, he went to England only in April 1244. After seven months he returned to the papal court at Lyons, took priest's orders and was consecrated archbishop by Innocent IV (Jan. 15, 1245), remaining at Lyons until 1249. Soldier, diplomat and administrator, but neither canonist nor theologian, this alien prince-bishop, though usually considered a mere royal creature, proved an exceptionally powerful archbishop. He tamed the aggressive independence of the Canterbury chapter; he reformed archiepiscopal finance and cleared his see of debt; he reduced the dependent see of Rochester to complete subordination; he fully enforced his metropolitan rights over all suffragan dioceses. Though he united the entire English clergy to resist Henry's demands for money and to defend ecclesiastical jurisdiction from royal encroachment (1256–59), he also used his great influence at Rome unwaveringly to support Henry III in his disputes with the barons (1258–65). He died in Savoy on July 18, 1270. (R. F. T.)

BONIFACIO, a town in Corsica, an island *département* of France, lies 2 mi. W. of Cape Pertusato, the southernmost point of the island, and gives its name to the strait between Corsica and Sardinia. It is situated high above the sea on a narrow limestone peninsula about 1 mi. long, which parallels the coast and forms a natural harbour. Pop. (1954) 1,895. Said to have been founded about A.D. 828 as a defense against pirates, the town was seized from Pisa by the Genoese near the end of the 12th century, and in 1420 repelled a siege by Alphonso V of Aragon. Captured by the French and Turks in 1554 it was restored to Genoa by the treaty of Cateau-Cambrésis (1559). The customs of the inhabitants differed from those of the other Corsicans, the vendetta being unknown, and a Genoese dialect still is spoken. The churches of St. Dominique (built by the Templars in the 13th century) and Ste. Marie Majeure (12th century) are the most interesting buildings. There is no railway, but a main road runs northwest to Ajaccio and another up the east coast to Bastia. Trade is chiefly with Sardinia, in cereals, wine and cork. There are olive groves nearby and oil and cork works in the town.

BONIFACIUS (d. A.D. 432), Roman general and governor of the province of Africa (425–431), first became famous for his defense of Marseilles against the Goths led by Ataulphus (*q.v.*) in A.D. 413. He commanded troops illegally in Africa from 422 to 425; his position was then legalized but when recalled to court in 427 he refused to leave Africa. He was widely believed to have invited the Vandals to Africa in 429 in order to repel the attacks of the imperial forces. Unable to withstand their advance under Gaiseric (*q.v.*), he became reconciled to the empress Placidia. Appointed *magister militum* (master of the soldiers) to suppress Aetius (*q.v.*), he defeated him at Rimini in 432, but received a wound from which he died three months later. He was a correspondent of St. Augustine of Hippo. (E. A. T.)

BONIFAZIO VERONESE (BONIFAZIO VENEZIANO, BONIFAZIO DE' PITATI) (1487–1553), Venetian painter, a secondary artist working under the shadow of his great Venetian contemporaries, was born in Verona in 1487 and migrated to Venice, where he worked until his death on Oct. 19, 1553. He appears to have been a pupil of Palma Vecchio, and Palma's influence is the dominant factor in his only signed and dated work, a "Virgin and Child With SS. Omobono, Barbara and John the Baptist" (1533), in the Palazzo Reale, Venice. Bonifazio's most celebrated works are a series executed for the Palazzo Camerlenghi, now in the Accademia at Venice, of which the earliest, a "Christ Enthroned With SS. Mark, Justina and Three Donors," dates from 1530, and the latest, an "Annunciation," from about 1544. Bonifazio is distinguished by a certain coloristic opulence, which lends interest to his loose-knit compositions and static, rather flaccid forms. Jacopo Bassano was his pupil.

See D. Westphal, *Bonifazio Veronese* (1931). (J. W. P-H.)

BONINGTON, RICHARD PARKES (1802–1828), English romantic painter of bright landscapes and history pieces, was born at Arnold near Nottingham, on Oct. 25, 1802. He was the son of a financially unreliable drawing master and a schoolmistress, who implanted in the boy a sense of history and a love for its décor that later dominated his art.

He exercised an influence out of all proportion to his brief life, of which the principal events corresponded with the rapid development and variation of his style. In Calais, France, where the father hoped to set up in the lace trade (*c.* 1817), Louis Francia taught the boy the Girtin tradition of water colour, which he himself had learned when a refugee in England. Against the father's wishes, he gave Bonington letters to friends, which took him to Paris with an introduction to young Eugène Delacroix. The two met accidentally in the Louvre, where, contrary to contemporary practice, Bonington was copying Dutch and Flemish rather than Italian masters. The two became friends and, encouraged by Théodore Géricault, undertook the study of Rubens, thus preparing themselves for John Constable's influence and laying the foundation of the new French school.

Bonington entered the École des Beaux-Arts (1819) and joined the atelier of Baron Gros, who had departed from David's rigid classicism (1820). His bright water colours, a novelty in Paris, financed sketching tours in Normandy, Picardy and Flanders (1821–23). He showed at the Salon in 1822 and at the famous Salon of 1824 with Constable, Sir Thomas Lawrence and others, where he won a gold medal. With Delacroix he studied Constable at dealers' exhibitions in Paris, and together they went to England (1825), where Bonington learned something of Turner's skill. More important, both were affected by the English fashion for painting scenes from history.

This new interest engrossed Bonington; he took immense pains to achieve accuracy, drawing details of armour, costume and furniture, although he did not abandon landscape, as the results of his journey to Venice (1826) show. In his subsequent historical pictures, he evolved in oil a new synthesis of Flemish and Venetian techniques. He strengthened his water colours by adding gum according to the new English practice. He showed in London (British institution, 1826, and Royal Academy, 1828), winning immediate popularity. He visited Lawrence in London in 1827 and died on a third visit to England on Sept. 23, 1828, from tuberculosis, death being hastened by heatstroke.

As a master of the romantic movement, as a technical innovator in oil and water colour, Bonington's influence was marked in England and France; he had many imitators, being the natural interpreter of romance in painting to both nations. His gifts as a draftsman were very high; as a colourist, good. He also showed his talent in the new medium of lithography, inevitably illustrating Sir Walter Scott.

Among his most familiar works are the "Coast Scene, Picardy" and "Henri IV and the Spanish Ambassador" (Wallace collection,

London); "Francis I and the Duchesse d'etampes" and "View of Venice" (Louvre). He may be best studied at the Wallace collection and the Louvre; good examples are in the national galleries of England, Scotland and Canada; in the Castle museum, Nottingham; and (for drawings) in the print room of the British museum.

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(Aw. S.)

BONIN ISLANDS (OGASAWARA-GUNTŌ) comprise four major island groups, roughly 40 sq.mi. in land surface area, lying about 500 mi. S.E. of the Japanese mainland. Pop. (1940) 7,361; in 1963 only one island was inhabited, pop. 215. The group includes Parry, Beechey, Bailey, Volcano and Marcus islands. The first three are part of Bonin Islands proper (area 28 sq.mi.), but Volcano Islands (*q.v.*) and Marcus Island are placed within the group for administrative purposes. The whole group is termed Bonin Volcano Islands. The principal island is Peel Island (Chichi-shima) with good deep-water anchorage at Futami-byōchi, but the most famous is Iwo Jima (*q.v.*).

The Bonin Islands form part of an outer festoon which stretches from the central volcanic zone of Japan through the Volcano, Mariana, Mackenzie, Yap and Palau islands to the Moluccas and which, originating in the latter stages of the "alpine" fold movements, is still unstable. The northern end of the arc passes into central Honshū, that part of Japan where earthquakes are most frequent, and in the Bonin group tiny islands appear and disappear. The arc has an important strategic position with regard to the Pacific approaches of the far east.

Although known to several explorers, each of whom gave the group a different name, these islands, conventionally called Bonin, were not permanently settled until 1830. The term "Bonin" is a corruption of the Japanese *Munin* meaning "empty of men," but the Japanese themselves term them "Ogasawara-guntō" after Ogasawara, who allegedly discovered them in 1593. Vague claims by Great Britain and the United States were not pursued, and Japan formally annexed them in 1876. Only about 11% of the total area is good arable land, the remainder being hilly and forest covered. The valuable timber includes cedar, rosewood, ironwood, boxwood, sandal and white oak. Whaling by small factory ships is conducted offshore.

After World War II the Bonin Islands were placed under U.S. military administration along with the Volcano Islands (Kazanrettō).

BONITO, a name applied to three fishes of the mackerel family (Scombridae). The Atlantic bonito (*Sarda sarda*) is abundant in the Mediterranean and the warmer parts of the Atlantic ocean. The Pacific bonito (*Sarda chiliensis*) lives in the Indo-Pacific area. The striped bonito (*Sarda orientalis*) is world-wide in warm oceanic waters. Bonitos are found in nontropical waters during the summer. They are similar in form to the bluefin tuna but are a smaller fish, not exceeding 30 in. in length. The colour is steel blue above, silvery below, with numerous narrow dark stripes. Bonito congregate in large schools. They will readily take bait trolled from a moving boat and are good sport. Bonito are very good eating and of considerable economic importance in tropical areas. (C. HU.)

BONIVARD, FRANÇOIS (1496?–1570), Genevan patriot, the hero of Lord Byron's poem "The Prisoner of Chillon," was born at Seyssel in Savoy, the son of Louis Bonivard, seigneur de Lompnes. His real character and history are widely different from the legendary account that Byron popularized. Having succeeded his uncle as prior of the Cluniac priory of St. Victor, close to Geneva, he began to oppose the encroachments that Charles III, duke of Savoy, and his kinsman the bishop of Geneva were making against that city's liberties. He was imprisoned by the duke at Gex from 1519 to 1521, lost his priory and became more and more anti-Savoyard. In 1528, supported by the city of Geneva, he took up arms against those who had seized his ecclesiastical revenues, but in 1530 he was again seized by the duke and imprisoned in the castle of Chillon, where he was kept underground from 1532 until the Bernese released him in 1536. Becoming a Protestant, he obtained a pension from Geneva and was married four times. In 1542 he began compiling his *Chroniques de Genève*, a history of Geneva from the earliest times. His manuscript was submitted to Calvin for correction in 1551 but was not published until 1831 (ed. by D. Dunant). The best edition is that of 1867. Bonivard also wrote *De l'ancienne et nouvelle police de Genève* (1555).

BONN, a city of Germany which after partition of the nation following World War II became the capital of the Federal Republic of Germany. A university city and Beethoven's birthplace, Bonn lies on the left bank of the Rhine, 24 km. (15 mi.) S. of Cologne, in North Rhine-Westphalia. Pop. (1961) 143,850. The river is crossed by the bridge to Beuel, built in 1949, and is flanked by an embankment 4 km. (2½ mi.) long, on the south side of which is the Parliament house. In the Koblenzerstrasse—parallel to the embankment—there are the buildings of several ministries, schools and hotels, the seats of the federal president and chancellor, and the well-known Alexander Koenig Zoological museum.

The central part of the city, with its narrow streets, contains the Münster (cathedral), built of gray stone in romanesque and Transitional styles (12th and 13th centuries). It is surmounted by five towers of which the central (315 ft. high) is a landmark in the Rhine valley. The Remigius church dates from 1295–1317 and the town hall on the market square from 1737. There Kinkel and his pupil Carl Schurz began the liberal revolt in the 1848 revolutions. The finest building is the university, founded in 1786 by the archbishops of Cologne; originally the electoral palace, it was built about 1717 out of the materials of the old fortifications. The university, suppressed in 1794, was refounded in 1818 as the Rheinische Friedrich Wilhelms university. The botanic garden surrounds the Poppelsdorf palace (1715–30) used by the university. The observatory, long under the charge of Friedrich Wilhelm August Argelander (*q.v.*), stands on the south side of the avenue. A new observatory with a radio telescope has been built on the Stockert near Euskirchen (18 mi.). The Rheinische Landesmuseum contains a valuable collection of Roman and Frankish relics as well as the cranium of the Neanderthal man. On the Kreuzberg, above the suburb of Poppelsdorf, is a 17th-century church and Franciscan monastery, approached by a flight of "holy steps," in imitation of those at Rome. A tower, the Alte Zoll, commanding a magnificent view of the Siebengebirge, is all that remains of the old fortifications and customhouses. A statue of Beethoven was erected in the Münsterplatz in 1845 and in 1889 a Beethoven museum was opened in the house where he was born. This was badly damaged in 1960 after it had been set on fire by a lunatic.

During World War II the old part of the town was severely damaged; the university, which had been remodeled early in the 19th century, was damaged by fire in 1944 and rebuilt after the war, and the old bridge was blown up in 1945. Notable features of the postwar town are the modern university clinics on the Venusberg, the theatre and the municipal concerts, including an annual Beethoven festival. The original Beethoven hall was destroyed, but a new one was completed in Sept. 1959. Other places of interest are the Arndt Memorial room and folklore exhibition in the Arndt house; the town hall gallery, where modern west German paintings and graphic arts are shown and where alternately there are exhibitions of old and modern masters; and the old cemetery near the centre of the town which contains the graves of many famous men and women.

Bonn is on the main line from the Ruhr and Cologne to Mainz and Basel. The railway along the right bank of the Rhine, from the Ruhr to Frankfurt, passes Beuel opposite Bonn. International trains to many parts of Europe call at Bonn. Long-distance buses connect Bonn with the tourist areas of western Germany as well as with Brussels and Amsterdam. Wahn airport (7 mi. N.) is shared by Bonn and Cologne. Rhine steamers ply between Bonn, Cologne and Mainz.

As the federal capital Bonn is the headquarters of many industrial, professional and economic associations and of the German Industrial and Commercial association. The chief manufactures are stationery, office furniture, light metal goods, stoneware, ciga-

rettes, adhesive plasters and flags; there are also important printing works, publishing houses and insurance companies.

Bonn (Bonna or Castra Bonnensia), a Roman military settlement, was the scene, in A.D. 70, of a defeat of the Romans by the Batavi. Greatly reduced by successive barbarian invasions, it was restored about 359 by the emperor Julian. In the centuries that followed the breakup of the Roman empire it again suffered, and was finally devastated in 889 by bands of Norman raiders. Fortified again in the 13th century, from 1267 to 1794 it was the residence of the electors of Cologne. During the various wars of the 16th, 17th and 18th centuries, the town was frequently besieged. Occupied by the French after 1794, it was given to Prussia in 1815 by the congress of Vienna. In World War II it was captured by Allied forces in March 1945. Bonn was made capital of the Federal Republic of Germany in 1949.

BONNARD, PIERRE (1867–1947), French painter, book illustrator, lithographer and etcher, and a leader of the modern French Intimiste school of painting, was born on Oct. 3, 1867, at Fontenayaux-Roses, near Paris. He began law studies about 1885, but spent much of his time at the Académie Julian, where he met Jean Édouard Vuillard (a lifelong friend), Maurice Denis, Paul Ranson and Paul Sérusier, all of whom formed the "Nabis" group (Hebrew *Nebiim,* "prophets"). He worked for a year at the Paris École des Beaux-Arts (1888), and in 1889, after he had sold a champagne poster design, his father allowed him to begin serious training. Japanese art and the precepts of Paul Gauguin then preoccupied him; his work was characterized by flat, black-outlined areas of warm, decorative colour and simplified forms. Humour, allied with keen observation of Parisian life, distinguished his exhibits at the Salon des Indépendants and his illustrations to *La Revue blanche* from 1891. He designed décor for the Théâtre d'Art, and in 1896 Durand-Ruel gave him his first one-man show. In 1895 Ambroise Vollard published the first of many volumes of lithographs, for which Bonnard did *Quelques Aspects de la vie de Paris,* and Bernheim-Jeune became the artist's chief dealer in 1898–99. By 1900, Bonnard's style changed; his palette became gayer, his brushwork looser and more transparent. He turned oftener to landscapes and spent long summers in the Seine valley and southern France. Bonnard liked to paint warm, sunlit domestic interiors, simple, yet radiating a sense of serene well-being. His compositions, often apparently so casually constructed, were always done from memory aided by the scantiest colour notes. Essentially modest and retiring, his death at Le Cannet, on Jan. 23, 1947, passed almost unnoticed.

See John Rewald, *Pierre Bonnard* (1948); Musée National d'Art Moderne, *Bonnard, Vuillard et les Nabis, 1888–1903* (1955).

(D. L. Fr.)

BONNAT, LÉON JOSEPH FLORENTIN (1833–1922), French painter best known as a portrait painter and teacher in the French academic tradition, was born at Bayonne on June 20, 1833. He studied under Federico Madrazo at Madrid, and under Léon Cogniet in Paris. His earlier works were genre and historical paintings in which his study of old Spanish art was evident. The long series of characteristic portraits began in 1875. In these he drew inspiration from Velázquez and the Spanish realists. He painted Thiers, Victor Hugo, Carnot, Taine, Pasteur and other contemporaries, about 200 in all, the finest of these being perhaps the portrait of Cogniet in the Luxembourg. In 1888 he became professor of painting at the École des Beaux-Arts, and in 1905 director. He died on Sept. 8, 1922.

BONNER (Boner), **EDMUND** (*c.* 1500–1569), bishop of London, has commonly been regarded as a notorious example of a persecuting Catholic bishop in the reign of Mary Tudor. Violent abuse, however, had been directed against the bishop before there was any Marian persecution of Protestants, by the virulent pen of John Bale, bishop of Ossory. Another contemporary, the Protestant martyrologist John Foxe, continued this vituperation of Bonner, so effectively indeed that Bale's denunciation of him as "bloody bishop Bonner" has persisted through the centuries and prejudiced most historians against him.

Bonner was an outstanding Oxford lawyer who served Henry VIII on various foreign embassies. He accepted from Henry first the bishopric of Hereford and later that of London, and promoted Henry's ecclesiastical adventures. He opposed, however, the advancing Protestantism of Edward VI's reign and spent most of this period in prison, being deprived of his London bishopric. Restored to his see on Mary's accession, he devoted himself to the affairs of his diocese, the importance of which made him an outstanding figure in that persecution of Protestants which marked Mary's reign. Bonner's reluctance to intensify the persecution in London, however, brought him a rebuke from Mary's government. Again deprived of his bishopric on his refusal to take the oath of supremacy at the beginning of the reign of Elizabeth I, he spent the last ten years of his life a prisoner in the Marshalsea and died there on Sept. 5, 1569.

Bibliography.—James Gairdner, in *Dictionary of National Biography,* vol. v, pp. 356–360, with bibliography (1886); Philip Hughes, *The Reformation in England,* vol. ii and iii (1954); Lacey Baldwin Smith, *Tudor Prelates and Politics, 1536–1558* (1953). (E. McD.)

BONNET, CHARLES (1720–1793), Swiss naturalist and philosophical writer, famous for his discovery of parthenogenesis in aphids, was born at Geneva on March 13, 1720, of a wealthy French family. He made law his profession, but his favourite pursuit was the study of natural science. In 1740 his paper to the Académie des Sciences containing a series of experiments establishing what is now termed parthenogenesis in aphids or plant lice obtained for him the honour of being admitted a corresponding member of the academy.

He began in 1741 to study reproduction by fusion and the regeneration of lost parts in the fresh-water hydra and other animals; and in the following year he discovered that the respiration of caterpillars and butterflies is performed by pores, to which the name of stigmata has since been given. Bonnet was admitted a fellow of the Royal society in 1743, the same year in which he became a doctor of laws.

In 1745 appeared his *Traité d'insectologie,* and nine years later his *Recherches sur l'usage des feuilles dans les plantes,* in which he suggests that plants possess powers of sensation and discernment. Bonnet considered that the most important function of leaves is to absorb, by their undersurface, dew that arises from the soil.

He was for many years regarded as an authority on the nutrition of plants, but his experiments and the conclusions he drew from them are more interesting historically than important scientifically.

The threatened failure of Bonnet's eyesight caused him to turn to philosophy. His *Essai de psychologie* was published (1754) anonymously in London and was followed by the *Essai analytique sur les facultés de l'âme* (1760), in which he develops his views regarding the physiological conditions of mental activity. He returned to physical science, but to the speculative side of it, in his *Considérations sur les corps organisés* (1762), designed to refute the theory of epigenesis, and to defend the doctrine of pre-existent germs (particles created by the Divine Being and having an inherent power of self-development). In his *Contemplation de la nature* (1764–65) he sets forth the hierarchy of all creatures, and in his *Palingénésie philosophique* (1769–70) he treats of the past and future of living beings, and supports the idea of the immortality of all forms of existence.

Bonnet's life was uneventful, and he seems never to have left Switzerland. Between 1752 and 1768 he was a member of the Great council in Geneva. He died at Genthod, near Geneva, on May 20, 1793.

BONNET, GEORGES ÉTIENNE (1889–), French statesman who played a leading part in the appeasement of Nazi Germany, was born at Bassillac, Dordogne, on July 23, 1889, and graduated in the faculty of law, Paris, and from the École Libre des Sciences Politiques. He was a Radical deputy for Dordogne from 1924 to 1928 and from 1929 to 1940. In the more progressive of the cabinets of 1925–26 and 1930–36 he held ministries responsible for financial, economic or social affairs. Increasing association with important banking and industrial interests caused him to move to the right, and he was regarded as another Raymond Poincaré who might save the franc. Under Léon Blum he was

ambassador to the United States for six months in 1937, but British influence thwarted hopes that he might negotiate a separate settlement of the French war debts. After serving Camille Chautemps as a critical finance minister, he was prevented by Radical and Socialist hostility from forming a government.

Bonnet became foreign minister under Édouard Daladier in 1938 and vigorously practised the appeasement of Germany. He was so hostile to the declaration of war in 1939 that he almost caused a breakdown in Anglo-French relations. Instead of resigning he went to the ministry of justice. He worked in favour of the French armistice of 1940, supported the Vichy regime, associated with extreme collaborators and was appointed to the national council. Yet he refused other office and left France before the Allied invasion. This ambiguous attitude saved him after the liberation, when proceedings were started against him but dropped. Expelled from the Radical party in 1944, he yet retained the support of his local federation and was readmitted in 1952, but was expelled again in 1955 for his opposition to Pierre Mendès-France. Bonnet's postwar influence was small, although he was elected a deputy in 1956 and 1958. He published books on jurisprudence, public finance and politics. (P. W. C.)

BONNET, a cap or covering for the head; usually one kept in place by ribbons or a string tied under the chin.

The name is from the coarse medieval cloth called bonnet derived from the Hindu *banat,* from which hats or hoods were made in the 14th century. From that time the bonnet was worn with many variations in style. It reached its greatest size during the last half of the 18th century, when it was worn over the elaborately dressed wigs then fashionable for women. It was the most popular type of head dress of the 19th century, when it assumed varying shapes with descriptive names such as the cabriolet bonnet, the coat scuttle bonnet, the poke bonnet, the cottage bonnet and the scoop bonnet.

In Scotland the term applies to a brimless cap worn by men and boys. The bonnet of a ship is a supplementary sail laced to the foot of the jib in light winds. The term bonnet is applied to certain protective devices having a form or use similar to the head covering, as in a steam engine or safety lamp, or to a gambler's or auctioneer's decoy. A common British use of the word is for the metal covering over the engine of an automobile.

(M. B. K.)

BONNEVILLE, BENJAMIN LOUIS EULALIE DE (1796–1878), American military engineer and frontiersman, who increased the knowledge of the Rocky mountains, was born in or near Paris on April 14, 1796. His father was the friend of La Fayette, Condorcet and Thomas Paine, and in 1803 Mme Bonneville and the children followed Paine to the United States. Their father, detained for political reasons, joined them later. He graduated from the U.S. Military academy at West Point, N.Y., in 1815 and his lifelong association with the frontier began with his assignment to Fort Smith, Ark., in 1821. In 1832 he obtained leave of absence from the army for purposes of exploration and spent four years based on the Green river in Wyoming, establishing himself as a fur trader. Washington Irving edited his journals published in 1837 (*The Adventures of Captain Bonneville, U.S.A., in the Rocky Mountains and the Far West*). Dismissed from the army for overstaying his leave, he was reinstated and served in the Mexican War, was brevetted brigadier-general in 1865, retired in 1866, and died at Fort Smith on June 12, 1878. He was acclaimed at one time as a notable explorer, but later estimates do not credit Bonneville with important discoveries; H. M. Chittenden (*American Fur Trade of the Far West,* 1902) differs from Washington Irving and regards Bonneville as more interested in trade than in discovery. He was, however, a skilful commander and treated the Indians he encountered humanely. (D. Mn.)

BONOMI, IVANOE (1873–1951), Italian statesman, premier (1921–22 and 1944–45) and leading anti-Fascist in World War II, was born in Mantua on Oct. 18, 1873. He entered parliament in 1909 as the Socialist deputy for Mantua but was expelled from the party in 1912 with Bissolati-Bergamaschi and joined the Reformist Socialist group. He served as a volunteer during World War I, and in 1920 as war minister in the government of Giolitti, he was a negotiator of the treaty of Rapallo between Italy and Yugoslavia. Bonomi was made prime minister in 1921 but was unable to control Fascist and Socialist excesses and resigned in Feb. 1922. He retired from politics until 1940 when he joined the anti-Fascist movement, becoming its leader in 1942. After Mussolini's fall on July 25, 1943, he headed the national committee of anti-Fascist groups and on the liberation of Rome on June 9, 1944, he was designated premier by the national committee of liberation of which he had also been president. The committee, however, began to press for a more vigorous policy and Bonomi resigned on Nov. 26, 1944, only to be reinstated through the intervention of the British government.

Bonomi laid the foundations of Italy's economic and administrative reconstruction and began the reorganization of the army. On June 12, 1945, he resigned in favour of Ferruccio Parri, but as chairman of the constituent assembly's committee for treaties he took part in the council of foreign ministers at Paris in 1946. He was president of the senate from 1948 until his death, in Rome, on April 20, 1951. (N. S. J.)

BONONCINI (Buononcini), **GIOVANNI BATTISTA** (1670– *c.* 1750), Italian composer, chiefly remembered as Handel's rival in England, was born at Modena, July 18, 1670, and studied with his father, the composer and theoretician Giovanni Maria Bononcini, and later under Giovanni Paolo Colonna at Bologna. He showed precocious musical gifts, obtaining his first appointment (as a cellist) in 1687, and soon becoming *maestro di cappella* of San Giovanni in Monte. By 1691 he had published eight sets of works, mainly instrumental music. But it was chiefly as an operatic composer that he was to be known. He moved to Rome about 1692 and in 1699, after a brief period in Venice, settled in Vienna with his brother, the composer Antonio Maria. He was appointed court composer the next year and remained at Vienna until 1711, when he probably returned to Italy.

In 1720 he was invited to London by the new operatic organization, the Royal Academy of Music. The stories of his rivalry with Handel, and their backing by opposed political and social factions, are well known. Eight of his operas were produced in London, the most successful being *Astarto, Crispo* and *Griselda.* Other compositions of this period include an anthem on the death (1722) of the duke of Marlborough (whose family favoured Bononcini) as well as harpsichord and chamber music. He left England in disgrace in the early 1730s and went to Paris after submitting, to the Academy of Ancient Music, as his own composition, a madrigal actually written by Antonio Lotti. His last known work, a *Te Deum,* was written in Vienna in the 1740s, and it is likely that he died in obscurity there or in Italy about 1750.

Though he was a prolific and gifted composer, Bononcini's abilities are naturally dwarfed by comparison with Handel's. Only in opera, where both used the same, highly conventionalized idiom, are the two men comparable; Bononcini may not have possessed Handel's orchestral or contrapuntal techniques nor his gifts of musical characterization, but his simple and fluent melodic style and his ability to write well for his singers at least partly compensated. In other fields, Bononcini is a competent and typical Italian composer of the period of Vivaldi and Albinoni.

(S. J. Sa.)

BONONIA: *see* Bologna.

BONPORTI, FRANCESCO ANTONIO (1672–1749), Italian composer, notable for his *Invenzioni,* short instrumental suites from which Bach took the title for his keyboard *Inventions.* Born at Trento and baptized there on June 11, 1672, in 1691 he went to Rome, where he studied theology and also composition. After ordination, in 1695 he returned to Trento, where for more than 40 years he held a minor position at the cathedral, meanwhile composing instrumental works that became widely known. His numerous trio-sonatas (Venice, 1696–1706), violin sonatas and concertos, and the ten *Invenzioni* (1712) show novel use of the recitative style and an unconventional handling of melody and rhythm. He hoped always for ecclesiastical preferment but was constantly disappointed, and in 1740 retired to Padua, where he died, Dec. 19, 1749.

See G. Barblan, *Un musicista trentino, F. A. Bonporti* (1940).

BON-SAI (Bonsai, Bonzai), a Japanese term that, strictly speaking, applies only to dwarf trees planted in shallow vessels, those in deeper pots being called *hachi-uye* ("pot-planted"). But both are known as *bon-sai*, irrespective of the vessels they grow in. The growth of the plants is controlled by pruning, fertilization, etc., so that the trees are trained into the stately shapes of ancient big trees, the vacant space in the pot suggesting plains or distant mountains. The trunk of the tree, the spread of the roots, the distribution of branches, all of which may be used to give an aged appearance to the tree, are especially important. Without showing any trace of artificiality, each tree should develop its own characteristics. The deciduous should have the dignity of age either with or without the leaves, as in nature, though in some the leaves, while in others the flowers or fruits, may constitute the main attraction, according to the season.

The *bon-sai* may consist of a single tree (*ippon-dachi*) either in an upright or leaning attitude; two trunks (*ai-oi*) growing out of a single stump or planted closely together to appear as such; groups (*yose-uye*) of similar or different kinds of trees to suggest a forest or wooded mountain side. It may also have high exposed roots (*ne-agari*); trees or vines drooping down (*ken-gai*) as if overhanging from a cliff; or roots growing out of and embracing a rock (*ishi-zuki*).

The pot in which the trees are planted plays an important part in the scheme, shapes and sizes being determined by the kinds of plants contained. The pots are generally plain, but some have considerable decoration in relief or in painting. They are of earthenware, with a hole in the bottom for drainage lest the roots rot, in shape round, oval, rectangular, octagonal or lobed, etc., of varying depths, and chosen to be in harmony with and in right proportion to the tree.

For centuries the Japanese have cultivated the art of dwarfing trees, using them as ornaments for rooms, and *bon-sai* still remains a hobby among the aristocrats as well as among the working people of Japan. *See* also Miniature Landscape.

Bibliography.—C. Chidamian, *Bonsai-Miniature Trees* (1955); K. Yashiroda, *Bonsai: Japanese Miniature Trees* (1960); Y. Yoshimura and Giovanna M. Halford, *Japanese Art of Miniature Trees and Landscapes* (1958).

BONSTETTEN, KARL VIKTOR VON (1745–1832), Swiss writer in both French and German, of wide cosmopolitan interests and outlook, was born at Bern on Sept. 3, 1745. Of a conservative and patrician family, he had to resist for 12 years being forced into the traditional career of municipal magistrate. Instead he studied Horace and Rousseau, traveled abroad and cultivated friendships in the liberal intellectual circles of Geneva (1763–67: Charles Bonnet), Leiden, England (1769: Thomas Gray), France, Germany (Friedrich von Matthisson) and Italy (*cf.* his *Voyage sur la scène des six derniers livres de l'Enéide* (1805). After his return to Bern and his father's death (1773), he at last entered provincial politics. He became the enlightened administrator, first of Saanen (1779; cf. *Briefe über ein schweizerisches Hirtenland*, 1781), then of Nyon (1787), and finally, a judge in the canton of Ticino (1795–97; *cf.* "Briefe über die ennetbirgischen Vogteien," in *Neue Schriften*, 4 vol., 1799–1801). After the French invasion and the collapse of the *ancien régime* in 1798, he became a happy emigrant, spending three years with Friederike Brun and her friends in Denmark (cf. *La Scandinavie et les Alpes*, 1826) before settling in Geneva. His charm and cosmopolitan temperament made him an outstanding member of the international elite there and are revealed in his wide correspondence (*Briefe an Matthisson*, ed. by H. H. Füssli, 1827; *Briefe an F. Brun*, ed. by F. von Matthisson, 1829; H. Zschokke, *Briefwechsel mit Bonstetten*, 1832), and in various books, forerunners of modern comparative studies of national characteristics. The best is his excellent *L'Homme du midi et l'homme du nord, ou l'influence des climats* (1824; Eng. trans. 1864). These surpass his philosophical works (*Pensées sur divers objets de bien public*, 1815; *Études de l'homme*, 1821; etc.). He also wrote autobiographical sketches, *Erinnerungen an mein Jugendleben* (1821) and *Souvenirs* (1832). He died at Geneva, Feb. 3, 1832.

See W. Klinke (ed.), *Karl von Bonstetten, Briefe, Jugenderinnerungen* (1945); M. L. Herking, *Charles Victor de Bonstetten* (1921). (A. Bx.)

BONTEBOK, an African antelope, *Damaliscus dorcas dorcas*, of the southern districts of Cape Province, standing about 3 ft. 4 in. high at the shoulder, the hindquarters lower, and extending 4 ft. 6 in. from nose to tail, the latter being about 10 in. long. The colour is rich brown, white below, with a lighter "saddle mark" over the back; a narrow white patch extends from between the horns and widens over the face below the eyes and there is a large white patch on the rump. The horns, up to 16 in. long, are curved and lyre-shaped. It is extinct as a wild animal and about 100 are preserved in Bontebok national park, Bredasdorp, and on some nearby farms. *See* Antelope. (L. H. M.)

BONTOK (Bontoc Igorot), an ethnic division of the Igorot (*q.v.*) or mountain peoples of north Luzon, Philippines. Occupying 32 villages in the Chico river headwaters area, they numbered about 40,000 in the 1950s. Once feared headhunters, they are now pacified. Rice, the staple food, is grown in terraces; social structure emphasizes bilateral kin groups and village sections (*ato*); trial mating in girls' houses (*olag*) precedes marriage; and religion focuses on animal sacrifice (pigs, chickens, dogs) for omen reading.

Trade from the lowlands, Christian missions, schools and other government activities, and influences from the provincial capital at Bontoc in the centre of the area, are gradually changing old ways of life.

Bibliography.—A. E. Jenks, *The Bontoc Igorot* (1905); F. M. Keesing, "Notes on Bontok Social Organization, Northern Philippines," *Amer. Anthrop.*, vol. 51, no. 4, pp. 578–601, with bibliography (1949). (F. M. Kg.)

BONUS, a term used in business to describe payments in addition to those ordinarily received or due. The original implication was that an exceptional or gratuitous payment is involved. While many uses of the term continued to carry this implication, bonuses came to be employed most widely as an integral part of wage and commission contracts. In these contexts, bonus is used to describe a subsidiary payment contingent upon certain performance by the recipient, as opposed to the basic or regular payment rate. Because the motive underlying a bonus payment system is to provide an incentive for performance, an attempt is usually made to relate the size of the bonus to individual performance. Industrial workers may be given attendance bonuses, production bonuses, efficiency bonuses or safety bonuses. Special bonuses for salesmen and agents, payable in addition to a basic commission rate for sales over and above a certain quota, are used commonly in the field of marketing. Such selling bonuses provide not only an incentive for greater sales efforts but also serve to reduce the turnover of salesmen if the bonus is payable at less frequent intervals than the basic commission rate, and if the bonus rate itself is scaled to length of service.

The problem of achieving an equitable and easily understood system to reward individual effort and also provide sufficient inducement to the individual concerned presents the principal difficulty in establishing the bonus form of payment. When the problem cannot be solved because it is not possible to establish clearly the contribution which a single individual makes to the results of the group, the device of a group bonus is used. The total payment is linked to over-all results obtained and is divided among individuals according to a predetermined arrangement, often based on the employee's salary and length of service. Such group bonus plans are employed most widely in compensating executives, managers and office workers. A less formal use of the bonus concept, which is designed to reward workers for a successful business year, is the annual or Christmas bonus. Bonuses granted to returning war veterans provide yet another example of the use of the bonus idea to express appreciation to members of a large group.

In the world of finance, the generic term bonus has been supplanted to a great extent by more specific terms, especially in the United States. It has become common practice for corporations to pay a regular conservatively computed quarterly dividend to holders of stock and to supplement these payments with a bonus payment, called an extra dividend, at the end of the fiscal year. This

practice enables a corporation to adjust total dividends to a possible decline in earnings by discontinuing the bonus payment while maintaining the regular rate. Mutual life insurance companies likewise establish their premium computations on a conservative basis and, at the end of the accounting period, refund the overpayments of premiums to policyholders as a bonus or dividend payment. Use is also made of bonuses to facilitate the sale of bonds, debentures and preferred stock. These bonuses can take the form of shares of common stock given to purchasers of the senior security which is being marketed; or, as is more usual today, such purchasers are given an option to purchase common stock at a set favourable price within a certain time, in the form of stock purchase warrants. *See* also PROFIT SHARING; WAGES. (EA. S.)

BOOK. Any discussion of books must, because of the complexity of the subject, be many sided to include the major facets that embrace origins, preparation and production as well as the multitude of associated interests that comprise the over-all picture. Books have content, and a study of the character and purpose of content is one obvious approach to them. Much social and historical analysis, broad literary criticism and systematic bibliography have dealt with the content of books. Books also have physical form. Interest in this aspect of books focuses on the materials from which they are made, their format, their script or typography and their illustration and decoration. The form of the book is the field of study of such specialized scholars as papyrologists, paleographers, art historians and analytical bibliographers. Finally, books are made and distributed to people. The investigation of this process is the province of the history of printing and publishing, the history of libraries, enumerative bibliography and textual criticism. In recent years surveys of reading and reading interests extended this study to the ultimate destination of the book in the hands of the reader. Thus there are many fields of specialization which are concerned with the subject of books. They are treated elsewhere in this encyclopaedia, but no one of them alone presents a discussion of the ways in which the contents, the form, the making, distribution and use of books are related to each other in the society which they serve—the subject discussed here.

After a brief introduction, which defines "book," this article is divided into the following sections and divisions:

I. The Origins of Books
  1. Books on Clay Tablets
  2. The Egyptian Papyrus Roll
  3. The Earliest Chinese Books
II. Greek and Roman Books
  1. Greek Books
  2. Roman Books
III. Vellum and the Codex
  1. Vellum and Parchment
  2. Christianity and the Book
IV. The Medieval Book
  1. The Monasteries
  2. The Revival of the Secular Book Trade
  3. Humanistic and Vernacular Books
V. The Invention of Printing
  1. Early Printing
  2. Incunabula
  3. Printed Illustrations
  4. Demand and Prices
VI. The 16th-Century Book
  1. Technical Advances
  2. Division of Labour
  3. Economics
  4. The Contents of Books
  5. Reading
VII. The Early Modern Book
  1. Authors and Content
  2. Librarians and Book Collectors
  3. Censorship
  4. The Book in America
  5. The Growth of Reading
  6. Prices
  7. The Art of the Book
VIII. The 19th-Century Book
  1. Industrialization
  2. Democracy
  3. Mechanization and the Art of the Book
IX. The Book in the 20th Century
  1. The Book and Other Media
  2. Photographic Processes
  3. Marketing Developments
  4. Comic Books
  5. Children's Books
  6. Modern Book Arts
  7. Reading in the 20th Century

For other specialized aspects of books *see* PUBLISHING; PAPYROLOGY; CALLIGRAPHY; PALEOGRAPHY; WRITING; ILLUMINATED MANUSCRIPTS; LIBRARY; PRINTING; PRINTING TYPE; TYPOGRAPHY; WOODCUT AND WOOD ENGRAVING; ENGRAVING, LINE; BOOKBINDING; BOOKSELLING; BOOK COLLECTING; LITHOGRAPH; BIBLIOGRAPHY; READING; TEXTUAL CRITICISM; CRITICISM.

The form, content and provisions for making and distributing books have varied so widely during their long history that it is necessary to look for some constant characteristics of the book in order to arrive at a definition of it. The most obvious characteristic is that a book is designed to serve as an instrument of communication. This has been the purpose of such diverse forms as the Babylonian clay tablet, the Egyptian papyrus roll, the medieval vellum codex, the printed paper codex (most familiar in modern times), the microfilm and various other combinations. The same holds true for equally great variations in content. Both Shakespeare's collected plays, first published in 1623, and the most ill-conceived and trivial tract published in that or any other year were designed as instruments of communication.

A second characteristic of the book is its use of writing or some other system of visual symbols (such as pictures or musical notation) to convey a meaning. A sophisticated medium of communication, it requires mastery of the hard-won skills of reading and writing. A third distinguishing feature is publication for tangible circulation. A temple column with a message carved on it is not a book. On the other hand, signs and placards which are easy enough to transport are made to attract the eye of the passer-by from a fixed location and are not usually considered books. Nor are private documents so considered.

A book, for the purpose of this discussion, is a written (or printed) message of considerable length, meant for public circulation and recorded on materials that are light yet durable enough to afford comparatively easy portability. Its primary purpose is to carry a message between people, depending on the twin faculties of portability and permanence. As such, the book transcends time and space to announce, to expound, and to preserve and transmit knowledge. Books have attended the preservation and dissemination of knowledge in every literate society. The following account, keeping mainly within the scope of civilization as it developed in western Europe and North America, considers the physical book as it appeared at different times in history, the characteristic content and survivals of copies and texts, the means of production and distribution, and the society which has been served.

I. THE ORIGINS OF BOOKS

How soon men began to make books after the invention of writing is hard to ascertain because of the problem of survival of the materials on which books were made. The oldest examples of writing are on stone. The more fragile materials which at various times have been used for writing are less indestructible. The earliest known books were the clay tablets of Mesopotamia and the papyrus rolls of Egypt. Examples of both date from the early 3rd millennium B.C.

1. Books on Clay Tablets.—The ancient Sumerians, Babylonians, Assyrians and Hittites wrote on tablets made from water-cleaned clay. Although these writing bricks varied in shape and dimensions, a common form was a tetrahedron about five inches long. While the clay was still wet, the writer used a stylus to inscribe it with cuneiform characters. By writing on every surface in small characters, he could copy a substantial text on a single tablet. For longer texts he used several tablets, linking them together by numbers and catchwords as is done in modern books.

Either dried in the sun or glazed in a kiln when finished, clay tablets were almost indestructible. Buried for thousands of years in the mounds of forgotten cities, they have been recovered intact in the archaeological excavations which began in the 19th century. One estimate placed the number of clay tablets recovered at 750,000, but new finds continually add to the total of survivals that

represent this book production of 2,000 years. The largest share of the survivals are private commercial documents and government archives. Of the remainder, there are many duplications in texts.

The nature and volume of the surviving records from Mesopotamia and Asia Minor indicate a heavy emphasis on the preservative function of writing and the book. A royal library was discovered in the ruins of the palace of Ashurbanipal, an Assyrian ruler of the 7th century B.C. Bricks containing texts of special value, legal codes, royal annals and epics were usually baked in a kiln for greater preservation. Reading and writing were taught in schools connected with temples, but considering the complex system of writing employed, it is doubtful whether more than a small specialized class learned to read and write.

Clay tablets and cuneiform writing went hand in hand. The script takes its modern name from the wedge-shaped marks made by the stylus in clay (*see* CUNEIFORM). When the Aramaic language and alphabet (*q.v.*) arose in the 6th century B.C., the clay tablet book declined because clay was not so adaptable to the Aramaic characters as papyrus was. Although survivals date as late as 6 B.C., such late examples were the symbols of reaction rather than the products of a thriving scholarship.

2. The Egyptian Papyrus Roll.—The papyrus roll of ancient Egypt is more nearly the direct ancestor of the modern book than is the clay tablet, and it is of about equal antiquity. Papyrus (*q.v.*) as a writing material resembles paper. It was made from a reedy plant of the same name which flourished in the Nile valley. Strips of papyrus pith laid at right angles on top of each other and pasted together made cream-coloured papery sheets. Although the sheets varied in size, ordinary ones measured about five to six inches wide. The sheets were pasted together at alternate edges to make a long roll. To make a book, the scribe copied a text on the side of the sheets where the strips of pith ran horizontally (recto), and the finished product was rolled up with the text inside.

Papyrus affected the style of writing just as clay tablets had done. Scribes wrote on it with a reed pen and inks of different colours. The result could be very decorative, especially when done in the monumental hieroglyphic style of writing, a style best adapted to stone inscriptions (*see* HIEROGLYPHS). The Egyptians created two cursive hands, the hieratic (priestly) and the demotic (commercial), which were better adapted to papyrus.

Compared to bricks, papyrus is fragile, yet an example is extant from 2500 B.C.; and older stone inscriptions portray scribes with rolls. This amazing survival is partly the result of the dry climate of Egypt, in which some rolls survived unprotected for centuries while buried in the desert sands. Another reason for the preservation of Egyptian books was the Egyptians' funerary customs. Obsessed by a concern with life after death, they wrote magical formulas on coffins and on the walls of tombs to guide the dead safely to the gates of the Egyptian underworld. When the space thus provided became insufficient, they entombed papyrus rolls containing the texts. These mortuary texts are now described collectively as the *Book of the Dead*, although the Egyptians never standardized a uniform collection. Such books, when overlooked by grave robbers, survived in good condition in the tomb.

Besides mortuary texts, Egyptian survivals include scientific writings and a large number of myths, stories and tales. The train of native Egyptian scholarship was broken, however, by Alexander's conquest of Egypt in the 4th century B.C.; and the Hellenization program undertaken by the Ptolemaic kings, who ruled from the 4th to the 1st century B.C. The *Book of the Dead* was known in the early Christian era, but not long afterward the books of Egypt were closed and remained a secret until, in the 19th century, Jean François Champollion and Thomas Young deciphered the writing of the Rosetta stone.

Quotations from ancient writings show that scribes were highly regarded in ancient Egypt. They were the priests and government officials employed in the temples, pyramid complexes and the courts of the Pharaohs. Herodotus reported that Egyptian embalmers did a thriving business in copies of the *Book of the Dead*.

3. The Earliest Chinese Books.—The Chinese, though not so early in their development as the Sumerians and the Egyptians, were the third people to create an extensive bookish scholarship independently. Although few survivals antedate the Christian era, literary and archaeological evidence indicates that the Chinese had writing and probably books at least as early as 1300 B.C. Those primitive books were made of wood or bamboo strips bound together with cords. Many such books were burned by the Ch'in emperor Shih Huang Ti in 213 B.C. The fragility of materials and the damp climate resulted in the loss of other ancient copies.

The Chinese developed an important literature early and maintained it through an unbroken tradition of scholarship. It was the strength of the tradition which Shih Huang Ti feared when he burned the books. However, enough scholars and books escaped the edict so that a Chinese national bibliography appeared in the 1st century B.C., prepared by a corps of specialists in medicine, military science, philosophy, poetry, divination and astronomy. A classified list of works on tablets and on silk, it mentioned 677 books. With such a tradition, the survival of Chinese texts was assured by continuous copying and was not dependent on the capacity of a lone example to withstand the wear of the centuries.

II. GREEK AND ROMAN BOOKS

1. Greek Books.—The Greeks adopted the papyrus roll and passed it on to the Romans. Although both Greeks and Romans used other writing materials (waxed wooden tablets, for example) the Greek and Roman words for book show identification with the Egyptian model. Greek *biblion* ("book") can be compared with *byblos* ("papyrus"), while the Latin *volumen* ("book") signified a roll. David Diringer reached the conclusion that papyrus was continuously in use in Greece from the 6th century B.C., and cited evidence to indicate its use as early as 900 B.C. Frederic G. Kenyon argued that Homer had books in the 9th century B.C. Plato, Xenophon and Aristophanes mentioned books and their use in the 5th century B.C. The oldest extant Greek rolls, however, date from the 4th century B.C.

The 30,000 extant Greek papyri permit a generalized description of the Greek book. Rolled up, it stood about nine or ten inches high and was an inch or an inch and a half in diameter. When the book was unrolled it displayed a text written in the Greek alphabet in columns about three inches wide separated by inch-wide margins. In spite of the Greek proficiency in decorative arts, few surviving books are illustrated. Such illustrations as have survived were of the practical sort in later scientific books.

Practicality was a mark of the Greek book. The alphabet, although not invented by the Greeks, was adapted and stabilized by them as an instrument of verbal communication with little decorative purpose. Unlike the monumental Egyptian survivals in a decorative hand which sometimes exceeded 100 ft. in length, Greek rolls seldom exceeded 35 ft. in length and featured little embellishment. Such a roll was about as large as could be conveniently held in the hands to read, and it was big enough to hold a book of Thucydides (or one of the longer New Testament Gospels). The average Greek book was shorter. Two books of Homer written in a later small hand fitted a 35-ft. roll.

During the golden age of Athens in the 5th century B.C., books were known and used but were lightly regarded as avenues of learning. Grecian scholarship of the time of Socrates was concerned with that which could be observed by living witnesses, and the interest was focused in the narrow geographical sphere of the city-state. It was an age of brilliant talk based on personal observation and experience. In literature this interest brought forth great tragedies and comedies, speeches, poems, histories and lectures which stand at the beginning of occidental literary traditions; but all evidence indicates that the preferred method of publication at that time was oral. The actor, the orator, the rhapsodist and the lecturer were supreme.

Given the interests and the scope of inquiry of Periclean Greeks, it is noteworthy that they had books and read them at all. The Greek readers were general readers. Though it should not be assumed that all who lived in Athens could read, those who could included more than the narrow circle of scribes and scholars who were trained from youth to reverence books and to make a career of the difficult arts of reading and writing. The Greek alphabet reduced the difficulty, and the Greek books with their nonspe-

cialized content were practical instruments of communication to a general public.

With the coming of Alexander the Great, the narrow peninsular outlook of the Greeks was broadened into a universal attitude which was reflected in their use of books. The Alexandrian kingdoms spread over the east and embraced ancient foreign cultures. The Greeks were forced to extend their interest to these alien peoples and into the records of the past. Consequently, the range of important things became too extensive for oral transmission and for the solitary speaker. In the important Hellenistic cities, most notably at Pergamum and Alexandria, centres of learning aiming at a world synthesis of knowledge grew up. (A noteworthy example of this synthesizing work was the Septuagint, which was a translation of the Hebrew Scriptures into Greek.) Libraries were a distinguishing feature of these centres. The Museum and the Serapeum at Alexandria were reputed at various times to have from 200,000 to 700,000 rolls. The Ptolemies at Alexandria pursued a vigorous collecting policy in an attempt to acquire good copies of all important texts; and scholars were constantly at work on textual scholarship and the writing of new books, including much detail from the broadened scope of knowledge. As a result, the Alexandrian literature was characterized by the many allusions to things and events outside the popular ken. For this scholarship the book superseded the oral presentation as a primary means of publication. Greek writers referred to the market in books and to prices paid for them. The discovery of surviving papyri in the rubbish heaps of provincial towns indicates that the trade was widely diffused. The record shows that the large libraries of the Hellenistic period maintained scriptoria in which extensive copying was done. However, survivals are scanty and there is no group of extant examples which bear such close resemblance to each other as to indicate that they were the product of the same scribe or scriptorium. Some surviving rolls bear the mark of professional work; others are amateurish. The volume of surviving Greek texts is so slender that it arouses speculation about the nature of the large book collections of Alexandria. There are various explanations. First, the Alexandrians were doing textual criticism and required many copies of the same text to carry on the work. Second, the record indicates that the volume of Greek literature was much larger than the survivals, a majority of the texts having been lost. Literary and bibliographical references made by ancient writers and bibliographers indicate, for example, that the dramatists Aeschylus, Sophocles, Euripides and Aristophanes wrote among them about 330 plays. The survivals number 43. Nearly all of Greek lyric poetry has been lost. Many of the texts died a lingering death. Only one-fourth of those cited by Stobaeus, an anthologist of the 5th century A.D., survived to modern times.

The survival of Greek texts depended on copying by succeeding generations. No manuscript is extant in the hand of either a Greek or Roman author, and the earliest extant copies of most works date from centuries after the composition. In such circumstances, the greatest factor in survival was the widespread and continuing popularity of a work. The centres of textual criticism fostered the preservation of some texts by establishing a canon of writings to be taught in the schools. This practice was more important than their own great libraries, because these collections were destroyed; while the widespread copying rendered books less vulnerable to local disasters. Finally, the universal interest and application of the content was an important factor which led to the survival of some nonliterary texts through translation into Arabic, Latin and other foreign languages.

2. Roman Books.—Rome was the channel through which the Greek book, both in its original garb and in its Latin dress, was introduced to the alien peoples of western Europe. When the Romans conquered Greece they carried home Greek libraries as a foundation for similar libraries in Rome. Roman libraries had separate collections of Greek and Latin books; but except for the substitution of the Latin alphabet, a Roman papyrus roll closely resembled a Greek one in content; there was much imitation.

The Romans developed a book trade on a fairly large scale. From the time of Cicero there is evidence of large scriptoria turning out copies of books for sale. On several occasions Cicero referred to book shops; Martial complained about professional copyists who became careless in their speed; Pliny described the extensive trade in papyrus. The trade decrees of Diocletian set a price for the copying of books.

Book ownership was widespread among Romans of the upper class. Private libraries were common, and were considered the necessary badge of distinction for anyone who aspired to high position or social importance. On the other hand, books were also within reach of less prosperous people because the use of slave labour to multiply copies kept prices relatively low. As many as 30 copies of a work might be made simultaneously by a reader dictating to slave copyists. From a comparative study of prices, Felix Reichman concluded that books were cheap enough for people with only moderate incomes to buy them.

The Roman emperors promoted public libraries, but the development in Rome differed from that in Alexandria where succeeding Ptolemies added to the ancestral establishment. There was a tendency for each of the Roman rulers to establish his own library. The Ulpian, established by Trajan, was renowned in antiquity for its scholarly collection. The Antonines appointed a procurator of libraries. Constantine made a survey which reported 28 public libraries in Rome in A.D. 300. All these public libraries in Rome and the provinces, as well as nearly all private collections, disappeared in the dissolution of the western Roman empire. With classical Latin texts, as with Greek texts, survival was dependent on an unbroken tradition of copying.

III. VELLUM AND THE CODEX

The substitution of the codex for the roll was a revolutionary change in the form of the book. The codex is the modern form of the book. Instead of having leaves fastened together on alternate edges to extend in a long strip, the codex was constructed from folded leaves bound together on one side—either the right or the left, depending on the direction of writing. (Some variant forms were bound at the top of the leaves.) The codex enjoyed several advantages over the roll. A compact pile of pages could be opened instantly to any point in the text, eliminating the cumbersome unrolling and rerolling, and facilitating the binding of many more leaves in a single book. In addition, the codex made feasible writing on both sides of the leaf; this was not practical for the roll. Because of its compactness, its ease of opening and its use of both sides of the leaf, the codex could conveniently contain longer texts. The difference can be illustrated with copies of the Bible. While the Gospel of Matthew about reached the practical limit of the roll, a common codex included the four Gospels and Acts bound together; and complete Bibles were not unknown.

The folded note tablets used by the Greeks and the Romans may have suggested the codex form, but its development to eventual supremacy was related to changes in the world of learning and in the materials for making books. The change in the scholarly outlook came from the rise of Christianity; the new material was vellum or parchment (*q.v.*). The codex is often called a Christian book in contrast to the pagan roll. It is also quite customarily called the vellum codex.

1. Vellum and Parchment.—Vellum and parchment are materials prepared from the skins of animals. Strictly speaking, vellum is a finer quality of parchment prepared from calf skins, but the terms have been used interchangeably since the middle ages. The forerunner of parchment as a writing material was leather. Egyptians referred to documents on leather as early as 2450 B.C., and a fragmentary Egyptian leather roll has been preserved from the 24th century B.C.; but leather was rarely used because papyrus was plentiful. Another early people who used leather for books were the Hebrews. The spectacular discovery of the Dead sea scrolls in the 1940s turned up collections of leather rolls stored in earthen jars in caves along the Dead sea. These liturgical and biblical books, produced by a Jewish ascetic sect, were thought by scholars to have been written near the time of Christ.

Parchment is greatly refined from leather. The skins of various animals—cattle, sheep and goats being most common—are washed and divested of hair or wool. Then the skin is stretched tight on a frame, scraped thin to remove further traces of hair and flesh,

whitened with chalk and smoothed with pumice. Tradition narrates that it was invented as the result of book-collecting rivalry between Ptolemy V of Egypt and Eumenes II of Pergamum about 190 B.C. Fearing the library at Pergamum might outstrip the collections at Alexandria, Ptolemy placed an embargo on papyrus to prevent his rival from making any more books, whereupon Eumenes made parchment. In some support of the tradition stands the fact that both Greek and Latin words for parchment mean "stuff from Pergamum."

Although parchment was used to produce book rolls, and although many early codices were on papyrus, the new writing material facilitated the success of the codex. A sheet of parchment could be cut in a size larger than a sheet of papyrus; it was flexible and durable; and it could receive writing on both sides. These qualities were important. In making a parchment or vellum codex, a large sheet was folded to form a folio of two leaves, a quaternion (quarto) of four or even an octavo of eight. Gatherings made from these foldings were then stitched together to form a book. Because papyrus was more brittle and could not be made in large enough sheets, the folio collected in quires (*i.e.*, loose sheets) was the limit of its usefulness. At the same time, because of the vertical alignment of the fibres on one side, papyrus was not well adapted for writing on both sides.

During 400 years the roll and the codex existed side by side. There were contemporary references to the codex book in the 1st century B.C.; actual survivals date from the 2nd century A.D. In the 4th century A.D. vellum or parchment as a material and the codex as a form became dominant; although there are later examples of rolls, and papyrus was occasionally used for official documents until the 10th century. Some influence of the roll on the codex can be seen in the use of multiple columns on the pages of early codices, much like the columnar writing on the rolls.

2. Christianity and the Book.—It is a marked characteristic of book survivals from the first four centuries A.D. that codices more often contained Christian writings, while pagan works were usually written on rolls. It was after Christianity had swept the Roman empire that the codex achieved its supremacy. There were several points in the Christian use of books that contributed to a preference for vellum and the codex. First, Christianity was rooted in Judaism, which for centuries had revered sacred writings. The Christians retained the Jewish Scriptures and added some writings of their own, a New Testament which they considered even more sacred. There was strong motivation for preserving these unchanging words on the most durable materials, and vellum was more durable than papyrus. Second, in referring to their sacred writings the Christians made comparative studies of sources. The writings were related, and students liked to refer from one source to another. This reference entailed having a comparatively large volume of writings available and increased the attractiveness of the easy turning of pages possible with a codex. In this respect it is noteworthy that Roman legal scholarship, which also required a comparison of sources, likewise showed an early preference for the codex. A third point was the expressed intention of early Christians to alienate themselves from pagan literature. The use of an entirely different form of book contributed to a sense of proper removal. At the same time the clinging of the pagan authors to an outmoded form may be ascribed in part to a conservative resistance to the Christian ideas.

Aside from the development of the codex, the Christian emphasis on books illustrates the role that the book has to play in society. In contrast with most of the many pagan religions, which were local and confined to a city or a province, the Christian religion aimed at universality. The process of Christianizing the Roman empire pursuant to this goal extended over three centuries, covered thousands of miles and embraced peoples of the most various backgrounds and individuals of the greatest differences of rank. In this process Christian scholarship produced a prolific stream of books, while the literary remains of the local pagan religions are exceedingly scarce. This difference reinforces the point made in contrasting the localized scholarship of the Periclean period with the bookishness of Alexandria. A world-wide outlook led to a greater dependence on books. Biblical texts and translations, commentaries, polemical tracts and pamphlets were important in the circumstances, not only to record belief but also to disseminate and explain it.

It has been noted that the vellum codex superseded the papyrus roll by A.D. 400. The truth is, that by the 4th century the Christian book had superseded the pagan book in every form. Little of importance was written in the classical tradition after A.D. 100. The greatest writers of the following three centuries were such Christian scholars as Origen, Pamphilus of Caesarea, Tertullian, St. Augustine and St. Jerome. Of all Christian books, however, the most numerous survivals are New Testament codices and apocryphal New Testament writings.

IV. THE MEDIEVAL BOOK

1. The Monasteries.—The dissolution of the western Roman empire during the 5th century, and the consequent dominance of marauding barbarians, threatened the existence of books. Fortunately the church withstood the assaults and remained as a stable agency which could provide the security and interest in tradition required by a bookish scholarship. Books found refuge in monasteries. The 6th-century Rule of St. Benedict enjoined monks to read books at certain times. The surrounding social chaos placed upon monasteries the responsibility for making books and creating libraries in order to implement the injunction. A more specific model was set by Cassiodorus Senator. After serving the Ostrogothic kings in high positions, Cassiodorus retired from public life in about 540 to found a monastery and establish a scriptorium at Vivarium. The scriptorium was the centre of his interest there. He supervised the copying of books and wrote guides to learning, the *Institutions of Divine and Human Readings*. These set forth references to laudable writers, discussed rules for editing, and suggested procedures for establishing a scriptorium and a library.

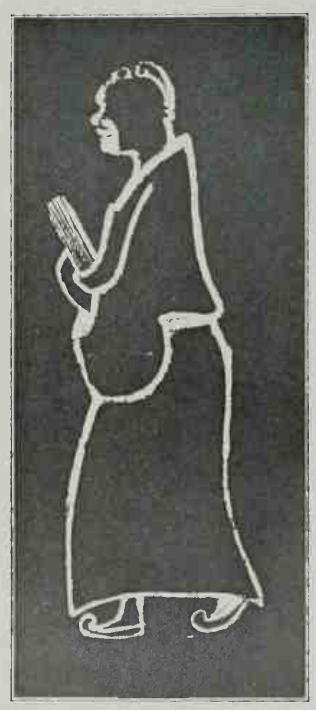
Following the early examples, monastic houses throughout the middle ages characteristically had libraries and scriptoria where they copied books to add to their collections. Arrangements for this activity varied from place to place. Occasionally the scriptorium was a single large room. Sometimes the copying was done in carrels, individual cells built in the cloister or library. Fittings for the scriptoria were spare; they lacked heat and artificial light. The labour (if contemporary complaints can be believed) was hard, for it was often said, "Two fingers hold the pen, but the whole body toils." The scribe sat at a desk copying in silence a text that was spread before him. The monks did not follow the practice of the Roman commercial scriptorium where a reader dictated a book while several scribes made simultaneous copies of it. Book production was slowed to a trickle, and the monastic library with as many as 600 volumes was considered to be quite large. Nevertheless, although the fruit was sparse, the bush was tough; and the monastic scriptoria kept the tradition of bookish scholarship alive from southern Italy to the coasts of Ireland during some trying centuries.

The medieval book was a codex written on vellum or parchment, although by the 15th century paper manuscripts were normal (*see* PAPER MANUFACTURE). Many medieval manuscripts attained a high perfection of colour and form and are renowned for their beauty. Such examples as the Book of Kells from Ireland, the Lindisfarne Gospels from England and the many brilliant "books of hours" made in France, to cite a few instances, are world renowned as examples of art. However, the customary book was less splendid. Written in a neat book hand that developed into the models from which printing types were drawn, the manuscript books of the middle ages, in all essential points, resembled very closely the printed books of the modern period.

Because the monastic book trade was largely internal, the contents of books are evident from the monastic library catalogues. Generally the catalogues grouped the books in three divisions. First came the Bible (*see* BIBLE, TRANSLATIONS OF) and commentaries. Writings of the church fathers and contemporary theologians followed. Finally there was a smaller section of worldly books—including at various places some classics, mathematics, medicine, astronomy, law and historical and philosophical writings. Books were written in Latin. Only with the onset of humanistic

Section 8 of the Milbank papyrus, Ptolemaic dynasty, from the *Book of the Dead*, a mortuary text written in ink on papyrus and left in Egyptian tombs to guide the dead to the underworld

Old Babylonian clay tablet, one of the earliest forms of the book, and the envelope in which it was sealed; a legal contract from about 1400 B.C.

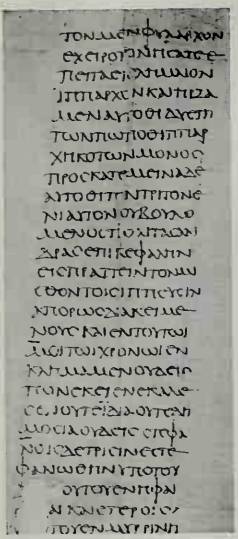


Ancient tomb tile showing a Chinese scholar carrying a bamboo book consisting of tablets tied together with string

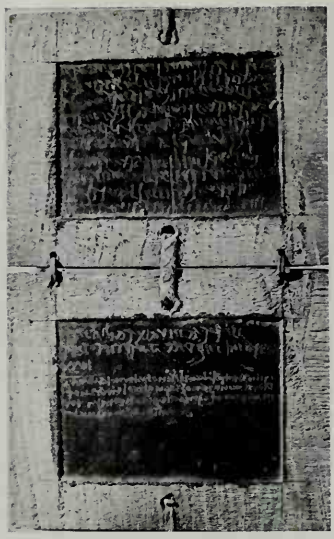
EARLY FORMS OF THE BOOK

BY COURTESY OF (TOP, BOTTOM LEFT) THE ORIENTAL INSTITUTE; PHOTOGRAPH, (BOTTOM RIGHT) FROM W. C. WHITE, "TOMB TILE PICTURES OF ANCIENT CHINA," UNIVERSITY OF TORONTO PRESS, 1939

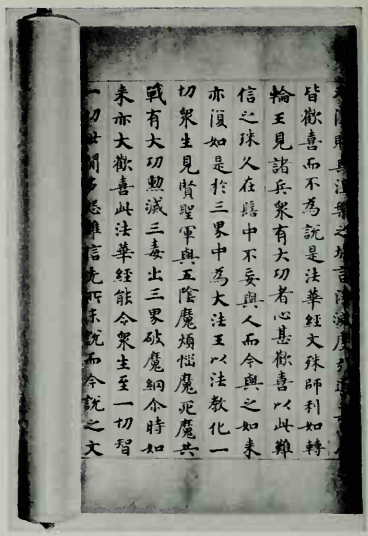
BOOK



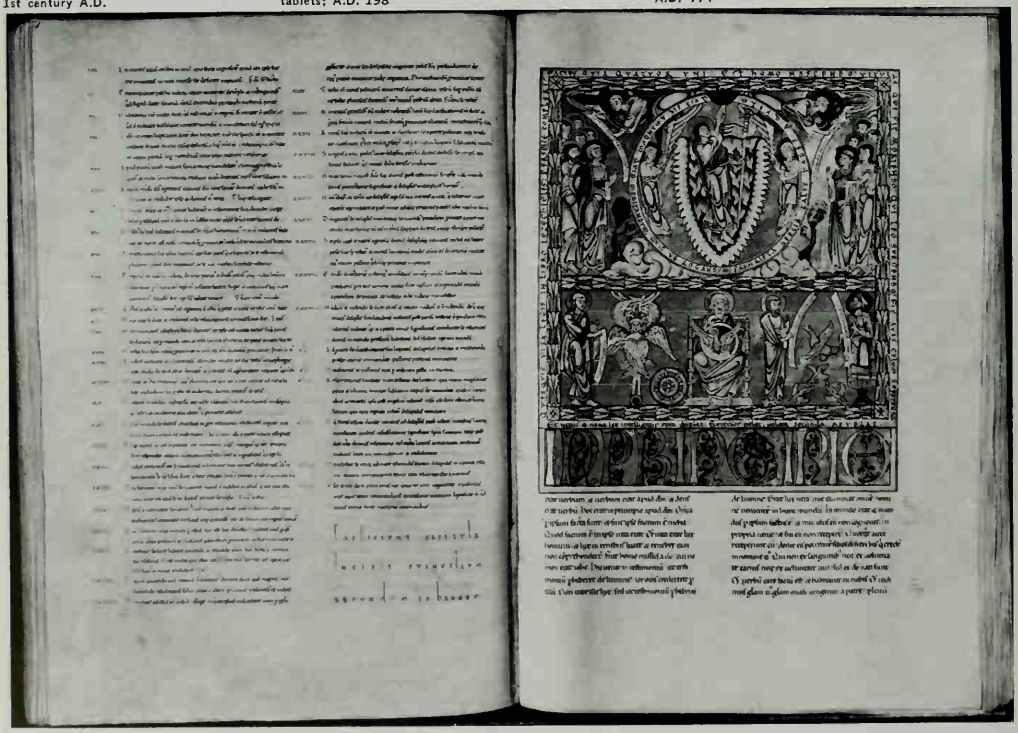
Column from a Greek papyrus roll containing the speeches of Hyperides; 1st century A.D.



Roman diptych showing the text written in cursive Latin on the interior sides of two waxed wooden tablets; A.D. 198



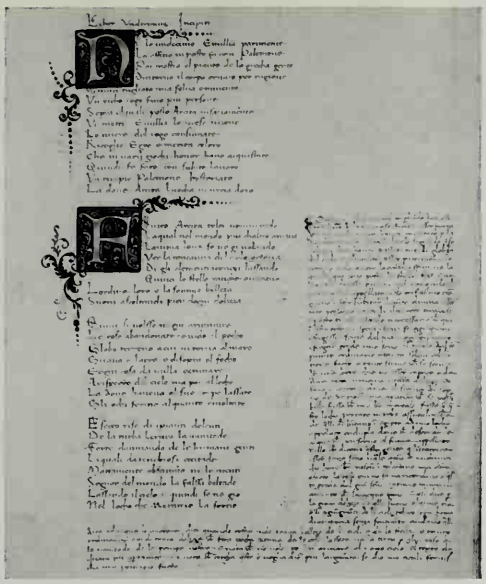
Chinese paper roll written in ink. Paper was invented in China in the 2nd century A.D. This piece was made in A.D. 774



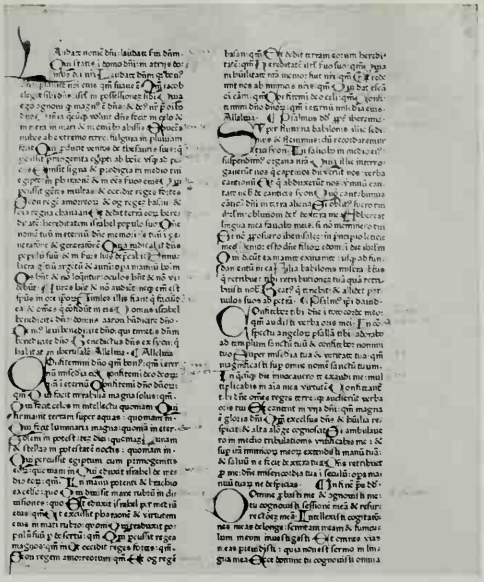
Facing pages from the Gospel of St. John, showing the capitula on the left and the first page on the right, with miniatures and illuminated initials; from a Vulgate version of the Bible written for the Abbey of Floreffe, near Namur, Belg.; *c.* 1160

GREEK, ROMAN, CHINESE AND EARLY CHRISTIAN BOOKMAKING

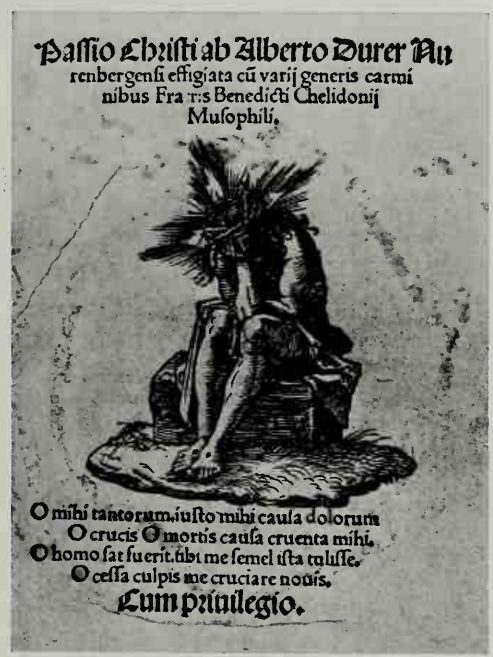
BY COURTESY OF (TOP LEFT, BOTTOM) THE TRUSTEES OF THE BRITISH MUSEUM, (TOP CENTRE) BODLEIAN LIBRARY, OXFORD, (TOP RIGHT) THE TRUSTEES OF THE BRITISH MUSEUM FROM "ANCIENT BOOKS AND MODERN DISCOVERIES," THE CAXTON CLUB, CHICAGO 1927



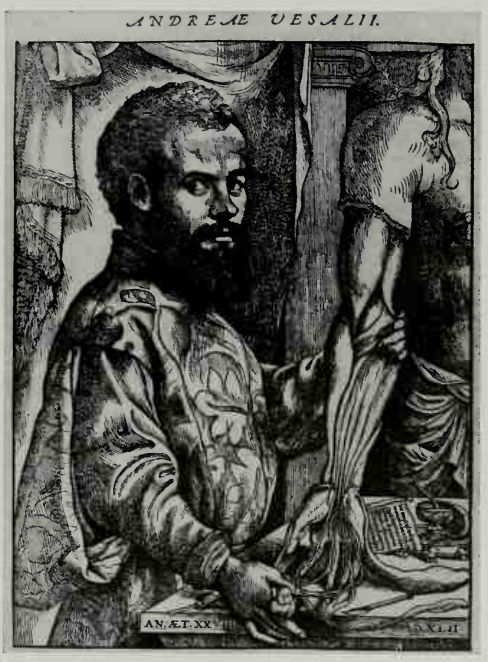
Page from Giovanni Boccaccio's *Teseida Poema, cum Commentario*, a manuscript book written on paper about 1430



Leaf from a Latin Bible published by Anton Koberger at Nürnberg, Ger., in 1475, bearing the handwritten references of the owner



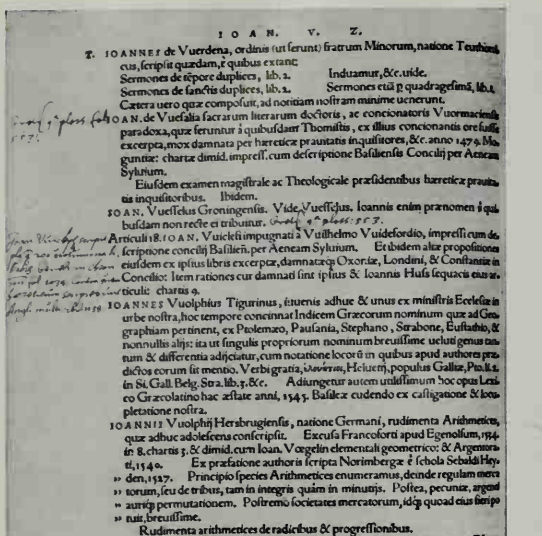
Woodcut by Albrecht Dürer illustrating the title page of *Die kleine Holzschnitt-Passion* published at Nürnberg in 1511



Woodcut illustration from one of Andreas Vesalius' 16th-century anatomical books showing the author demonstrating the dissection of an arm

PAGES OF 15TH- AND 16TH-CENTURY EUROPEAN BOOKS

ALL (EXCEPT BOTTOM LEFT) BY COURTESY OF THE UNIVERSITY OF CHICAGO LIBRARY



IOAN. V. Z.

T. IOANNES de Vuerdena, ordinis (ut ferunt) fratrum Minorum, natione Teuthonicus, scripsit quædam, quibus extant:

Sermones de tempore duplices, lib. 2. Indutamur, &c. uide.
Sermones de sanctis duplices, lib. 2. Sermones etiã p quadragesimã, lib. 1.

Cætera uero quæ composuit, ad nostram notitiam minime uenerunt.

IOAN. de Vuesalia sacræ uim literarum doctoris, ac conciunatoris Vuormaciensis, paradoxa, quæ feruntur à quibusdam Thomistis, ex diuus conciunantis ore fusis excerpta, mox damnata per hæreticæ prauitatis inquisitores, &c. anno 1479. Magguntiæ: chartæ dimid. impressi. cum deser iptione Basiliensis Concilij per Aeneam Sylvium.

Eiusdem examen magistrale ac Theologicale præsidentibus hæreticæ prauitatis inquisitoribus. Ibidem.

IOAN. Vuesselius Groningensis. Vide Vuesselius. Ioannis enim prænomen à quibusdam non recte ei tribuitur.

Articuli 18. IOAN. Vuickefi impugnati à Vuilhelmo Vuidefordio, impressi cum declaratione, scripti one concilij Basilien. per Aeneam Sylvium. Et ibidem alter propositiones eiusdem ex ipsius libris excerptæ, damnatæq; Oxoniæ, Londini, & Constantiæ in Concilio: Item rationes cur damnati sint ipsius & Ioannis Husi sequacis eius articuli: chartis 9.

IOANNES Vuolphius Tigurinus, etuenis adhuc & unus ex ministris Ecclesiæ in urbe nostra, hoc tempore concinnat Indicem Græcorum nominum quæ ad Geographiam pertinent, ex Ptolemæo, Pausania, Stephano, Strabone, Eustathio, & nonnullis aliis: ita ut singulis propriorum nominum breuissime ueluti genus tantum & differentia adjiciatur, cum notatione locorũ in quibus apud authores prædictos eorum fit mentio. Verbi gratia, Ἰλιον, Ilium, populus Galliæ, Pto. 8. in Sti. Gall. Belg. Strz. lib. 3. &c. Adiungetur autem uindissimum hoc opus Latino Græcolatino hac æstate anni, 1545. Basileæ cudendo ex castigatione & locupletatione nostra.

IOANNIS Vuolphij Hersbrugiensis, natione Germani, rudimenta Arithmeticæ, quæ adhuc adolescens conscripsit. Excusa Francofurti apud Egenolphum, 1526. in 8. chartis 3. & dimid. cum Ioan. Vogelin elementali geometricæ: & Argentorati. Ex præfatione authoris scripta Norimbergæ è schola Sebaldi Heydeni, 1540.

» den, 1537.
» torum, seu de tribus, tam in integris quàm in minutijs. Postea, pecuniæ, argenti
» aurisq; permutationem. Postremo fodalitates mercatorum, idq; quoad eius fieri po
» tuit, breuissime.

Rudimenta arithmeticæ de radicibus & progressionibus.

IOANNIS Vuitrij Remensis, natione Galli, epigrammatum libri duo, impressi Lugduni apud Seb. Gryphium, 1536. in 8. chartis 11. & ibidẽ anno sequente apud Patricium Salmonium: cum præfatione authoris scripta Lugduni, 1536. Versus apparent de Christo & argumenta & ad imitationem Martialis compositi.

T. did. 1540. IOANNES Zacharias, natione Teuthonicus, patria Erfordensis, scripsit quædam præclara opuscula, e quibus ferunt: S. Jac. Ep.

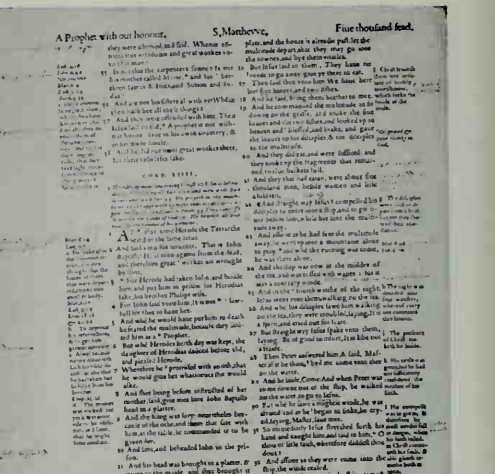
Super Sententias,	lib. 4.	In Genesim,	lib. 1.
In Exodum,	lib. 1.	In Leuiticum,	lib. 1.
In Epistolas Pauli,	lib. 14.	Sermones uarij,	lib. 1.

Et alia quædam.

IOANNIS Zachariæ cuiusdam medicina, extat Græce in Italia.

IOAN. Zonaras monachus, historicus, historiam Græce ab exordio mundi usque ad eius finem epitomes nomine collegit, usq; ad sua tempora, nempe Michaelis imperatoris Constantinopolitani. Hæc historia Græce extat Romæ. Vide supra in IOAN.

Page from *Bibliotheca universalis*, first printed bibliography, published by Konrad von Gesner in 1545. A comprehensive list of scholarly books written in Latin, Greek, or Hebrew arranged alphabetically by the first names of the authors



A Prophet without honour. 5. Matthew. Five thousand feast.

plate and the house is already full: let the bridegroome depart alone: they may go woe the sooner, and bye them selues.

But Iesus said vnto them, They haue not need to go away: giue ye them to eate.

They said vnto him: We haue here but fiue loues and two fishes.

And he said, Bring them hither to me.

And he commanded the multitude to sit downe vpon the grasse, and tooke the fiue loaues and the two fishes and looked vp to heauen and blessed and brake, and gaue the loaues to his disciples & his disciples gaue vnto the multitude.

And they did all eate and were fulfilled: and they tooke vp the fragments that remained, twelue full baskets.

And they that had eaten, were about fiue thousand men, beside women and little children.

And straight way Iesus compelled his disciples to get vp into a ship & go before vnto the other side, while he sent the multitude away.

And when he had sent the multitude away, he went apart into a mountaine aboue to pray. And when the euening was come, he was there alone.

And the ship was now in the middes of the sea, and was tossed with waues: for it was a contrary winde.

And in the fourth watche of the night, Iesus went vnto them walking vpon the sea.

And when the disciples saw him walking vpon the sea, they were troubled, saying, It is one commeth vnto vs.

And they cried out for feare.

But straight way Iesus spake vnto them, saying, Be of good comfort, it is I, be not afraid.

Then Peter answered him & said, Master if it be thou, bid me come vnto thee vpon the water.

And he said, Come. And when Peter was come downe out of the ship, he walked vpon the water to go to Iesus.

But when he saw a mighty winde, he was afraid: and as he began to sinke, he cryed, saying, Master, saue me.

And straight way Iesus stretched forth his hand and caught him and said to him, O thou of little faith, wherefore doubtest thou?

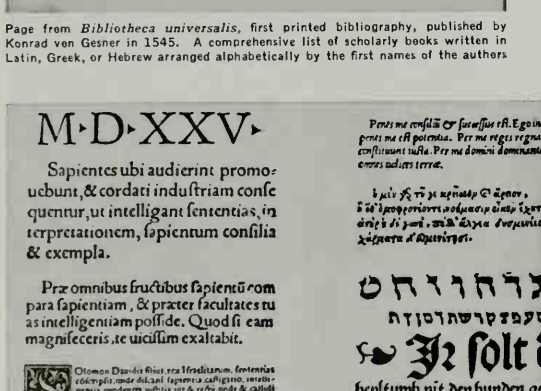
And assone as they were come into the ship, the winde ceased.

Then they that were in the ship, came & worshipped him, saying, Of a truth thou art the Sonne of God.

And when they were come ouer, they came into the land of Genezareth.

And when the men of that place knewe him, they sent out into all that countrey round about and brought vnto him all sicke, and that were diseased.

And besought him, that they might only touch the hemme of his garment: and as many as touched it, were made perfect whole.



M·D·XXV·

Sapientes ubi audierint promouebuntur, & cordati industriam consequentur, ut intelligant sententias, interpretationem, sapientum consilia & exempla.

Præ omnibus fructibus sapientiæ comparate sapientiam, & præter facultates tuas intelligentiam posside. Quod si eam magnifeceris, te uicissim exaltabit.

Ottomon Dux dixit rex Israelitarum, sententias edocuit, mode didacti sapientia castigatio, intellectus prudentia, institutio, ars & recte, unde & callidi uerbi imperij & pœne scientiam & consilia pepere.

Sapientia foras clamitat, se plateis uoci edit, inuitat ibi pene pro pœne ciuentes, & in urbe concionatur.

Quotidie tandem imperium imminet imperitum, & subito imperio sæuus delectamen, & tetus tiennium odibit. Adhortatio nouella ad incrementum meum. Ecce spiritum meum nobis effabo, sententiam meã expediam. Do meus uerba mea uestrum.

Deus enim ex ore suo sapientiam & scientiam, & intelligentiam largitur, rectis dat sua ipsum. Protegit probos. Iuit uiarum & uias sanctorum suorum custodit. Im de mũ intelliges iustitiam, ius, rectas & bonas uias omnes.

Petes me consilia & suscipies ea. Ego intelligentia sum, mea mihi potentia. Per me reges regnant, & principes constituunt iusta. Per me domini dominantur, & regnant omnes iudices terræ.

Ἐμὲ γὰρ ἐγὼ τὸ κρίνασθαι ἐξέρχομαι,
ἐν δὲ πλατείαις φθέγγομαι ἐπὶ πύλαις τῆς πόλεως
ἐπὶ τῇ θύρᾳ μου κάθημαι, καὶ ἔξω τοῦ ἀνδρείου
λέγομαι ἐν ἀγορᾷ.

אבגדהוזחט
יכלמנסעפצקרשתסוזקן

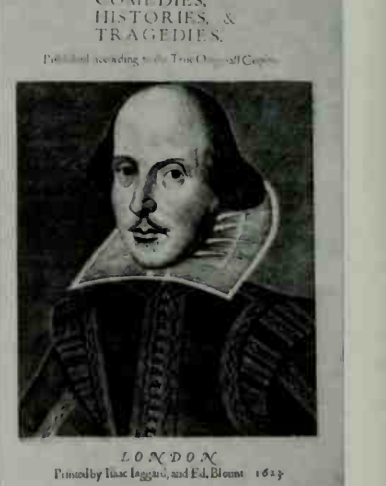
Jr solt das

beseltumb nit den bunden gebē/Vnd eüwere perlē nit für die sew werffen/auff das sie die selbigen nit zutretten mit iren füssen/vnd sich wenden/vñ euch zerreissen. ꝛc.

Alles das jr wöllent/das euch die leut thun sōllē/das thunt jn auch ir/Das ist das gesetz vñ die propheten.
Der Herr aus sihet auff die en fürchten.

Jo. Petrius

Specimen type sheet issued in 1525 by J. Petri, a type founder from Basel, Switz., showing some of the type faces available to printers during the 16th century



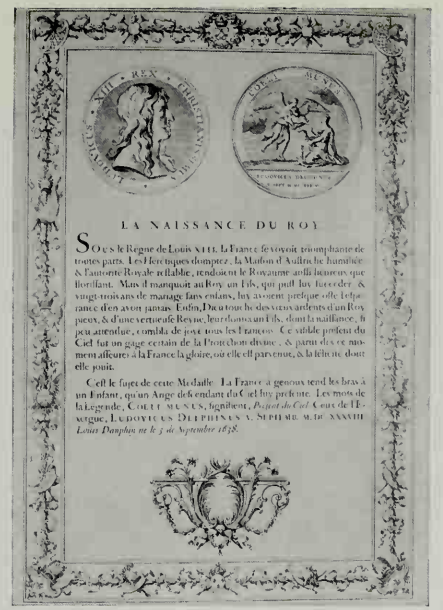
Mr. WILLIAM
SHAKESPEARES
COMEDIES,
HISTORIES, &
TRAGEDIES.

LONDON
Printed by Isaac Iaggard, and Ed. Blount 1623

Droeshout engraving of William Shakespeare, title page of the First Folio edition of Shakespeare's plays; 1623

A 16TH-CENTURY TYPE SHEET AND PAGES FROM 16TH- AND 17TH-CENTURY BOOKS

BY COURTESY OF (TOP LEFT AND RIGHT) THE UNIVERSITY OF CHICAGO LIBRARY, (BOTTOM RIGHT) THE FOLGER SHAKESPEARE LIBRARY; PHOTOGRAPH, (BOTTOM LEFT) FROM D. B. UPDIKE, PRINTING TYPES: THEIR HISTORY, FORMS AND USE. THE BELKNAP PRESS OF HARVARD UNIVERSITY PRESS, 1922, 1937, 1962

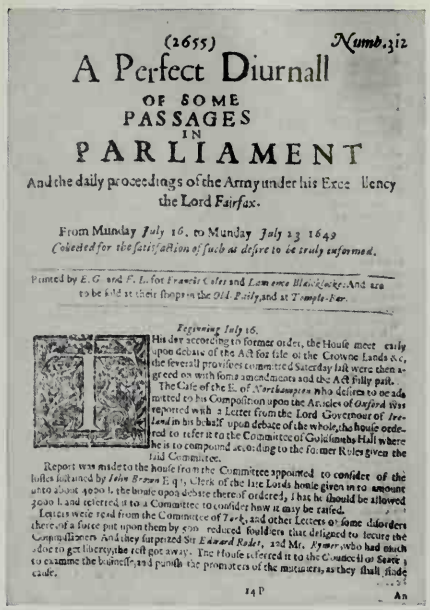


LA NAISSANCE DU ROY

SOYES le Regne de Louis XIII. la France se voyoit triomphante de toutes parts. Les Heretiques domptez, la Maison d'Autriche humiliée & l'autorité Royale reſtablie, rendoient le Royaume auſſi heureux que floriſſant. Mais il manquoit au Roy un Fils, qui pût luy ſuccéder, & vingt-trois ans de mariage ſans enfans, luy avoient preſque oſté l'eſperance d'en avoir jamais. Enfin, Dieu touché des tres-ardentes d'un Roy pieux, & d'une vertueuſe Reine, leur donna un Fils, dont la naiſſance, à peu attendue, combla de joye tous les François. Ce viſible preſent du Ciel fut un gage certain de la Protection divine, & parut dés ce moment aſſeurer à la France la gloire, où elle eſt parvenue, & la felicité dont elle joüit.

Ceſt le ſujet de cette Medaille. La France à genoux tend les bras à un Enfant, qui un Ange deſcendant du Ciel luy preſente. Les mots de la Legende, COELI MUNUS, ſignifient, *Preſent du Ciel*. Ceux de l'Exergue, LUDOVICUS DELPHINUS NATUS MDCXXXVIII *Louis Dauphin né le 5 de Septembre 1638.*

Engraved frontispiece of the *Médailles sur les Événements du Régne de Louis le Grand*, 1702, from the Imprimerie Royale, established by Cardinal Richelieu



(2655) Numb. 312

A Perfect Diurnall

OF SOME PASSAGES IN PARLIAMENT

And the daily proceedings of the Army under his Excellency the Lord Fairfax.

From Munday *July* 16. to Munday *July* 23 1649

Collected for the satisfaction of such as desire to be truly informed.

Printed by *E. G.* and *F. L.* for *Francis Coles* and *Lawrence Blaiklocke*: And are to be ſold at their ſhops in the *Old Baily*, and at *Temple-Bar*.

Beginning July 16.

His day according to former order, the House meet early upon debate of the Act for ſale of the Crowne Lands &c, the ſeverall proviſoes committed Saturday laſt were then agreed on with ſome amendments and the Act fully paſt.

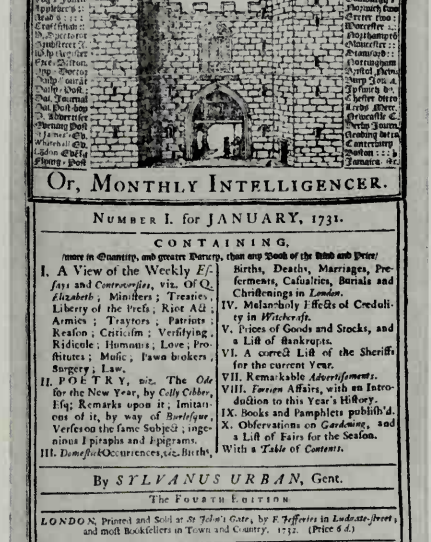
The Caſe of the E. of *Northampton* who deſires to be admitted to his Compoſition upon the Articles of *Oxford* was reported with a Letter from the Lord Governour of *Ireland* in his behalf upon debate of the whole, the houſe ordered to refer it to the Committee of Goldſmiths Hall where he is to compound according to the former Rules given the ſaid Committee.

Report was made to the houſe from the Committee appointed to conſider of the loſſes ſuſtained by *John Brown* Eſq; Clerk of the late Lords houſe given in to amount unto 3000*l.* upon *Monday* laſt, the houſe upon debate there of ordered, That he ſhould be allowed 3000 *l.* and referred it to a Committee to conſider how it may be raiſed.

Letters were read from the Committee of *York*, and other Letters of ſome diſorders there of a force put upon them by ſom reduced ſouldiers that deſigned to ſecure the Commiſſioners And they ſurprized Sir *Edward Rodes*, and Mr. *Rymer*, who had much adoe to get liberty the reſt got away. The Houſe referred it to the Councell of State to examine the buſineſſe, and punish the promoters of the mutineers, as they ſhall finde cauſe.

14 P An

Page of the *Perfect Diurnal* of July, 1649, a Parliamentary newspaper, or newsbook, which was popular in England during the 17th century



The Gentleman's Magazine:

BY JOHN GATE.

Or, Monthly Intelligencer.

NUMBER I. for JANUARY, 1731.

CONTAINING,

(more in Quantity, and greater Variety, than any Book of the Kind and Price)

I. A View of the Weekly *Eſſays* and *Controverſies*, viz. Of Q. *Elizabeth*; Miniſters; Treaties; Liberty of the Preſs; Riot Act; Armies; Traytors; Patriots; Reaſon; Criticiſm; Verſifying; Ridicule; Humours; Love; Proſtitutes; Muſic; Pawn brokers; Surgery; Law.

II. POETRY, viz. The *Ode* for the New Year, by *Colley Cibber*, Eſq; Remarks upon it, Imitations of it, by way of *Burleſque*, Verſes on the ſame Subject; ingenious Epitaphs and Epigrams.

III. *Domeſtick* Occurrences, viz. Births, Deaths, Marriages, Preferments, Caſualties, Burials and Chriſtenings in *London*.

IV. Melancholy Effects of Credulity in *Witchcraft*.

V. Prices of Goods and Stocks, and a Liſt of Bankrupts.

VI. A correct Liſt of the Sheriffs for the current Year.

VII. Remarkable *Advertiſements*.

VIII. *Foreign* Affairs, with an Introduction to this Year's Hiſtory.

IX. Books and Pamphlets publiſh'd.

X. Obſervations on *Gardening*, and a Liſt of Fairs for the Season.

With a *Table* of *Contents*.

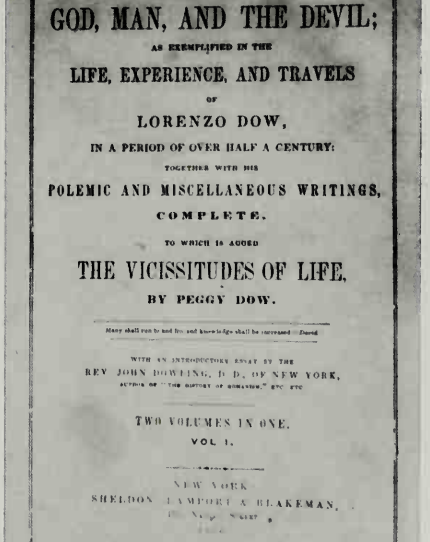
By *SYLVANUS URBAN*, Gent.

The FOURTH EDITION

LONDON, Printed and Sold at *St. John's Gate*, by *F. Jefferies* in *Ludgate-ſtreet*, and moſt Bookſellers in Town and Country. 1732. (Price 6 *d.*)

Note, *A few are printed on fine* Royal Paper, *large Margin, for the Curious.*

Front page of the fourth edition of the *Gentleman's Magazine: Or, Monthly Intelligencer*, a periodical journal published in England from 1731 to 1907



THE DEALINGS OF

GOD, MAN, AND THE DEVIL;

AS EXEMPLIFIED IN THE

LIFE, EXPERIENCE, AND TRAVELS

OF

LORENZO DOW,

IN A PERIOD OF OVER HALF A CENTURY:

TOGETHER WITH HIS

POLEMIC AND MISCELLANEOUS WRITINGS,

COMPLETE.

TO WHICH IS ADDED

THE VICISSITUDES OF LIFE,

BY PEGGY DOW.

Many shall run to and fro, and knowledge shall be increased.—Daniel

WITH AN INTRODUCTORY ESSAY BY THE REV. JOHN DOWLING, D. D., OF NEW YORK, AUTHOR OF "THE HISTORY OF ROMANISM," ETC. ETC.

TWO VOLUMES IN ONE.

VOL. I.

NEW YORK:

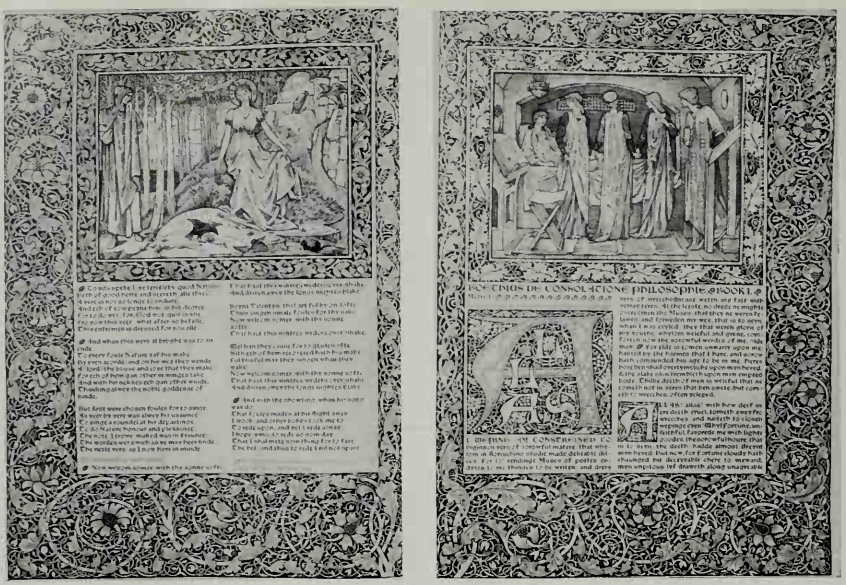
SHELDON, LAMPORT & BLAKEMAN,

Title page of a journal of Lorenzo Dow, a 19th-century U.S. evangelist. Published in 1856, it illustrates the cluttered title page characteristic of 19th-century books

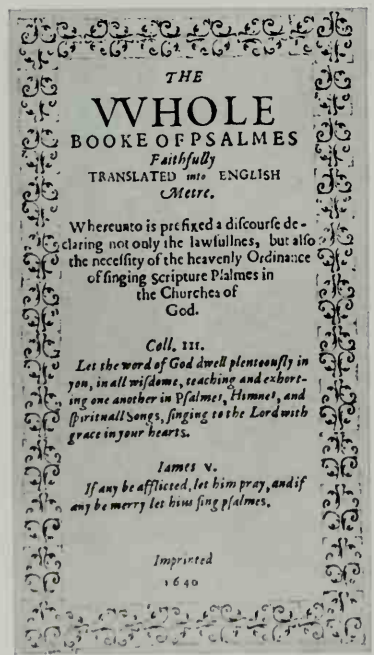
PUBLICATIONS OF THE 17TH, 18TH AND 19TH CENTURIES

BY COURTESY OF (TOP RIGHT, BOTTOM LEFT) THE UNIVERSITY OF CHICAGO LIBRARY; PHOTOGRAPH, (TOP LEFT) FROM STANLEY MORISON, "FOUR CENTURIES OF FINE PRINTING" (BENN)

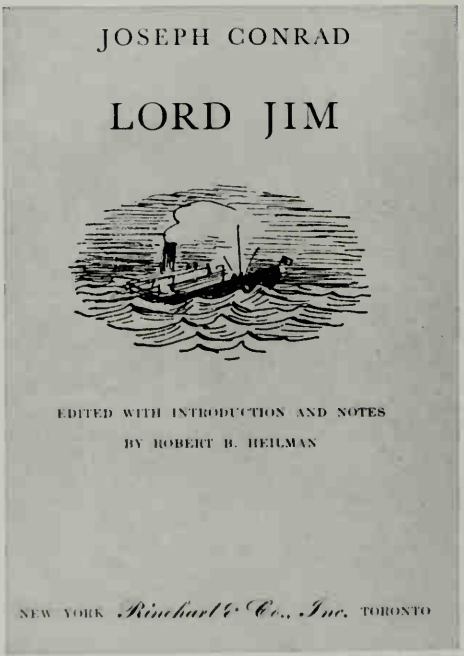
BOOK



Two facing pages from the works of Geoffrey Chaucer, published in 1896 by William Morris, founder of the Kelmscott press, Hammersmith, Eng., and a leader in the 19th-century revival of the art of bookmaking. Pictures by Sir Edward Coley Burne-Jones, borders and initial letters by Morris



The *Bay Psalm Book*, a photographic facsimile, published in 1957 by the University of Chicago press, of the first book printed in the U.S., Cambridge press, Mass., 1640



Title page of a paper-bound edition of Joseph Conrad's *Lord Jim* which was selected as outstanding in design by the American Institute of Graphic Arts in 1958

19TH- AND 20TH-CENTURY PRINTING AND BOOKMAKING

BY COURTESY OF (TOP LEFT AND RIGHT) THE UNIVERSITY OF CHICAGO LIBRARY; PHOTOGRAPHS, (BOTTOM LEFT) REPRODUCED BY PERMISSION OF THE UNIVERSITY OF CHICAGO PRESS, (BOTTOM RIGHT) REPRODUCED BY PERMISSION OF HOLT, RINEHART AND WINSTON, INC.

scholarship in the 14th century, and the rise of important vernacular writers at about the same time, did books in the Greek language and in the various vernacular languages assume any prominence in these catalogues. Most monks had specialized duties, and this was pertinent to the use of books in monasteries. While some monks were noted scholars and writers, many could not even read. However, the custom of reading aloud in the refectory exposed even illiterate monks to the cultural heritage in books.

2. The Revival of the Secular Book Trade.—For six centuries after Cassiodorus, references to book production outside monasteries are few and hard to interpret. An expansion in book production was notable with the rise of the universities in the 12th century. Much of the impetus of the universities came from a revived interest in the writings of the Greeks of antiquity, which were studied mainly in Latin translation. Around the universities, which were located in the cities, grew up a demand for books. University stationers supplied the demand. The stationers were controlled by the universities, which framed regulations about the content and size of books and set prices for sale and for rental. The University of Vercelli in Piedmont, Italy, framed such a regulation in 1228, and many similar acts are recorded for other universities. A characteristic of the work of the university stationer which had not been so apparent in the work of the monastic scriptoria was his manifolding of copies.

There can be no doubt that books were readily exposed for sale in the 14th century. This is evident in *Philobiblon,* a book finished in 1345 describing the book-collecting activities of Richard de Bury, bishop of Durham. The book relates how the bishop established good relations with stationers and booksellers in England, France, Germany and Italy by sending advance payments. This practice indicates a widespread market. Evidence from the same century indicates that the stationers were organized in craft guilds in the same way that other trades were organized. A London record of 1357 granted exemption from jury service to writers of text hand. In 1403 the Stationers' Company of London appealed to the city for the right of having their own ordinances.

3. Humanistic and Vernacular Books.—The manuscript books of the 14th and 15th centuries were affected by the rise of humanism and the growth of the vernacular languages *(see* RENAISSANCE). Humanism has long stood as a notable example of the capacity of the book to preserve knowledge through centuries of disinterest and neglect. Petrarch was one of the most notable men early connected with the movement; in the first half of the 14th century he began to search for texts of classical Roman authors. He found neglected copies in the dust heaps of monastery libraries, the product of the monastic scriptorium; but he and others generated an enthusiasm for the style of writing and pagan contents that was not medieval. They searched library collections throughout western Europe with the aim of recovering and purifying the classical texts. The restored texts, with the humanistic commentaries and original works in Ciceronian rhetoric, became the prized books collected by lay and ecclesiastical princes. The Laurentian library in Florence, the Ambrosian in Milan, the modern Vatican library and important collections in the Bibliothèque Nationale date from this movement. In England, remote from the influence of Italy, Humphrey, duke of Gloucester, donated humanistic books to Oxford university. By 1450 most of the Latin classics had been recovered and the humanists had turned their attention to Greece, even before the fall of Constantinople in 1453 caused the exodus of so many books and scholars from the eastern capital.

Concurrently with the revived interest in classical literature and language came the production of vernacular books. A vernacular literature had long been growing; and anonymous medieval authors had composed poems and stories of first importance before the 14th century, but the publication had been largely oral. In the 14th and 15th centuries vernacular books appeared. The anonymous classics were put in writing; and such creative geniuses as Dante, Petrarch, Boccaccio, Chaucer and Villon led a great number of lesser writers in producing vernacular books.

The expanded literary production found an expanded society capable of participating in the use and enjoyment of books. Lay princes as well as churchmen promoted learning and were among the patrons of humanism, although the practising humanists themselves were for the most part ecclesiastics. As for books in the vernacular, there is evidence that tradesmen and artisans in the cities were learning to read and write. John Wycliffe directed his English translation of the Bible to them in part. When the vernacular Bible, along with Wycliffe's other works, was proscribed, some of those prosecuted for reading them were artisans. Surviving letters and bills from tradesmen to the great families with whom they dealt are extant from the 15th century. The cities had begun to collect guildhall libraries.

The 15th century brought the manuscript book to a point where it merged naturally, if perceptibly, into a world of print. In the wake of the humanists, the content of books was enlarged to embrace as large a sphere of human activity as had interested the classical models. New writers emerged to put books in the language of the people. More groups of people enjoyed the advantage of literacy. Books were recognized as objects in trade and were handled by guilds as were other articles of commerce. Paper was replacing vellum as the material for books. Creation of the printing press wanted only ingenuity and patience.

V. THE INVENTION OF PRINTING

1. Early Printing.—Printing books on a printing press with movable metal types is traditionally credited as the invention of Johann Gutenberg *(q.v.)* of Mainz, Ger., who was experimenting with the process as early as 1439. There is, however, no extant piece of printing which satisfies the majority of critics that it was done by Gutenberg. The 42-line Bible known as Gutenberg's, of which the Mazarin library copy bears the rubricator's date of 1456, is thought by a preponderance of bibliographers to have been printed by Johann Fust *(q.v.)* and Peter Schöffer. Later investigations, dramatized by the action of the Pierpont Morgan library in trading a copy of the Bible for a missal, indicated that perhaps the Constance missal antedated the Bible as the first substantial printed book. The first dated European book was the Mainz psalter printed by Fust and Schöffer in 1457. So rapid was the spread of printing that by 1500 a press was at work in every major European country except Russia; and about 40,000 issues and editions averaging perhaps 200 copies each had come from the presses. Thus in a period of a scant 50 years following the invention of printing, more copies of books were made than had been copied throughout several preceding centuries.

The process of printing itself is much older than the 15th-century European development. The Babylonians used seals to print their signatures on wet clay tablets. The Chinese printed with wood blocks and passed the art on to the Japanese, who in A.D. 770 supposedly printed 1,000,000 copies of a prayer charm. The oldest extant block book is the Diamond Sutra, a book of Buddhist aphorisms printed in China in A.D. 868. The far eastern peoples even experimented with movable types made of wood, clay, tin and other metals, but the ideograms and syllabaries they employed made block books more practical for them.

The extent to which China influenced the development of printing in Europe is questionable. Some Chinese contributions were notable. Paper, so necessary for the exploitation of the printing press, reached Europe from China by way of Islam. Block books and the block printing of pictures preceded printing with movable types in Europe. Since trade routes to the far east were open, this may have been a direct influence. In the European process, there were inventive refinements. The German printers solved the problem of casting metal types of true dimensions and of devising a form in which separate types could be locked in order for printing. They developed an oil-based ink to meet the requirements of metal type. They constructed the printing press, a refined and precise instrument often regarded too lightly.

In Europe little of the motivation which prompted the huge printing of the Japanese charms was present. Although the earliest printed books in Europe were religious in content, they were not produced with the idea that there was a special religious virtue in their mechanical repetition. Instead they were produced to inform through reading. Books had secured a place where reading

was regarded as an important avenue for human learning without regard for supernatural rewards. The trade in books had grown on this basis, and the quick development and spread of printing were a commercial exploitation of the growing market in books. As evidence of the commercial nature of the development, the list of the foremost early printers includes more names of the ingenious masters of trades and crafts—Gutenberg; Fust, the banker; Nicolas Jenson, the die cutter; William Caxton (*q.v.*), the merchant—than of priests and scholars.

2. Incunabula.—Fifteenth-century printed books, known as incunabula (*q.v.*), featured both traditional and new characteristics. In appearance, the printed books very closely resembled manuscripts. Type faces copied the design of local book hands. From chapter headings, headlines, initial letters and rubrication (often added by hand in a style imitative of the manuscript from which the book was printed) down to the justified right-hand margin, the printed book imitated the manuscript. Title pages giving the name of the printer and the place of publication were usually lacking, such information appearing, if at all, in a concluding paragraph called the colophon (*q.v.*). If there was no attempt to hide the fact from conservative purchasers that the book was printed, there was at the same time little effort to advertise the fact. Some people still preferred manuscript books for one reason or another; and as late as 1486 Johann Tritheim was still conducting a busy scriptorium at the monastery of Sponheim. In content as well as appearance, incunabula were strongly influenced by tradition. The most frequently printed books, in order, were the *Ars minor* of Aelius Donatus, the *Doctrinale puerorum* of Alexander de Villa Dei, Jacobus de Voragine's *Golden Legend* and the Vulgate Bible. By far the largest number of books printed were in Latin.

Along with the traditional, there was much that was new. Nearly three-fourths of the authors listed in the first seven volumes of the *Gesamtkatalog der Wiegendrucke* (as far as it goes, the most comprehensive author list of incunabula) were 15th-century authors. In spite of the preponderance of Latin books a large percentage were in the vernacular, the proportion increasing with distance from Italy. In England, Caxton with his *Dictes and Sayenges of the Phylosophers* (1477) set the pattern for vernacular publishing; and nearly two-thirds of English incunabula were in English. The distribution of subjects treated by 15th-century printed books was as follows: religion 45%, literature 30%, law 10%, science 10% and miscellaneous 5%. As compared with medieval books, incunabula had a high proportion of literature, illustrating the influence of the humanist and the vernacular writer.

3. Printed Illustrations.—Although 15th-century printers characteristically exploited the existing book without attempting to reform learning with the new device of the printing press, their use of printed illustrations actually produced a new means of expression. Printers used woodcuts to print illustrations with the relief process, and experimented with intaglio in copper engravings. Woodcut pictures preceded metal types. It was a simple development to make woodcuts type-high and lock them in the forms with type to print illustrated books. Albrecht Pfister of Bamberg was printing books illustrated with woodcuts about 1461. Copper engravings were also tried. With their adaptability for fine lines, engravings were especially suitable for the reproduction of maps; among the few incunabula illustrated with engravings is a Ptolemy *Geographia* printed at Rome by Arnoldus Buckinck in 1478. However, because engravings required a different press and introduced a separate process into printing, and because experiments with woodcuts were so satisfying, there was no extensive use of engravings before 1550.

The printing of illustrations greatly improved the possibilities for combining pictures with texts in books. Once a picture was prepared for printing, it could be repeated an indefinite number of times with little loss in detail, accuracy, form or original vigour. When great artists such as Albrecht Dürer designed woodcuts the result was books of high aesthetic value which could be produced in great numbers. *Hypnerotomachia Poliphili*, printed by Aldus Manutius in 1499, is a monument to the early perfection of the woodcut and to book illustration in general. Equally as important as the reproduction of great art was the opportunity that printed illustrations offered for the faithful reproduction of pictures and diagrams in scientific books. Although early herbals fell far short of modern standards in their depiction of poisonous plants (often following the custom of using the same picture to illustrate different things symbolically), the process had great potential which was expertly exploited in the anatomical books of Andreas Vesalius in the 16th century. The dawning scientific scholarship profited from the development of printed illustrations; it is significant that both anatomy, with its need for precise illustration of the human body, and cartography, with maps, greatly expanded after development of printed illustrations.

4. Demand and Prices.—The most that can be said about the public demand for books in the 15th century is that the printing press was eagerly accepted and that it developed rapidly. Printers were eagerly sought for. When the English parliament in 1483 passed a law excluding foreign artisans from settling in England, printers were specifically exempted lest restrictions against foreign printers delay the progress of so useful an art. Books were cheaper, especially the small and useful books for which the existing demand justified the printing of large editions from a single setting of type. The general reduction in prices of books was described in 1467 by the bishop of Aleria. Writing to Pope Paul II, he said that books were one-fifth their former price. That books were selling well is indicated by the invasion of the book market by men from other fields. The records of the port of London show that grocers were importing books for sale along with their more usual merchandise.

VI. THE 16TH-CENTURY BOOK

1. Technical Advances.—In the 16th century came the culmination of early printing experiments. Typography was standardized in three major styles—black letter, roman and italic. Except for the cutting of Greek, Hebrew, Anglo-Saxon and other exotic letters, radical experimentation in type design practically ceased. The roman letter gained the most ground; in England by 1600 it had displaced the original black-letter fonts for nearly everything but Bibles. The title page bearing the title, the names of the author, publisher, printer and bookseller, the place of publication and the date was standard by 1520. Pagination, foliation and the printing of signatures, innovations made by Arnold ther Hoernen and Johann Koelhoff of Cologne in the 1470s, were uniformly used. The printing press was so perfected that there were no major changes in its construction until the Stanhope iron press in about 1800.

As a result of the early maturity of printing, some 16th-century books are noted for their perfection of form. Geoffroy Tory of Paris added to the possibilities of decoration with his printed borders and ornaments, 15th-century innovations perfected by him. Hans Holbein the younger followed the precedent of Dürer in devoting his high talents to the illustration of books, his *Totentanz* of 1538 being the most famous. Books printed by the Aldine press in Venice, the Estiennes in Paris, Christophe Plantin in Antwerp and the Elzevirs in Leiden set high standards of impression, typography and design.

2. Division of Labour.—With the end of experimentation came standardization. This was reflected by a division of labour in the printing trade. While the early printers had designed their own types, the 16th-century printer bought his types from a noted designer like Claude Garamond of Paris. Although the incunabula printer may have set type and pulled the bar of his own press, the so-called master printers of the 16th-century were more notable for their publishing activities. They had employees to perform the hard physical labour. Anton Koberger of Nürnberg had 24 presses and hired more than 100 workmen; Plantin had 25 presses and 150 workmen. Aldus Manutius, Johann Froben (Basel, Switz.), Plantin, and Robert and Henri Estienne (Paris and Geneva) are often referred to as scholar-printers, but they are famous for their corps of scholarly editors. Froben employed Erasmus as an editor. The building-up of an editorial office belongs to the activities of the publisher rather than the printer.

3. Economies.—The publishers exploited the genius of the printing press to print many books cheaply. As compared to 40,-

000 incunabula, they published 520,000 issues and editions. Disregarding some notable exceptions, the student of the 16th-century book finds a trend to small, cheap formats. In place of expensive folios, Wynkyn de Worde, Caxton's successor, published about 800 low-priced quartos, generally undistinguished in appearance and content but of proven salability. More highly regarded, but illustrative of the same development, were the cheap classics in octavo with which Aldus Manutius earned his greatest fame. In the second quarter of the 16th century, the printers of Paris and Lyons halved the size of the Aldine octavos with their 16mos, only to be outdone at Antwerp and Leiden with still smaller volumes. Printed on thinner paper, these small formats were made still less bulky with the substitution of pasteboard for wooden sides in binding.

With the dominance of publishing and the increase in numbers of journeymen printers, there arose a struggle over markets and printing rights. Printers and publishers tried to take the risk out of publishing by acquiring patents of privilege for the exclusive publication of books known to be in demand. These included laws, service books, school books and (as the Reformation progressed) Bibles. Printers also soon discovered that any risk publication that succeeded required some protection to prevent other printers from copying the profitable book. Consequently, the struggle for printing privileges was a notable feature of publishing in the 16th century. It was characterized by the appointment of official printers, by the granting of protection to single books, by the parceling out of important classes of books and by the self-regulation of the book trade.

The development of printing privileges may be traced in the English book trade. In 1504 Richard Pynson and William Faques were the first to print statutes with royal authority. Pynson kept the title of royal printer until his death in 1530, and the post grew to be a valuable privilege. In 1518 a two-year privilege was granted for Richard Pace's sermon on the recent peace. Anthony Marler in 1542 was granted a privilege for printing all Bibles in English. This practice led the way to granting privileges for schoolbooks, books on common law, primers and all standard works of steady sale. The Stationers' Company of London was chartered in 1557, partly to supervise the administration of commercial privileges and partly to restrict the content of publications. In carrying out the first aim the company established a register of copies where a publisher might enter the title of a book he was publishing and thus secure protection from copying. The publication of unprivileged works was not generally profitable, however; and in 1583 the unprivileged printers of London complained that the printing of ballads, plays and such other things as were not privileged did not provide enough work to keep a man alive. In desperation, a group of rebel printers in 1585 pirated to the extent of 20,000 copies the *ABC and Little Catechism*, privileged to Richard Day.

4. The Contents of Books.—The printing press was the instrument of the Reformation, and controversial religious books and pamphlets bulked large among 16th-century books. Beginning with Martin Luther's challenge to oral debate in 1517, the course of the Reformation can be traced by the debate in print. Attacks brought animadversions, and animadversions evoked refutations. Although religious controversy in books was not new, the use of books in the Reformation had new features. The scope of the controversy was enlarged by the publication in large numbers of books in the vernacular, calculated to appeal to the general public. The reformers emphasized the vernacular Bible as a book for everyone to read. John Huss and John Wycliffe had also promoted vernacular reading, but they were unable to copy books fast enough to prevent their suppression. The printing press outran the censor. William Tyndale's controversial rendering of the New Testament in English with its even more controversial prologues was published in an edition of 3,000 copies. Though banned in England, this edition was circulated because of the possibility of publishing it in a friendlier foreign country. The smuggling of banned books from one country to another was another characteristic of Reformation printing.

Aside from its use in pure controversy, the printing press was instrumental in putting new religious programs into effect. By 1517, religion in Europe depended strongly on a widespread distribution of books. Radical changes in religion required the quick publication of vernacular Bibles or the substitution of new service books for those in use in all the churches. For example, Richard Grafton and Edward Whitchurch received royal writs of assistance in 1548 allowing them to seize presses and supplies and to impress workmen to print the *Book of Common Prayer* to have it ready for use in all the churches in 1549.

As important as the Reformation books (and Counter-Reformation books) were in the 16th century, the percentage of religious books among all those published did not increase. A study of all the books printed in England or books printed abroad for use in England showed that only about 40% were religious and 20% were literary. Religious controversy was as strong in England as anywhere, but the humanists and the authors of plays, poems and tales made their influence felt.

The expansion of intellectual interests as reflected in books is illustrated by the beginnings of modern bibliography. In 1545, Konrad von Gesner published his *Bibliotheca universalis*, an author list of books in Latin, Greek and Hebrew; he followed it up with the publication of subsidiary lists classified by subject. John Bale compiled a list of writings by all the authors of England, Scotland and Wales. Florian Trefler, an Augsburg monk, complained of the difficulty of locating books in libraries, and recommended the construction of a classified catalogue. The Frankfurt fair catalogues were used as records of current publications; and Andrew Maunsell, a London bookseller, compiled in 1595 a *Catalogue of English Printed Books* in which he established rules for distinguishing between authors in his entries. The significant points about these developments are the serious interest taken by scholars in all kinds of books and the beginnings of a systematic approach to bibliography. The day of the man of one book had ended.

5. Reading.—The extent of reading in the 16th century may be inferred from accounts of reading motivations, the growth of schools, studies of book ownership, studies of censorship, and the generalized content of publications (as described above). The Reformation provided motivation for reading. The reformers emphasized the importance of Bible reading by all communicants. Vernacular Bibles were published in large and frequent editions. Luther wrote a pamphlet on education, setting forth a school program. English clergymen were ordered to teach their parishioners to read the Creed, Pater Noster and Ten Commandments, and to show them where they might purchase copies of these. Village petty schools and grammar schools were established in England.

Records of book ownership are comparatively rare, and yield information mainly about scholars who left accounts of their books or whose books were inventoried on their deaths. An inventory (published in the late 1950s) of private library catalogues in England from 1500 to 1640 showed that, apart from the clergy, only university scholars and physicians owned books in any numbers.

Records of attempts to ban books have been used as evidence of popular reading. Mostly connected with the religious controversy, book proscriptions betrayed a great fear of a popular audience and were most violent against vernacular books. Sixteenth-century proscriptions began with a papal bull (1520) which forbade anybody to read any of Luther's writings. This was followed by a stream of proclamations, statutes and injunctions issued by kings, parliaments and bishops against the works of other reformers and counterreformers. Prosecutions resulting from disobedience to these measures often found tradesmen in the toils of the law. Thomas More, who was commissioned to refute William Tyndale's argument in favour of an English Bible, wrote in 1528 that more than 40% of the population "could never read English yet," a statement which permits the inference that almost 60% were literate.

VII. THE EARLY MODERN BOOK

1. Authors and Content.—Generally undistinguished in appearance, the 1,250,000 issues and editions published in the 17th century included a high number of unsurpassed brilliance in content. The list of authors whose works were being published for the first time includes Shakespeare, Cervantes, Bacon, Descartes,

Galileo, Molière, Milton, Newton and others scarcely less important. This flowering of literary and scientific genius was at the top of a generally expanded publication. The content of books was marked by a serious consideration of events and experiences which had not been reported in earlier books. History recovered some critical spirit and interest in common details. Biographers recounted the lives of mortals far below the degree of saints, popes, emperors and kings. Antiquarians and excursionists explored local fields and alleys, describing them in books illustrated with engraved maps and pictures. News books appeared to report a limited but immediate account of daily events. Scientists and inventors reported their experiments in scientific periodicals invented for the purpose. Taking a cue from science, literary magazines appeared for the first time. Nearly every literary form reached a high peak of artistry. The vernacular made strong inroads into Latin (even as the language of scholarship) when Descartes published his *Discours de la méthode* in French. The book became common; and John Bunyan, a little-schooled tinker, wrote a literary classic, *Pilgrim's Progress*, which was widely read by unschooled artisans.

The enlarged content of books reflected a changed approach to knowledge, best described as the birth of the modern scientific outlook. This view continued the shift away from medieval otherworldliness which had begun with humanism and was carried on through the Reformation and the age of discovery. It emphasized the reality of sensual experience in contrast with the medieval assertion of its unreality. This revised attitude was not bookish, because it derided book learning while ascribing greatest importance to observation and experience as avenues of learning. Since, however, the whole field of experience far exceeded the capacity of any individual, the new approach to knowledge was reflected in books; not only in the published reports of scientific experiments, but in the whole range of life and thought reported in print.

2. Librarians and Book Collectors.—These developments were accompanied by a rise in the esteem accorded to current publication by serious students and scholars; illustrated by the activities of librarians and book collectors. Gabriel Naudé, advising Cardinal Mazarin on the establishment of a library in a treatise published in 1627, urged the acquisition of contemporary books, even those considered on some accounts to be trivial or erroneous, in order to illustrate the different aspects of human thought. A few years earlier Sir Thomas Bodley had reluctantly accepted deposit copies from the Stationers' company for his Oxford university library. The same spirit of comprehensive collecting affected their purchases of old books. Naudé built a collection of 40,000 volumes in a few years and found it necessary to provide a subject catalogue to the contents of the Mazarin library, as Bodley had provided a classified catalogue for the Bodleian. An outstanding example of the comprehensive current collector was George Thomason, a London bookseller, who collected nearly 23,000 tracts and pamphlets published in England during the troubled years of civil conflict from 1640 to 1661 in order to preserve them for posterity. The amount of reading required of a scholar was so greatly expanded that there is speculation that the 17th century finally ended the medieval custom of reading everything aloud; only by reading silently could a man read fast enough to absorb it all.

3. Censorship.—The increased diversity inherent in the new approach to knowledge, and the magnified importance of individual writers were reflected in a changed attitude toward censorship (*q.v.*). Throughout the Reformation period, censorship was normal. Any book assaulting the accepted social order was banned. Few objected to the principle, although banned writers worked for a changed system in which their own books would be promoted while those of their adversaries were proscribed. John Milton's *Areopagitica*, published in 1644, was a pamphlet which developed a principle of freedom. Milton argued that if freedom were allowed for the publication of a variety of opinions, truth would triumph over falsehood in a free encounter; but if restrictions on publication continued, an ignorant censor might slay truth before it ever became known. Freedom of publication was slow in making headway. Milton himself turned censor for the Commonwealth, and the Restoration licensing act of 1662 was stringently enforced. Yet a spirit favouring a variation of opinion in print was growing. In 1695 the English licensing law was allowed to lapse. An immediate effect of the lapse of the licensing act was the legalization of printing in English towns and cities outside of London.

The lapse of licensing removed the support from the Stationers' Company of London and the authority of its register in protecting printers' copies. Agitation for a law to protect printing rights resulted in the passage of the copyright law of 1709, which vested the rights for publication in the author. The shift from printer's privilege to copyright was another outgrowth of expanded publication and the emphasis on individuals. By the end of the 17th century some authors had acquired large personal followings. Consequently publishers were eager to print their books and could afford to pay them for the privilege. Jacob Tonson paid John Dryden £1,200 for his translation of Virgil. The changed circumstances which made the works of an author commercially valuable, coupled with the agitation for a law to protect printing property, led to modern copyright legislation.

4. The Book in America.—American colonists wasted few years in establishing the printing press. The Spanish began printing in Mexico in the 1530s. Puritans settled at Massachusetts Bay in 1630 and set up a printing press at Cambridge in 1638. The earliest surviving imprint of the Cambridge press, the *Bay Psalm Book*, was printed by Stephen Day in 1640. Four English colonies in America had presses before 1700; Georgia, the last colony established, was also the 13th colony to have a press (1762). The *American Bibliography* of Charles Evans records 18,300 different publications during the colonial period. An analysis of the account books of Franklin and Hall in Philadelphia indicates that probably 70,000 more unrecorded imprints issued from the colonial press. The largest printing centres were Boston, New York and Philadelphia. Most books and papers were in English, but Pennsylvania had a noteworthy German press, and there was some printing in Dutch, French and the Indian languages.

The three largest classes of colonial printing were theology (37%), law (19.5%) and literature (19.5%). Regional variations made theology most important in New England (46%), literature in the middle colonies (27%), and law in the south (52%). Southern printing was the scantiest; the high percentage of legal printing there represented the work of the official printers.

The place of the book in colonial America cannot be judged by colonial printing alone. The colonists brought books with them, and they imported books from Europe. William Brewster brought a library to Plymouth, and on his death in 1644 left a collection of nearly 400 books. John Harvard in 1638 willed his collection of books to Massachusetts Bay for the college authorized in 1636. Cotton Mather in 1700 had 2,000 to 3,000 books in his library and cited over 300 authors. William Byrd of Virginia and James Logan of Philadelphia built large private collections, mostly from importations. The Philadelphia Library company, on its organization in 1731, immediately ordered books from a London bookseller. The Reverend Thomas Bray promoted a scheme of parish libraries with books and funds supplied from England. Much colonial writing, perhaps the most important part, was printed abroad.

The colonial book, made in America, played a definite role in fabricating a colonial mentality from various European backgrounds. Many colonial books expressed the dissidence existing in the colonies. The first book published, the *Bay Psalm Book*, was expressive of the Puritan discontent with the ecclesiastical settlement at home. Many other religious books were of a similar nature. Newspapers, legal publishing and almanacs were fitted to the local situation. The jealousy with which the colonists regarded their rights to free political discussion in print came to the fore in 1735 in the Zenger case. John Peter Zenger, a New York printer, was arrested and brought to trial for his printed criticisms of the conduct of the English governor of the colony. Disregarding the instructions of the trial judge after the brilliant defense conducted by Andrew Hamilton, the colonial jury acquitted Zenger on the ground that his charges were based on fact, a key consideration in libel cases after that time.

5. The Growth of Reading.—A great expansion in the reading public during the 17th and 18th centuries came from the increasing literacy of women. Girls had attended the vernacular schools during the 16th century, and by the 17th century a woman such as Aphra Behn (*q.v.*) could attain fame as a writer. Much of the prose fiction which became popular in the 18th century was addressed to women, and circulating libraries catered to their tastes. Sermons castigating women for wasting their time reading light novels were common.

The general expansion in reading must be viewed historically to seem impressive. Literacy was not universal. Most serious and sustained reading took place in large cities, and cultured travelers often complained of the stark book poverty of provincial towns. However, newspapers circulated widely, even in provincial towns; and it was no great novelty for an artisan or farmer to become a man of letters. The invasion of the world of letters and learning by such men as Benjamin Franklin and Robert Burns is as significant as is the fact that most poor plowmen had neither the skill nor the opportunity to read much if at all. In the 18th century there was great faith in the ability of the common man to educate himself by reading. Concrete expressions of that faith were the encyclopaedias, expensive publishing gambles that were successful. Diderot and the French Encyclopaedists were most famous, but the *Encyclopædia Britannica,* the German *Brockhaus* and other national encyclopaedias date from the late 18th century. The many subscription libraries which grew up in England and America were another demonstration of the force of the idea of self-education through the use of books.

6. Prices.—Books were neither more nor less difficult to buy than they are today. The prices, when a ratio of currency values is considered, were approximately the equivalent of modern prices for books. In America a book of poems sold for 1*s.* 3*d.*; and the huge Mennonite martyr book, a folio of 1,512 pages, sold for £1. English prices were higher, but money was not so scarce. Single poems by Pope sold at 1*s.* 6*d.* Novels sold for 1*s.* 6*d.* around 1750 but then increased to 2*s.* 6*d.* a volume. Subscription books such as Dryden's Virgil at £5 5*s.* and Johnson's *Dictionary* at £4 15*s.* (bound) were expensive. The first edition of the *Encyclopædia Britannica* published complete in 1771 cost £12 for the three volumes, but it had been issued serially beginning in 1768 at 6*d.* an issue. This sort of installment selling put it in reach of more people.

7. The Art of the Book.—Although 17th-century books were generally inferior in appearance to the best examples of the 16th century, type design did not languish perpetually. Cardinal Richelieu established the Imprimerie Royale from which at the end of the century came the *romains du roi* ("king's types") of Philippe Grandjean. In the 18th century William Caslon cut his old-style roman letters; John Baskerville his transitional; and Giambatista Bodoni and Pierre and Firmin Didot developed the modern face. A perfectionist, Baskerville introduced wove paper to set off his types.

The techniques of illustration developed rapidly. Etching, dry point, mezzotint and aquatint were intaglio processes that were widely used. Thomas Bewick's wood engravings changed the technique of the woodcut and became popular in cheaper books. Printed by the relief process, wood engravings became the medium of the 19th-century illustrated weeklies. Aloys Senefelder's discovery of the lithographic process of printing illustrations (about 1798) was the most significant because lithography is the basis for offset printing.

VIII. THE 19TH-CENTURY BOOK

Spurred on by industrialization, democracy and urbanization, book production multiplied in the 19th century. The number of issues and editions quadrupled, reaching 8,000,000 as compared to 2,000,000 for the 18th century. The sizes of editions also increased. By 1900, best-selling novels sold more than 600,000 copies. The penny newspapers and the popular magazines with aggregate circulations running into the millions created the phenomenon of mass communication.

1. Industrialization.—The mechanization of printing (*q.v.*) provided the means for producing books in vastly larger quantities, but mechanization cannot explain the increased demand for books which it was created to meet. Industrialization in the larger sense had a relation to that demand. The handicraft shops became factories, and around factories grew cities. In every industrial country the percentage of rural as compared to urban population dwindled steadily. Urbanization meant enlarged communities. Once again in the history of man and the book, man's field of interest was stretched beyond the circle of his personal experience. It was extended even farther because, along with the other inventions that accompanied industrialization, there were developments in rapid transportation and in long-distance communication —the railroad, the steamship and the telegraph—that comparatively laid the world at every man's doorstep. People used many means to enlarge their information. Lecture courses and lyceums flourished. The book also, with its ability to carry a message across time and space, satisfied the desire for experience in a world too large for a man to encompass in his daily rounds. In this respect the industrial cities of the 19th century were akin to Ptolemy's Alexandria.

2. Democracy.—Literacy increased in the 19th century, as shown by statistical reports available for the first time during this period. The growth of democracy, with its emphasis on the widespread public discussion of political issues and on popular education, fostered free schools. Public libraries, a product of the cities, made books available to all. Reading matter was cheap. Advertising in newspapers and magazines paid for the cost of production so that copies of them sold below cost. The famous Tauchnitz editions of separate books, founded in Leipzig in 1837, by 1935 listed more than 5,000 English-language titles at 50 cents. Philipp Reclam's *Universal-Bibliothek,* another German series (started in 1867), published ten titles a month, growing in 50 years to a list of 6,000 for 20 pfennig (about 10 cents) a copy. Reclam sold more than 18,000,000 copies of German classics. The Boston Society for the Diffusion of Knowledge began publishing cheap paperbound books in 1831, but the development was stifled by an adverse postal ruling in 1843. A more vigorous paperback publishing program flourished in the United States from 1870 to 1890. In 1885 one-third of the titles published in the United States were paperbound books. It was the era of the dime novel, but many cheap books in the United States were pirated from foreign publishers; and the program did not survive the copyright act of 1891, which enabled foreign authors to obtain American copyright on books printed in the U.S.

One development in content during the 19th century was the increased emphasis on children's books. The effect of popular education was seen in the heavy publication of schoolbooks, but children's books as generally defined escaped the confines of the classroom. Children's magazines appeared, and books written especially for children attracted the efforts of many authors, some of whom wrote classics.

3. Mechanization and the Art of the Book.—With the mechanization of printing, the investments in publishing greatly increased, and only large and strong houses could flourish. They established editorial offices in the largest cities, and publishing and manufacturing of books were separated farther than ever. The spirit of craftsmanship which had motivated many of the small printers with their hand presses declined. Principles of book design were ignored. Machine-made pulp paper deteriorated rapidly. The sewing machine did not duplicate the sturdy work of the hand binder. Late in the century Theodore De Vinne, an American typographer, tried to revive an interest in style. The most influential man, however, was William Morris (*q.v.*), who started the private press movement in 1891 with his Kelmscott press (Hammersmith, Eng.).

In trying to bring art back to the printing of books, Morris made a fetish of handwork. He set type by hand, printed with a hand press on handmade paper and had his books bound by hand. With the aid of Emery Walker he designed new types; and his Chaucer is reputed to be the most beautiful book ever printed in England. His preference for heavy black-letter type, however, made his books more ornamental than readable. Characteristically, his

Kelmscott editions, and the editions from the other private presses which followed its lead, were small and expensive. Their chief contribution to bookmaking was the dramatic way in which they called attention to the artistic possibilities of the book. The publishers of large popular editions were later inspired by the private presses to breathe some art into the machine.

IX. THE BOOK IN THE 20TH CENTURY

1. The Book and Other Media.—The 20th-century book has been affected by the growth of motion pictures, radio and television. These mediums can reach large audiences who have only to look and listen to receive messages presented with all the warmth of the human voice and the vividness of action. Each medium as it was introduced quickly won a wide following. Scientific studies of listening, viewing and reading habits have revealed that more people in the United States watch television or listen to the radio than read newspapers; as many view the movies as read magazines; and that the smallest number of people read books as separately published literary products. Yet the new mediums have not replaced books. More books are being published and the circulation of magazines and newspapers is higher today than before.

The book has survived in face of this competition because of its peculiar capacities as an instrument of communication. First, it is a storehouse of knowledge. While the voice and image of the new media are fleeting, the printed word endures, and the reader can look at it again at his own convenience. Thus it is uniquely valuable for the serious student who needs to refresh his memory while labouring through a difficult passage, as well as for transmitting the cultural heritage from one generation to another. Second, the book is an individual instrument of communication. Silent reading is a solitary act; the reader may go as fast or as slowly as he pleases, while viewing and listening are group activities. Third, the book is cheaper to produce than radio, television and motion picture programs and can afford to cater to smaller audiences. This characteristic promotes individuality because programs aimed at large audiences must seek common ground. Fourth, the book is a compact instrument of communication. A good reader can cover more in an hour than a listener could hear in four hours.

2. Photographic Processes.—Economical photographic processes used in printing have made it possible for publishers to exploit the individuality of the book by printing small editions for limited audiences. One important device is the photo-offset press built in 1904. The photo-offset press may be used to print large editions, but its economy also permits the publication of very small editions. The pages of a previously printed book or a typescript are photographed to make printing plates, eliminating the expense of type composition. This advantage makes an edition of 500 copies feasible as compared to a much higher number for letterpress. The process is used to reissue out-of-print books and to print original typescripts cheaply. Chiefly for scholarly publishing, photo-offset from typescripts is exploited by university presses and specialized private publishers such as the Scarecrow press. One advantage of the photographic technique for scholarly materials is the ease with which complex drawings, diagrams, other illustrative materials and exotic alphabets may be reproduced. Other methods of publishing small editions (called near-print along with photo-offset typescript) make use of office duplicating machines. Scholars in some very specialized and advanced fields find nearly all their reading materials in near-print.

The ease with which photographic reproductions of texts can be reduced in size led to the development of microtexts. With a microtext the page of a book may be reduced to as little as $\frac{1}{100}$ of its original size, so that it must be read with aid of a magnifying reader. An obvious advantage of microtext, important when the flood of print is crowding library shelves intolerably, is reduction in bulk. Libraries generally reduce bulky historical records, such as old newspapers, to microtext for preservation.

A microtext may be a translucent film or an opaque card or sheet. Microfilm, the former, may be a negative or a positive print. Its use makes practicable the reproduction of a single copy of a book. The microfilm is always in print as long as the negative lasts. Libraries in many cases thus make microfilms instead of lending books on interlibrary loan. Opaque cards and sheets are printed both photographically and with the offset press. Opaque microtexts can be issued economically in as few as 50 copies. All the methods of microreproduction are used to reprint rare and unobtainable books and to print such original materials as doctoral dissertations, specialized monographs and anthropological field notes. The invention in the 1950s of photographic type-composing machines opened the possibility for original composition in microtext.

3. Marketing Developments.—In contrast to the experimentation with small and specialized editions, book clubs were a marketing innovation to distribute huge editions by mail. Although German publishers in 1919 began distributing special editions of the classics by mail, the book club which systematically distributed new books by mail order subscription was an American invention. The earliest clubs were the Book-of-the-Month club (1926) and the Literary guild (1927). By the 1960s about 90 book clubs served the United States. By advertising judicious selections heavily, offering book premiums, and reducing prices in accord with their high sales, the large general clubs could sell editions of several hundred thousand copies. In Great Britain, where their development was more gradual, there were between 20 and 30 book clubs in existence in the 1960s.

A revival of paper-bound publishing was the other innovation. The Albatross Modern Continental library, a German venture begun in 1932, published about 400 titles and then took over Tauchnitz. Penguin Books, organized in England in 1935, adopted the Albatross format. Penguin quickly became the largest and most prominent publisher in a domestic language, penetrating the market wherever English was spoken. Pocket Books began the 20th-century U.S. era of paper-bound publishing in 1939, to be followed quickly by Avon and New American Library of World Literature, originally a Penguin subsidiary. By the 1960s over 14,000 titles were available from more than 200 U.S. paper-bound publishers. Annual sales of 30 of these publishers exceeded 250,000,000. In Great Britain about 50 firms published paper-bound books.

The U.S. paper-bound publishers owed their success to the inexpensive format and to the exploitation of new sales outlets. In the 1960s cheap paper-bound books sold for prices ranging from 25 to 75 cents. They were sold on newsstands, in drugstores and in grocery stores as well as in bookstores, making use of more than 100,000 outlets in the United States and Canada. Sales of 200,000 copies were required to show a profit. Another development was the production of more limited editions of scholarly paper-bound books at prices ranging from 85 cents up. Many university presses adopted this format.

4. Comic Books.—Another mass publishing development was the comic book. Ostensibly for children, comic books are picture stories told through the depicted conversation of the illustrated characters. The technique is at least as old as the *Biblia Pauperum* ("Poor Bible") of the 15th century, but the immediate predecessor of the comic book is the comic strip (*see* CARICATURE AND CARTOON) of the newspapers. The first comic book published was *Famous Funnies* in 1934. They were so popular that in 15 years comic book publishers in the United States were selling at least 35,000,000 copies a month, and over 400 titles were on newsstands. "Comic" is a misnomer, for the books are general in content, ranging from funny animal stories to lurid accounts of crime written in the tradition of the chapbook (*q.v.*) and the dime novel. Scholars interested in the reading of children have had mixed reactions to the comic book. Some denounced the content as harmful and contributing to juvenile delinquency. (Canada banned the sale of crime comics and some cities in the U.S. adopted restrictive ordinances against them. Great Britain introduced legislation in 1956 to ban the sale of horror comics.) Other scholars defended the comic book technique and praised it for introducing children to reading. Surveys indicated that about 90% of the children from the ages of 7 to 17 who had comic books available read them. Some publishers abridged literary classics and issued other "educational" comic books.

5. Children's Books.—Another development in children's books excited general praise. There has been a notable increase

in the number of good books published for children, and the author specializing in juvenile stories has come to occupy a very respectable niche in the world of letters. Educational developments deemphasizing the textbook in favour of more extensive reading promoted this. The growth of children's libraries and the interest of the American Library association also furnished some impetus to the development. Some attention has been focused on good publishing for children in the U.S. by two awards given by Frederick G. Melcher, the Newbery medal since 1922 for the most outstanding juvenile book published during the year and the Caldecott medal since 1938 for the best picture book. Similar annual awards in Great Britain are the Carnegie medal, first awarded in 1937, for the children's book most distinguished in content and printing, and the Kate Greenaway medal, first awarded in 1956, for the best illustrations by a British artist. An important development was the publication of well-designed and illustrated 25-cent books for children. Simon and Schuster pioneered in this field with their Little Golden Books, which have international distribution and are translated in many languages. (*See* CHILDREN'S LITERATURE.)

6. Modern Book Arts.—The 20th century has united art with the machine to produce beautiful books. The happy union shows some influence of the experimenters with private presses. It also reflects the influence of printing historians such as Daniel Berkeley Updike, printer of the Merrymount press; Stanley Morison, adviser to the *Times* (London); Douglas C. McMurtrie; and others who called attention to the art of printing. A number of periodicals, among them *The Fleuron, Dolphin, Alphabet and Image, Imprimatur, Monotype Recorder* and *Signature* in the U.S., and the *Book Collector in Great Britain,* though exposed to a high rate of early mortality, fostered interest in beautiful books. The American Institute of Graphic Arts conducts trade book clinics and after 1923 sponsored an exhibition of the best 50 books of the year. In England the National Book league performed a similar function.

The union of art with the machine in book production has paralleled other 20th-century developments in industrial design and merchandising. Publishers strive to present an attractive package to the customer. Large presses hire experts in typography and design. An outstanding example of an adviser to a press was Bruce Rogers, long connected with Riverside press, whose beautiful books became collectors' items.

7. Reading in the 20th Century.—Modern statistical reporting yields a fairly clear picture of ability to read. In such countries as Norway and the Netherlands, illiteracy is negligible. In most modern industrial countries well over 90% of the population can read. Functional literacy alone, however, does not make habitual book readers. The American Institute of Public Opinion reported surveys of adult book reading in highly literate countries (1950–57). In Great Britain over one-half those interviewed were reading a book when they were questioned. In Scandinavia, western Germany, Canada, and Australia, book readers ranged from 30% to 45%. In the U.S. less than 20% were book readers. However, surveys made over a period of 20 years showed that 60% of the adults in the U.S. read at least one magazine regularly and 85% read one or more newspapers daily.

Some efforts to extend reading led to a study of the factors which make a book readable. Investigators tried to discover the relationship of literary style, vocabulary and syntax to speed and comprehension of reading. Pioneered by educators interested in teaching reading in schools, readability studies have developed findings applicable to the reading of adults. Some investigators derived formulas for readability. Perhaps the most widely publicized formula was that of Rudolf Flesch, which is based on sentence length and word length.

After the founding of the United Nations, the United Nations Educational, Scientific and Cultural Organization (UNESCO), through its Fundamental Education program, tried to promote reading in the underdeveloped areas of the world. There is a double barrier: (1) illiteracy is high; reports from India and Egypt revealed that no more than 15% of the inhabitants could read at mid-20th century; (2) publishing has languished in those countries, and there is a lack of vernacular books for people to read. The governments and the Fundamental Education program had the twin objectives of increasing literacy and publishing vernacular books for general reading.

For countries possessing ancient and complex cultures but with few vernacular books questions have been raised about the importance of the book in society. Some students regard publishing programs and campaigns to promote literacy as too slow to be helpful in a rapidly changing world. They recommend a greater use of radio, television and motion pictures to educate the citizens of such countries in technological aspects and cultural relations of a shrinking planet, *e.g.*, the stories and themes of the folk culture of India were cast directly into motion pictures without the mediation of books. However, the experience of the countries which are literate, have strong publishing activities and also have the new media, indicates the essential role of the book, which derives from its characteristics of relative permanence and portability. The message of the book lasts longer, and caters to the individual as opposed to the mass.

See also references under "Book" in the Index volume.

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(H. W. WR.)

BOOKBINDING, the joining together of a number of leaves (most frequently of paper, parchment or vellum) within covers to form a codex or book (*q.v.*) as opposed to a roll.

HISTORY

Bookbinding began when the codex started to replace the roll. The parchment notebook first appeared as a rival to wax tablets shortly before the beginning of the Christian era. Classical texts existed in codex form before the end of the 1st century A.D. but at first the codex was normally reserved for Christian books and did not become common for pagan literature before the 4th century.

Coptic and Islamic Bindings.—The earliest elaborately decorated bookbindings were those produced for use on church altars and those that survive are often magnificent examples of the jeweler's, goldsmith's, ivory carver's or embroiderer's arts. But the typical artistic bookbinding is of decorated leather, an art first practised in the monasteries of the Coptic Church in Egypt. Surviving examples, mostly of red or brown goatskin from the 8th

and 9th centuries, show a maturity of design and a wide variety of techniques that indicate the craft had been practised several centuries earlier. In contrast with later European bindings they appear to have been produced by specialists in all forms of decorative leather work and show a variety of techniques—tooling, piercing of the leather and decoration with a stylus.

The earliest-known Islamic bindings were influenced by Coptic designs and methods. At first the horizontal axis of the book was usually longer than its height and the covers were blind-tooled (*i.e.*, ungilt) with formal decoration. By the 11th century the characteristic Islamic design of an oval centre ornament with triangular cornerpieces was in use in Egypt. Two centuries later bindings of first-class workmanship were being produced in Morocco. The vertical axis had now become the longer one and the use of gold, both in the form of paint and as gold leaf impressed with a hot metal tool, had become established. Moroccan bindings of the highest class—the majority covering Korans—continued to be produced throughout the 14th and 15th centuries, but even finer craftsmanship was practised in Persia during the 15th century. Floral designs began to replace geometric patterns and some pictorial bindings were produced by embossing with molds. Vivid colouring and delicate filigree work were used with great effect on the insides (or *doublures*) of the covers and flaps that are a feature of these oriental bindings. Similar work was produced in Turkey.

Lacquered bindings appeared first in Persia in the second quarter of the 16th century, the design being painted on specially prepared leather or pasteboard. This style was particularly popular in India as well as Persia and is still practised in the east. But hardly any new ideas have been introduced into oriental bookbinding since the 16th century and the work has become more and more repetitive and the quality has steadily deteriorated.

European Binding and Decoration.—*Beginnings.*—The earliest known European decorated leather binding, that of the Stonyhurst Gospels from the tomb of St. Cuthbert, is probably English work of the late 7th century. In technique this and one of the three bindings at Fulda that belonged to St. Boniface, the English apostle to the Germans who died in 754, show affinities with Coptic and Islamic work. But by the 10th century European bindings had developed a totally different construction from those of north Africa and Asia, being sewn on cords securely laced into the boards of the binding. Their decoration also developed on different lines, consisting almost invariably of tooling in blind with individual engraved tools. The earliest Carolingian and Ottonian bindings were probably produced in German and French monasteries. They are of blind-tooled deerskin; many of their tools are circular and resemble coin designs.

A more interesting romanesque group dates from the 11th to the 13th centuries. Most of these were produced by lay craftsmen for university students in Paris. Only a few were bound in England, where the technique of blind tooling died out completely by the 14th century. In France, however, it was never wholly abandoned and in all countries, when the invention of printing led to a great extension of binding activity, there was a strong revival of blind tooling. These Gothic bindings of the second half of the 15th century were again mainly decorated with blind lines and single engraved tools, but the period also saw the spread of two labour-saving devices, the roll (first used in Germany), which produced an engraved strip of decoration, and the block or panel stamp (found in the Netherlands as early as the 13th century), which printed a complete design on the covers of a book with the aid of a simple press. In German-speaking countries there was also practised the so-called *cuir ciselé* or "cut-leather" technique, which usually involved freehand designs on the leather with a stylus or folder rather than a knife. Bindings in the Gothic style continued to be produced in Germany and eastern Europe all through the 16th century and for some time later. By 1459, however, gold-tooled bindings were being produced in north Italy (probably at Venice), the influence of the Levant being shown in the designs of the covers, the patterns of individual tools and a greater delicacy of workmanship. The introduction of gold tooling into southern Italy may have been via Spain, where it had appeared through the influence of Moorish craftsmen. From Naples (where they had worked for the Aragonese royal family) came the craftsmen who bound at Buda in the last decade of the 15th century for King Matthias Corvinus of Hungary.

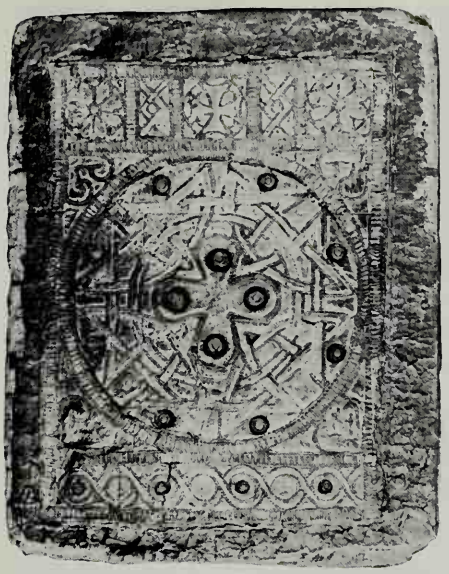
16th-Century Developments.—Until after 1530 Italian gold-tooled bindings were supreme in Europe, the early French gilt bindings from the Blois bindery being imitative of Italian work. In 1538, however, morocco leather (made from good-quality goatskin) became available in France and from that time on the Paris binders have enjoyed a supremacy that has seldom been challenged. The earliest great French collector was Jean Grolier, who used the well-known device *Jo. Grolierii et Amicorum*—for Jean Grolier and his friends. An even greater collection than that of Grolier or his friend "Maiolus" (Thomas Mahieu) was formed by Henry II of France, whose binder was probably Claude de Picques. The tools used in this great period of French bookbinding were derived via pattern books for embroidery or metalwork from oriental or arabesque models and most of the designs incorporated interlacing strapwork. Further elaboration of this strapwork to outline small compartments of various shapes and sizes with a ribbon bounded by a double line on one side and a single line on the other produced the characteristic fanfare design of the last quarter of the 16th century, some of the best of which came from the workshop of Nicolas Ève.

Italian binding, notably the fine series of Roman medallion bindings probably executed for Pierluigi Farnese (not, as was at one time thought, for Demetrio Canevari) and his tutor, Apollonio Filareto, kept pace with the best Paris binding up to the middle of the 16th century. The leading German binder of the period was Jakob Krause, court bookbinder to the elector of Saxony.

The most characteristic early 16th-century English bindings were those blocked in blind with panel stamps of the royal arms, used as decoration and not to denote royal ownership. The earliest English gilt binding dates from 1519, but gold tooling was not regularly practised before 1530, when a craftsman called King Henry's binder was working in the Italian style. Thomas Berthelet, the king's printer, was paid for supplying Henry VIII with "gorgeously gilt" bindings, but it is not known whether he had his own bindery, and several different shops were copying French designs in London in the 1540s and 1550s. One notable English collector, Thomas Wotton, acquired nearly all his finest bindings in France. The English gold-tooled bindings from the libraries of Robert Dudley, earl of Leicester, and Queen Elizabeth I show strong French influence; some were probably the work of Huguenot refugees from Paris and Lyons.

17th Century.—The Lyonese bindings with large blocked centre- and cornerpieces of oriental derivation, which had been produced in almost every European country during the second half of the 16th century, continued in fashion at the start of the 17th. The better-class Paris bindings, however, were either still in the fanfare style or had rectangular panel designs with spiral and floral tools having solid outlines. It was probably in this style that Le Gascon worked. The bindings erroneously associated with his name date from shortly before 1640 until about 1660 and have designs based on the fanfare patterns and tools with dotted (*pointillé*) outlines. Some of them are the work of Florimond Badier. The last 40 years of the century showed little innovation in French binding although one or two examples of great distinction were produced in the 1660s for the royal family. In Germany the political situation was not conducive to luxury trades such as fine binding. The characteristic Italian bindings of the century—nearly all the best examples come from Rome—very frequently incorporate a fan in their decoration. The same design appears in France and also in England, where during the first half of the 17th century most of the leather bindings were rather coarse and clumsy imitations of French work.

In the Commonwealth period variegated colour and more delicate tooling were introduced and with the Restoration came the golden age of English binding. It is now possible to recognize the work of some of the binders of this period, such as Stephen and Thomas Lewis, Henry Evans, Samuel Mearne, Fletcher, Roger



Decorated leather Coptic binding on an 8th-century manuscript of the Four Gospels from the library of the monastery of St. Michael of the Desert, Fayum, Upper Egypt. It is made of papyrus boards covered with dark brown leather, to which is stitched an elaborate panel of red leather openwork tracery over a gilt parchment background

German jeweled binding, a characteristic medieval altar book binding on the Sion Gospels, from the Cathedral of Sion, Valais, Switzerland; *c.* A.D. 1000. The embossed figure of Christ and surrounding foliage date from the 12th century. The boards are of beechwood overlaid with gold. Each frame is set with precious stones; cloisonné enamels decorate the outer frame

Late 7th-century English binding on the Stonyhurst manuscript Gospel of St. John, found when the shrine of St. Cuthbert (d. 687) at Durham was opened in 1104. The binding is red goatskin over thin birch boards; the central vine-leaf ornament and inner and outer frame lines are molded over cords. The interlacing ornament has been coloured in yellow, blue and perhaps green

12th-century Romanesque binding on the Winchester Domesday Book (*Liber de Terris Regis Reddentibus Langabulum et Brugium in Winton*); *c.* 1148. The original brown leather sides are mounted on a modern binding. They are tooled in blind (without using gold) with individual hand tools; most of the designs portray fabulous monsters

COPTIC AND EUROPEAN BINDINGS OF THE 7TH TO THE 12TH CENTURIES

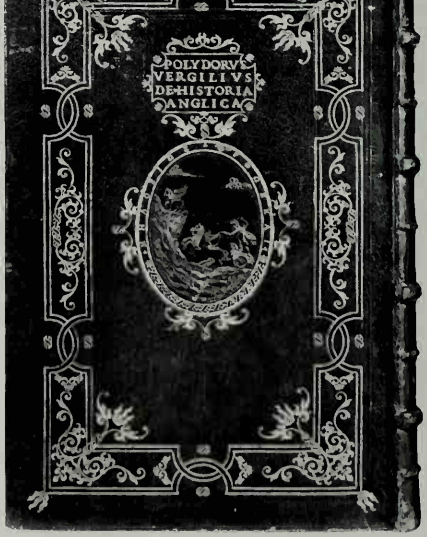
BY COURTESY OF (TOP LEFT) THE PIERPONT MORGAN LIBRARY, (TOP RIGHT) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, (BOTTOM LEFT) STONYHURST COLLEGE; PHOTOGRAPH, (BOTTOM RIGHT) SOCIETY OF ANTIQUARIES OF LONDON

BOOKBINDING

Persian binding on an early 15th-century manuscript Koran. The cover is of light brown morocco leather (goatskin) tooled in gold; the *doublure* (inside of the cover, illustrated here) is of red morocco leather. The centre and corner pieces and the panels of the frame are cut out and filled with delicate filigree work of brown leather over blue grounds and gold designs

German 15th-century Gothic binding on Bartholomaeus Anglicus' *De proprietatibus rerum*, Nürnberg, 1483. It is made of wooden boards covered with blind-tooled brown leather and fitted with metal clasps, bosses and corner pieces. The design of the central panel and the inclusion of the author's name on the upper cover are characteristic of Nürnberg work

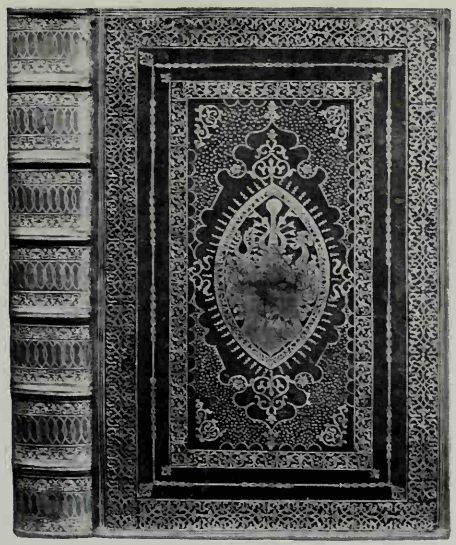
French binding on a volume of Cicero, *c.* 1545. Bound in Paris for Jean Grolier, one of the earliest great French book collectors, it carries the ownership inscription *Jo. Grolierii et Amicorum* ("Jean Grolier and his friends"). The binding is made of green morocco leather with an elaborate gold-tooled interlaced geometrical design



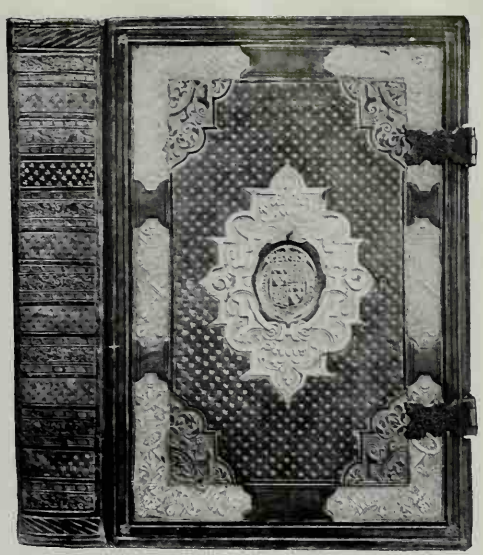
16th-century Italian binding on Polydore Virgil's *Anglicae historiae libri XXVI*, one of a series of Roman medallion bindings probably executed for Pierluigi Farnese. It is made of gold-tooled green morocco leather with a central painted medallion representing Apollo driving his chariot toward Mt. Helicon, on which Pegasus stands

PERSIAN AND EUROPEAN 15TH- AND 16TH-CENTURY BINDINGS

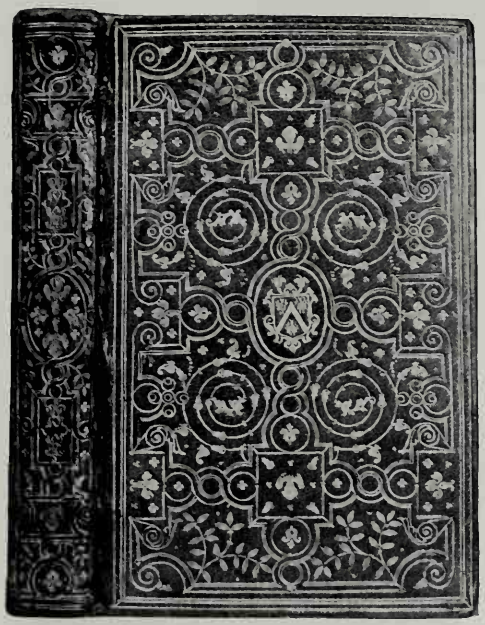
BY COURTESY OF (TOP LEFT) WALTERS ART GALLERY, BALTIMORE, MD., (TOP RIGHT) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, (BOTTOM RIGHT) THE TRUSTEES OF THE BRITISH MUSEUM; PHOTOGRAPH, (BOTTOM LEFT) BY PERMISSION OF THE PROVOST AND FELLOWS OF ETON COLLEGE



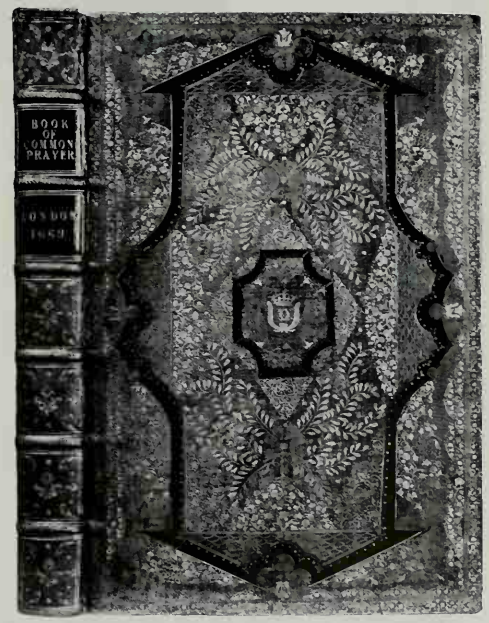
German binding on Plutarch's *Vitae illustrium virorum*, c. 1580, by Jakob Krause, whose initials appear on the fore-edge. It is made of gold-tooled brown calf. The edges of the leaves are gilt, goffered and painted. In the centre is the coat of arms of Augustus I, Elector of Saxony, for whom Krause was court bookbinder



16th-century English binding on "Matthew of Westminster," *Flores historiarum*, bound for Queen Elizabeth I; 1570. The brown calf binding is blocked and tooled in gold with onlays of white leather. The gold tooling is French in style; and the initials IDP, in the L-shaped corner pieces, are possibly those of the Huguenot binder, Jean de Planche



French binding on *Poetae Graeci*, bound in Paris; c. 1575. The binding is of red morocco leather and bears the coat of arms of the historian J. A. de Thou as a bachelor. It is decorated with a gold-tooled fanfare design produced by an elaborate pattern of interlacing strapwork, a characteristic style of French bookbinding during the late 16th century



English Restoration binding by Samuel Mearne on a Book of Common Prayer, London; c. 1669. A cottage-roof binding, so-called because of its broken pediment design painted in black, it is made of gold-tooled, red morocco leather. Bound for one of the royal chapels, it carries the cipher of King Charles II

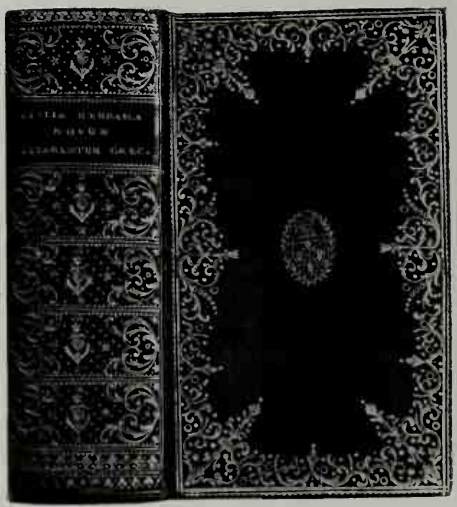
GERMAN, ENGLISH AND FRENCH BINDINGS OF THE 16TH AND 17TH CENTURIES

BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

BOOKBINDING

French mosaic binding bound for Queen Marie Thérèse; 1661. Made of gold-tooled red morocco leather with brown and olive inlays, it carries the arms and cipher of Louis XIV's consort. The crowned dolphins probably are in honour of the dauphin, born in the year in which this presentation copy was bound

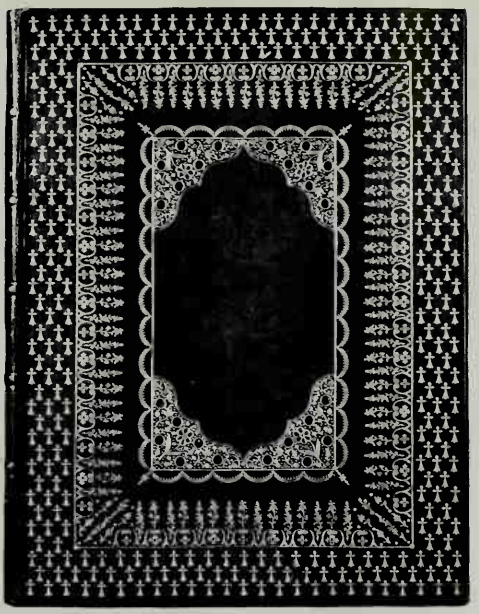
French mosaic binding on *La Sainte Bible*, Cologne, 1739, bound by Le Monnier; c. 1750. It is made of gold-tooled red morocco leather with cream, citron and olive onlays which form a floral design. It is signed at the foot of the cover MONNIER FECIT



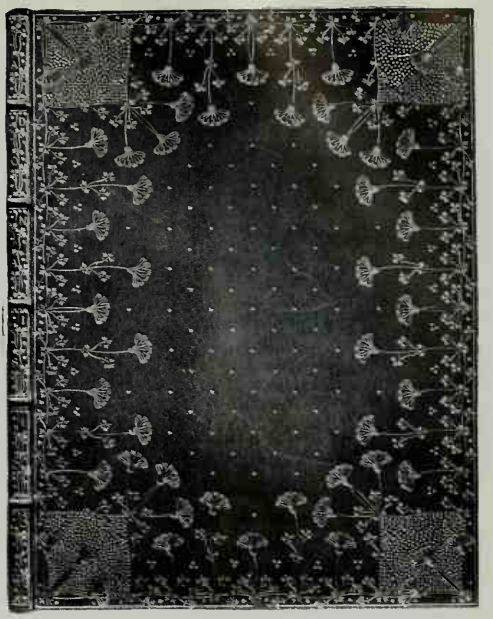
French binding on *Biblia Hebraica; Novum Testamentum Graec.*, Glasgow, 1750, bound by N. D. Derôme; c. 1770. A dentelle binding of blue morocco leather with a gold-tooled lacework border. The coat of arms of C. M. Cracherode was added later

FRENCH BINDINGS OF THE 17TH AND 18TH CENTURIES

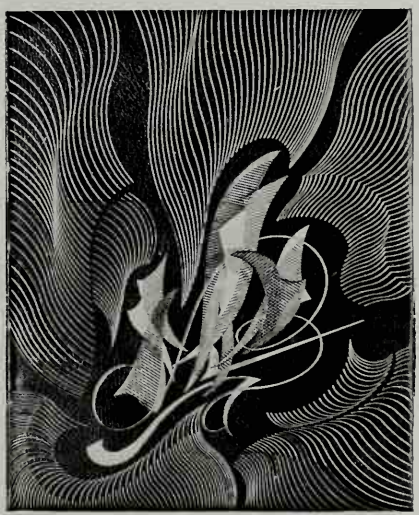
BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM



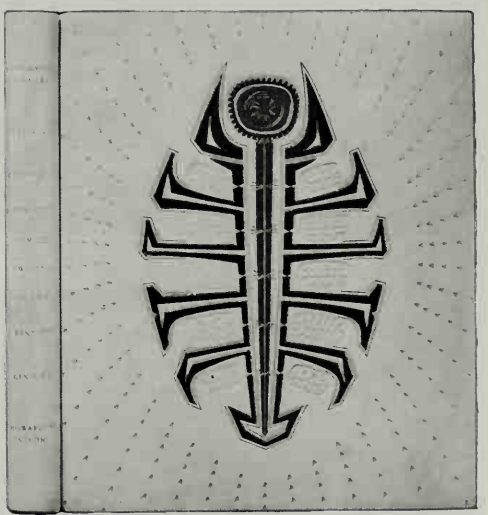
English binding on *An Account of the Bedford Missal* bound about 1794 by Roger Payne, an influential London binder during the late 18th century. The binding is made of olive morocco on which is a gold-tooled panel design. Payne's designs were among the few English styles to be copied in Paris



English binding on Shelley's *Adonais* bound by T. J. Cobden-Sanderson of London; 1888. Made of brown morocco leather, the binding is delicately decorated in gold with floral tools which the binder designed himself. Cobden-Sanderson's designs gave new impetus to leather binding in England



French binding on Léon-Paul Fargue's *D'après Paris* bound by Paul Bonet; 1945. The binding is of black morocco leather, tooled in gold, with onlays of blue, red, brown and white leather. The central motif is an abstract "Ship of Paris" plunging through the waves



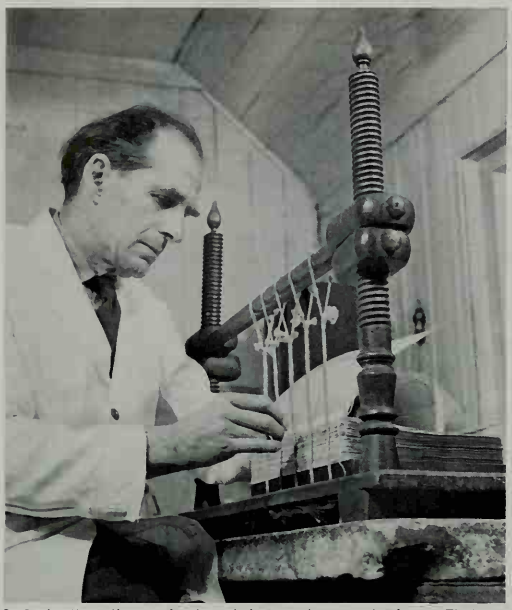
Alum-tawed pigskin binding on H. M. Nixon's *Styles and Designs of Bookbinding from the Twelfth to the Twentieth Century*, bound by Peter Waters of England; 1960. Tooled in gold and blocked in blind, it has onlays of orange, brown, gray, dark and light blue leather

ENGLISH AND FRENCH BINDINGS OF THE 18TH TO THE 20TH CENTURIES

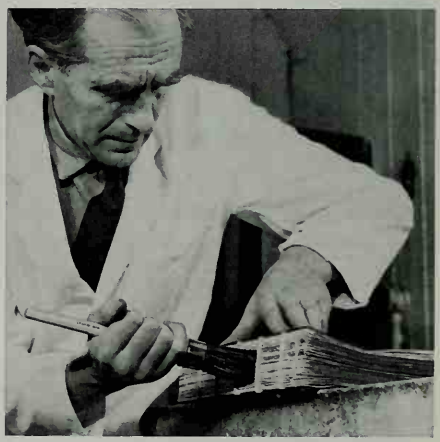
BY COURTESY OF (TOP LEFT) LORD ROTHSCHILD, (TOP RIGHT) THE TRUSTEES OF THE BRITISH MUSEUM, (BOTTOM LEFT) LIBRARY OF CONGRESS, LESSING J. ROSENWALD COLLECTION, PHOTOGRAPH, (BOTTOM RIGHT) PETER WATERS

BOOKBINDING

PRINCIPAL STAGES IN THE BINDING OF A BOOK BY HAND



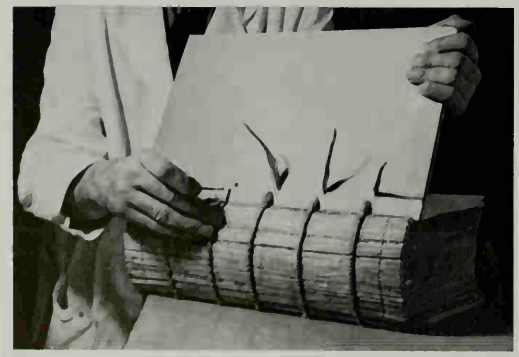
1. Sewing the sections, or signatures, to hemp cords on a sewing frame. The bookbinder in this series of photographs is Sydney M. Cockerell, English binder



2. Applying the adhesive to the spine of the sewn book

3. Backing: forming the joints on the spine of a book in a lying press

4. Lacing the ends of the sewing cords (slips) into the boards



5. Making the headband with silk thread

PHOTOGRAPHS ON BOTH PAGES BY COURTESY OF THEO COCKERELL

6. Thinning the edge of the covering leather with a paring knife

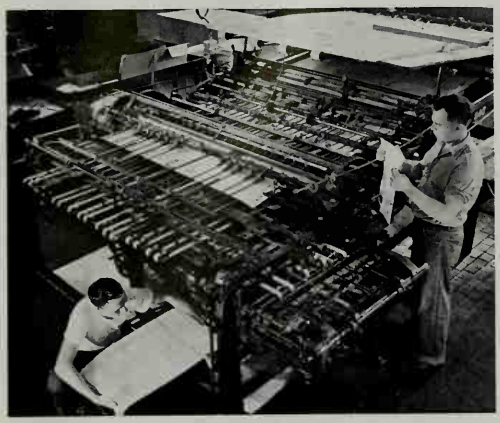
7. Paring the inner surface of the covering leather with a spokeshave

8. Shaping the damp leather to the bands of the covered book with band nippers

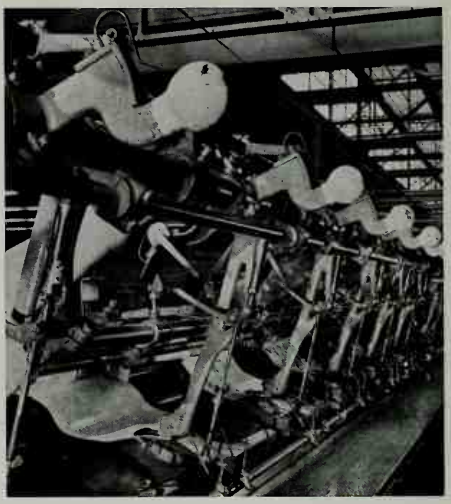
9. Tooling the title on the spine with handle letters through gold leaf

10. Running a gold line on the covered book with a fillet through gold leaf

BOOKBINDING



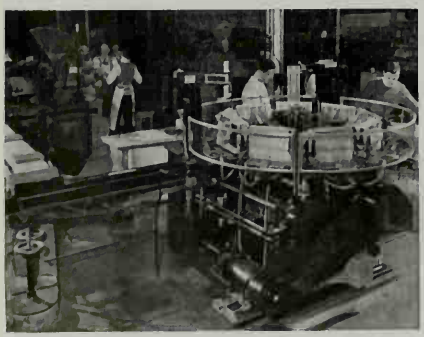
Large, flat, printed sheets (above) are fed into the folding machine one by one. After passing through a series of rollers, the folded signatures are delivered into the packer (below)



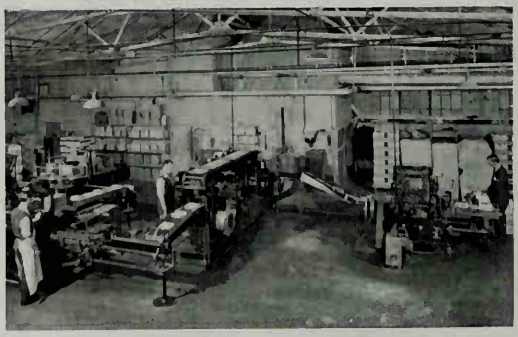
The gathering machine gathers the different signatures in their proper sequence for binding

The Smyth sewing machine sews each signature to the preceding signature through the back folds. This type of sewing allows books to open flat

After gluing, the book back gluing machine passes the books along a conveyer where air blowers speed up the drying and permit the next operation within a few minutes



The book form and pressing machine presses the completed books and forms the joint with hot irons



Smyth automation line—equipped with rounder and backer, triple liner, casing-in machine and book form and pressing machine—shapes books, glues backs, applies gauze, headbands and tapes, fits cover and presses completed book and with hot irons forms the joints. About 2,000 books are produced every hour

SOME OF THE PRINCIPAL STEPS IN MACHINE BOOKBINDING

BY COURTESY OF (TOP LEFT AND RIGHT, CENTRE LEFT) R. R. DONNELLEY & SONS CO., (CENTRE RIGHT) KEY AND WHITING LTD., LONDON, (BOTTOM) LEIGHTON-STRAKER BK. BDG. CO. LTD., LONDON, (CENTRE RIGHT, BOTTOM) © ENCYCLOPÆDIA BRITANNICA

Bartlett of Oxford, Richard Balley and Alexander Cleeve. Some of the tools they used are in the French *pointillé* style; others, including small floral volutes, are typically English. A feature of many of the designs is the broken pediment of the so-called "cottage" or "cottage-roof" bindings, while other designs, such as those used by the "Naval binder" in making his mosaic bindings, are strongly reminiscent of oriental carpets.

18th Century.—The regency (1715–23) introduced a new spirit into French binding marked by the mosaic bindings of Augustin du Seuil and Antoine Michel Padeloup. Later in the century bindings in this style signed Lemonnier show an astonishing technical virtuosity. High standards of execution were also maintained on the dentelle bindings with their lacelike gold-tooled borders—the work of N. D. Derôme and others—and on the simpler armorial bindings of red morocco. Rome remained the most important binding centre in Italy, but most of the bindings produced there were rather clumsy imitations of French dentelle bindings, as were most of the Netherlandish and Spanish bindings of the century.

English binding degenerated markedly in the first half of the 18th century. The "cottage" style long outstayed its welcome and the Harleian style with its diamond-shaped centre ornament and rectangular border proved uninspired and mechanical, except in the hands of Moore of Cambridge. Both designs and standard of technique improved markedly in the 1760s. Robert Adam and James ("Athenian") Stuart each produced one fine neoclassical design. Rococo elements were introduced by Andreas Linde and Johann Baumgarten, earliest of the German-born craftsmen who almost monopolized fine binding in London at the end of the century. The most influential London binder of the 1790s was, however, Roger Payne, one of the very few English binders whose style was copied in Paris. The Edwards brothers of Halifax patented in 1785 a process involving the painting of figures and coats of arms on the underside of transparent vellum.

19th Century.—In the 19th century neoclassical, Pompeian and Egyptian influences were ousted by "romantic" bindings employing coloured onlays and often tooled in the cathedral style with a central design resembling that of a Gothic rose window. From about 1840 to 1880 in all countries there was little new design in leather binding, the emphasis being on delicacy and precision of finish in carrying out pastiches of earlier styles. Meanwhile designers were devoting their attention to the opportunities afforded by the cloth-cased gift books of the period. In the 1880s new life was injected into leather binding design by Marius Michel in Paris and the ex-barrister T. J. Cobden-Sanderson in London.

20th Century.—The first six decades of the 20th century saw a flourishing school of modern binders in Paris with Pierre Legrain as its pioneer in the 1920s and Paul Bonet, Rose Adler and Pierre Lucien Martin among its leading figures. In England notable work was carried out by Douglas and Sydney M. Cockerell, Sybil Pye, George Fisher of the Gregynog Press bindery, Roger Powell in partnership with Peter Waters, and Edgar Mansfield.

Influential 20th-century binders in other countries included Otto Zahn, Edith Diehl, Curtis Walters, Marguerite Lahey and Harold Tribolet in the United States; Paul Kersten, Otto Dorfner, Franz Weisse and Ignaz Wiemeler in Germany; Anker Kyster in Denmark; Giovanni Pacchiotti and Pio Colombo in Italy; and Emilio Brugalla in Spain.

Fore-Edge Painting.—The edges of the leaves of medieval manuscripts were sometimes painted, and gold-tooled bindings have usually had the edges gilt with burnished gold, often goffered with heated tools and occasionally coloured. From 1650 onward a number of London binders, including Stephen and Thomas Lewis, Fletcher, Henry Evans, and Samuel and Charles Mearne, as well as A. Ogstoun, Erskine and A. Hislop in Edinburgh, practised a new decorative method. In this method floral scrolls or scenes were painted upon the fanned-out fore-edge of the leaves and concealed by a normal gilt edge when the book was closed; they became visible when it was opened. In the 18th century the method was continued by John Brindley, who bound for Queen Caroline, and later by the Edwards of Halifax bindery. A few genuine examples were produced during the 19th century, but the great majority of those found on early 19th-century books are modern. (H. M. N.)

HAND BINDING

Books now are produced by machinery and bound by machinery, though some books are still bound by hand because the machine cannot deal economically with single copies, nor can it repair a rare book or produce a work of art. Therefore there are hand binders to deal with the binding of single copies. Their work includes the making of fine tooled bindings, binding reference books and books of special economic or personal value, and the repair of rare medieval manuscripts, early printed books and historical documents.

Materials for Bindings.—The traditional binding material is leather because it is flexible and can be molded to fit the book. If properly prepared it is very durable. The book can be covered all over in leather (whole or full binding) or it may have a leather-covered spine with leather corners and paper or cloth sides to the boards (half binding in Britain, three-quarter binding in U.S.); without the corners it is called a quarter binding (in U.S., half or French binding). Vellum made from calfskin is also an excellent covering material provided the construction of the book is suitable and the book is not subjected to large changes in humidity. Small vellum corners (vellum tips) are often used in place of leather corners. The skins of numbers of different animals have been used for leather bindings. Goatskin (morocco) is one of the most suitable. The leather should be tanned for binding, free from injurious acids and chemically protected against the acid rot that can be caused by the sulfur dioxide of urban areas. Besides leather there are sound binding cloths (coloured cloths that are fast to light). Polyvinyl acetate adhesives are replacing animal glues; they can be used cold and are less liable to insect attack.

Construction.—The binder's job is to fasten together the folded leaves of the codex form of book. This is done by sewing with linen thread through the fold of the sections around hemp cords or over linen tapes, stretched at right angles across the spine of the book. As a rule the binder makes up end paper sections that may be of coloured paper and sews them with the book. When the book is sewn the ends of the cords are cut off, leaving a projection of about 1½ in. on each side of the spine of the book. These projections are called slips and are of vital importance because they provide the attachment for the boards of the binding.

The spine of the book is next coated with thin glue; this holds the sections together and enables the book to be shaped. The edges of the book may be cut at this stage. Before the glue has set, the spine is made convex by tapping it with a hammer (rounding); this causes the fore edge to become concave. The setting of the glue holds the book in this shape. When the book is opened the spine becomes concave, therefore any material stuck to the spine must be flexible, or the book will be stiff to open.

Backing.—Ridges (joints) are formed on each side of the spine by fanning the backs of the sections over backing boards held in a lying press (backing). This fanning is done with a hammer, the joints forming a groove for the boards to hinge in. At one time wood was used for book boards, hence the name codex, derived from the earlier Latin *caudex* ("tree trunk"). Wooden boards are still used occasionally but the majority of books are now bound using hard cardboard (millboard). The board is cut so as to project slightly beyond the edges of the leaves; these projections are called squares. Holes are punched in the board, the cord slips are frayed out, pasted and laced through the holes, the burrs around the holes are hammered flat and the ends of the slips cut off flush. When the book is sewn on tapes split boards comprised of a thin and thick card stuck together are used, the tape slips being inserted between the two boards. Headbands are sewn on to make up to the height of the squares at the head and tail of the spine. The headbands can be sewn with coloured silks over vellum strips; they are securely attached to the book by frequent tie-downs through the backs of the sections.

Leather Covers.—A leather cover is cut from a skin, allowing for a turn-in all around; the turn-in of the leather is reduced

in thickness by paring with a knife or spokeshave (skiving) so that the edges of the covered boards will not be clumsy. The leather is pared along the joints so that the boards can be opened freely. The paring must be kept to a minimum since excessive thinning of the skin weakens it. The cover is well pasted with flour paste and allowed to soak. The moisture in the paste penetrates into the leather, making it supple so that it can be molded to fit the book; the pasted cover is placed on the book and drawn down over the spine. The leather is turned in over the boards and at the head and tail of the spine. Damp leather can be molded to almost any shape and a well-covered book looks as if the leather had grown on it. When the leather is dry the turn-ins are trimmed and the space filled level with thin cardboard.

Titling and Decoration.—The title is tooled on the spine with heated handle letters. A separate tool is used for each letter impressed on the leather. If the lettering is to be in gold the impressions are painted with white of egg (glair), gold leaf is laid on and the hot tools struck again through the gold. The heat of the tool sets the glair, which holds the gold in position, and the surplus gold is removed with a gold rubber. If the binding is to be tooled, the pattern is drawn on thin paper and the finishing tools struck on to the leather through the paper. The finishing tools can be engraved and cut to almost any shape—dots, rings, curves (gouges), straight lines, leaves, etc. Long lines are run with a rotating brass wheel (fillet); repeating strip patterns are made with a roll (a wide fillet with a pattern engraved on the periphery). Large emblems, arms and crests are put in with a blocking press since they require more than hand pressure to strike them. Coloured leathers can be used for decoration combined with the tooling, termed inlay when cut into the leather of the cover, or onlay, which is more usual, when very thin leather is applied to the surface of the cover.

Bindings can be further enriched with metal corners and clasps made of silver, sometimes gold-plated. Heavy books such as lectern Bibles may have metal or ivory bosses for the book to ride on or they may be studded with silver nails to protect the leather from friction. The latter treatment is usual for church service books and rolls of honour.

Design.—Technique is essential and it takes years to train a skilled binder. The most important factor in the making of a fine binding is the design; this includes the selection of the materials and methods as well as the decoration. On rare occasions a fine binding may be classed as a work of art. A sound binding will protect a book for several hundred years. (S. M. Co.)

MACHINE BOOKBINDING

The increasing demand for books throughout the world has forced manufacturers to look for machines that give high productivity and eliminate hand operations as much as possible. This has led to great advances in the mechanical methods of binding books and to the introduction of automation. Machine production is divided into two main classes, edition or hard-bound products and paperback publications.

Edition or Case Binding.—*Folding and Gathering.*—The sheets arriving from the press have to be folded into sections, or signatures. Machines designed for this purpose can fold 64-page sheets at speeds of up to 3,000 sheets an hour, delivering them as one 64-page, two 32-page or four 16-page sections. New types of printing machines also incorporate folding mechanisms that deliver all the sections for a small book at one operation.

Bundling removes air from between the leaves and facilitates stacking of the folded signatures. The sections are placed into a trough, between boards of the size of the sections, where they are compressed either mechanically or hydraulically and then are tied with cord or tapes.

End sheets or end papers are attached mechanically to the first and last sections of the book by automatic machines that handle up to 5,000 end sheets per hour. These machines are also used for tipping (pasting) illustrated plates to the outside of the sections, but plates that have to be positioned opposite a text appearing inside a section have to be pasted in by hand. Sections of books subjected to hard usage sometimes are reinforced with strips of linen or paper along the folded or binding edge; this is done on machines called strippers. Reinforced signatures, usually the first and last, help hold the book in the case since the reinforcing strips are glued to the case boards under the end sheets.

Machines for gathering or collating sections consist of a number of boxes or hoppers into which quantities of each signature are placed at the start of the operation; there is one hopper for each signature, and the signatures are arranged in the hoppers in consecutive order, *i.e.*, a pile of signature number one is placed in the number one hopper, of signature number two in the number two hopper, etc. The action of the machine is such that on each cycle a section is pulled by an arm or drum from the bottom of the pile of each hopper and dropped on a traveling conveyer; with each revolution of the machine, the conveyer belt advances the distance from one hopper to the next to receive the next signature. When the machine is in full operation one complete, gathered book is delivered at each cycle of the machine. A gatherer will deliver as many as 120 books a minute.

Sewing.—The sections, having been gathered into their correct order, are then ready to be connected together either by sewing, which is the usual method, or by threadless or unsewn binding (called "perfect" binding in U.S.), which utilizes glue instead of thread. Great progress has been made in the speed and versatility of the sewing machine, and the models in greatest use in the 1960s were either the semiautomatics, whereby the operator places the sections to be sewn over a stationary saddle from which they are conveyed automatically to the sewing position, or the fully automatic sewers, which are equipped with a hopper into which the sections are placed with the subsequent operations of feeding and sewing and cutting-off being accomplished at speeds in excess of 100 sections per minute without any further action by the operator. It is possible for these machines to affix tapes to the backs of the books when extra strength is required. It is not unusual for large heavy books such as encyclopaedias, reference books and library books to be side sewn. Side sewing machines are equipped with heads that drill holes through the books, with synchronized stitching heads sewing through the prepared holes.

Threadless or unsewn binding gained prominence during the 1950s. This system substitutes for the sewing operation the method whereby the backs of the sections are cut off so that the book block is of single leaves; hot or cold glue of a flexible nature is then applied with a strip of gauze or linen. This system of binding is often used in the production of novels and books of that general type, but it is not extensively employed for bonding together books composed of mixed types of paper.

Smashing and Nipping.—In order to reduce swell and bring the books down to a uniform thickness it is necessary to smash or nip. Nipping is the term used for reducing the back swell, and smashing applies to the allover compression of the book. Whether the book is nipped or smashed depends upon the type of paper used. With novels it is only necessary to nip the backs of the books whereas with Bibles allover smashing is essential to make sure that the air trapped between the large number of leaves is completely expelled. Nipping has assumed increased importance with the introduction of automation into the binderies, since automatic production depends to a great extent upon the uniformity of books.

Book-trimming is invariably performed on three-knife cutting machines that trim all three sides of a four-inch to six-inch pile of books at 15 to 25 piles per minute. They are usually automatically fed with delivery onto a moving belt. A machine developed in the United States trims books singly at speeds up to 70 books per minute, which facilitates the incorporation of the trimming stage into an automatic line.

Book back gluing is now carried out at high speed on automatic machines that pass the books after gluing along a conveyer where hot and cold air remove surplus surface moisture from the adhesive and permit the succeeding operation within a few minutes. Some machines perform both the back nipping and gluing in one operation.

Edge Colouring.—Edges of the book are coloured (stained) in various ways. Usually only the head is coloured. The most popu-

lar colouring method is that in which a gun is used to spray spirit or water colours; brush and sponge methods utilizing solid jelly colours are common in European countries. The gilt-edging of books by mechanical means is now possible with two machines patented in Great Britain and some machines developed in the United States. With one process, gold from a plastic backing is blocked (stamped) onto the edges; the second process utilizes heated rollers. The mechanical application of gilt to the edges of books has revolutionized the art of edge decoration. Books may now be edge-decorated with gold, imitation gold or coloured foils at speeds many times that of the hand method.

Rounding and Backing.—Several machines were used in the early 1960s for putting the round into the back of the books and making the joint or shoulder into which the cover boards hinge. One, operating at up to 40 books per minute, is equipped with an automatic feeder that transfers the books between two rollers that exert pressure while rotating and force the book into the rounded shape. The books are then clamped between steel jaws with a predetermined amount of the back protruding according to the size of the joint required, and a concave steel former oscillates across the back of the books, splaying the signatures over the edges of the jaws and thereby forming the joint. A second machine is used for very long runs because it will handle two books at each cycle and, although the rounding and backing action is similar to that of the machine described first, this machine also glues off the backbone and applies the crash or super, the head and tail bands and the paper backbone lining. Recent hydraulic modifications to one rounder and backer made possible the handling of books of varying sizes without alterations to the settings and made the machine suitable for library rebinding.

Thumb indexing is still largely a hand operation but it has been speeded up considerably by the introduction of indexing guns operated by compressed air and by the printing of key marks on the margin of the book to facilitate the locating of the cutting position.

The gluing and lining of the backs is also performed by machines designed especially for this purpose. The machines will handle either rounded and backed books or flat back books. There is no provision on them for rounding and backing.

Casing-in, or affixing the book into its case (cover), is accomplished entirely by semiautomatic or fully automatic machines. Books are fed into a trough and automatically split onto an ascending blade that carries the book between paste rollers; the rollers apply adhesive to the end papers with allowance made for additional paste in the joints. The cases are automatically fed over a forming iron that is heated to give the correct size and shape to the backbone of the case and are then positioned accurately over the ascending book. The pasted book and the case are brought into contact and discharged from the machine. Semiautomatic casing-in machines can be equipped with a book back gluing attachment for tight back bindings, in which the case is glued directly to the backbone of the book, and a development called the joint and side gluing attachment can be fitted to the infeed so that the books being fed come into contact with two glue rollers that apply an exact amount of cold adhesive into the joint and along the mull (crash) of the book to give additional strength.

Books are fed automatically from the casing-in machine into a book forming and pressing machine. On entering this machine the books are forced accurately into contact with the case and then firmly gripped between clamp plates and transferred through the machine, where pressure is applied to the books and heated irons form the joint. The books are conditioned to a limited extent and hold their shape under varying temperatures better than with the earlier book press methods.

Jacketing has also been mechanized and machines are available that not only accurately position the jacket around the book but also heat-form it into a perfect fit.

The making of the cases is now entirely a mechanical operation. Casemaking equipment can be divided into two classes: machines that make the cases from sheets of cloth already cut to size, and those that have the cloth fed into them from a roll cut to the proper width. With the sheet-fed casemakers the sheets of cloth are automatically fed onto a cylinder that revolves in contact with a glue roll. The glued cloth is transferred to a platform where the two boards and back lining are positioned accurately by a suction head and turn-in rollers fold the edges of the cloth securely over the boards. The cases then pass into a press that ensures firm contact of cloth to board over the entire case. In quarter-bound or three-piece cases it is usual for them to be passed twice through the sheet-fed casemaker although with roll-fed machines the case can be produced in one operation. Three-piece cases can also be made by first using a flat stripper to attach the two side pieces of cloth to the backbone strip and then finishing the case on a sheet-fed casemaker. A U.S. designed high-speed casemaker makes full-bound or quarter-bound cases in one operation at a speed of up to 40 cases per minute.

The modern casemaker is very versatile and will handle not only cloth but also paper, artificial leather and certain leathers of uniform thickness with round corners and with a centreboard in place of the back lining if required. The pieces of cloth for the casemaker are cut on cloth-cutting machines that cut reels (rolls) of various materials up to 72 in. wide and 24 in. in diameter. These cutters slit and cut off from reels of book cloth or artificial leather at 40 crosscuts per minute, are equipped with a device for taking the curl out of the material and rewind the excess cloth. Board cutting is carried out at high speed and with great accuracy, with the board being cut in two directions in one operation. Blocking of the cases is performed on a variety of high-speed blocking presses. Some machines are capable of operating at 2,000 cycles per hour on some types of blocking and can feed cases either singly or two-up. A British rotary blocker operates at speeds up to 8,000 an hour on ink and blind and up to 4,000 an hour with gold.

Automation was introduced into the binderies of the world during the 1950s. The invention of conveyer feeders incorporating a simple mechanical timing device made possible the linking together of many bookbinding machines into an automatic line, and by the early 1960s development had reached the stage where books could pass through the operations of sewing, smashing, trimming, gluing, rounding and backing, triple lining, casing-in, pressing, jacketing and packaging without intermediate handling.

Paperbacks.—Although a percentage of paperbacks is still produced on lines similar to those of the case-bound book with individual folding of the flat sheets into sections and sewing, wire stitching or gluing together of the pages, the specialist binderies have installed combination units that eliminate separate operations. These machines gather the sections into correct order, cut off the backs to form single sheets, glue, apply a strip of mull or super, apply the paper cover with adhesive and deliver the copies for trimming at speeds exceeding 3,000 an hour one-up or double this figure with two-up work. Single copy trimmers are often incorporated into these production lines. With two-up production, band saws part the books before they are moved to the three-knife pile trimmers for completion.

Packaging or wrapping for mailing is accomplished by automatic machines often in conjunction with addressing equipment synchronized with the wrapping device. (E. A. Bo.)

BIBLIOGRAPHY.—D. E. Miner, *History of Bookbinding, 525–1950 A.D.: an Exhibition Held at the Baltimore Museum of Art* (1958); H. M. Nixon, *Broxbourne Library: Styles and Designs of Bookbinding* (1957); J. P. Harthan, *Bookbinding,* Victoria and Albert Museum (1950); G. D. Hobson, *English Bindings 1490–1940 in the Library of J. R. Abbey* (1940); A. R. A. Hobson, *French and Italian Collectors and Their Bindings* (1953); L. M. Michon, *La Reliure française* (1951). (H. M. N.)

BOOKCASE: *see* CABINET FURNITURE.

BOOK COLLECTING, the exercise of taste, judgment and connoisseurship in the formation of a special kind of library. The collector's library is not formed primarily for reference, for current reading or for entertainment alone, though it may include these among other benefits as valuable by-products. The instinct to collect manifests itself in many fields. Persons who combine this urge with a love of the things of the mind and the spirit and a reverence for the past have often turned to the hobby of book collecting. There are many instances of omnivorous accumulators

who have made notable collections without any clearly defined rationale, and of collectors who have relied almost entirely on agents for the gathering and management of their libraries; but in its classical form, book collecting is a highly personal activity manifesting considerable intellectual discipline.

Other articles of interest in connection with book collecting include BOOK, which discusses how the content, form, making, distribution and use of books are related; LIBRARY, which covers the public collections of books; and BOOKBINDING. A related field of interest is covered in the article BOOKPLATE. Readers wishing further guidance on BIBLIOGRAPHY will want to consult that article.

The avocation has had far-reaching consequences in the history of civilization. Private collections have provided the cornerstones of many of the world's great libraries and have enriched beyond measure existing foundations. It is no accident that Oxford's famous library bears the name of Sir Thomas Bodley (*q.v.*), or that the collection formed by Charles V lies at the heart of the Bibliothèque Nationale, or that the oldest university in the United States is named for John Harvard, who bequeathed his books to it. Through the efforts of past book collectors, basic sources of history and priceless monuments of art and literature have survived that might otherwise have been irretrievably lost. Apart from spectacular rarities, the background materials of history, ranging from works of primary importance to the merest ephemera, owe their preservation to collectors. The cost of such materials is often so modest that book collecting is not beyond anyone's means, if he charts his course intelligently. The exercise of individual discrimination, frequently running counter to popular fashion, has played a large part in the survival of these records of the past. And an important element in the pleasure experienced by the seasoned collector is the satisfaction of backing his own choice and of slowly creating from apparently disparate materials an entity with point and significance, capped by triumphant vindication in the resulting harmonious collection. Only in very recent times have governments and institutions assumed some of the functions of the private collector; and institutional collections can seldom, if ever, indulge in the flexibility and the idiosyncrasy that provide much of the strength and charm of a private library.

THE PRINCIPLES OF BOOK COLLECTING

What Is Collected.—Much of the attraction of book collecting lies in the thrill of the chase. If the books he seeks were always easy to procure, the collector would not esteem them so highly. Their rarity provides an extra fillip, yet it is a rarity that is not necessarily reflected in price. Many books sought by collectors are far more uncommon than Gutenberg Bibles or First Folios of Shakespeare but, when they can be found at all, they sell for a small fraction of the price of the famous rarities. Many a collector has spent years of patient search to obtain some book, perhaps insignificant in itself, but important to him because it fills a vital gap in his collection. Every book in a good collection gains by association with its peers.

Many of the books that are the objects of a collector's efforts fall into the class of first editions or first printings. The pursuit of first editions has often been dismissed as a kind of foolish sentimentalism, yet there are good reasons why the earliest appearance of a book should be the most desirable. The first edition frequently is the only one overseen by the author, and presents the best text of his work, while in later editions his intentions are obscured by careless errors that have crept in. In fact, the first edition is the only edition of many books. If later editions contain authorial revisions, the first is still necessary so that the changes can be analyzed. In illustrated books, the earliest impressions of the plates are often best. Later impressions may be less carefully printed in response to the demands of the market, and plates and blocks may be worn or injured. And even the charge of sentimentalism can be admitted and outfaced: a book that has made its mark in the world can hardly fail to arouse interest and even awe when we see it in the form in which it first presented its ideas to the public. Book collecting in its highest form is inevitably bound up with reverence for the past achievements of the human mind. There would be far fewer collectors if collecting were not rich in emotional overtones.

Building a Collection.—The successful collector marks out the scope and goal of his collection with some precision. The end must be suited to his means. These need not be great, but it is foolish to embark on a collection foredoomed to lack its central focus because the collector cannot afford it. Nor should he attempt to collect the uncollectible. Certain classes of books that were scarce to begin with have disappeared into permanent institutional collections to such an extent that it is virtually impossible for the longest purse to secure a good run of them, and there is no prospect that the supply will ever again increase. Such, for example, are Elizabethan dramatic quartos; nearly in the same class are medieval illuminated manuscripts. Such fields present great difficulties to the collector, and in them prime specimens command very high prices. As long as institutional libraries continue to grow at a rapid rate, more and more classes of books will approach the status of the uncollectible. By the same token, the collector will recognize which books in his field are verging on the uncollectible, and will be prepared to make great efforts to secure them whenever they are available. The chance may never occur again.

The wise collector also governs his activities according to the fashions of the day, avoiding when he can those kinds of books in popular favour and hence artificially overvalued. To appreciate the force of fashion, one need only contrast the prices of Kipling first editions in the 1920s, when they were very much in vogue, with those 30 years later, when Kipling had sunk in popular esteem. The same change of fortune can be observed in the works of numerous other authors and in many other fields of collecting. In the early 19th century certain specimens of 16th-century printing were valued as highly as they ever have been; a century later some original Aldine editions could be purchased for less than the cost of a microfilm of their text. A few well-informed collectors interested in the same specialty will create a competitive market. When they are joined by the uninformed multitude collecting by rote, inflation results; when fashion changes, values slump. Only the great classics of book collecting—the accepted masterpieces of literature and art in their most desirable editions—can be counted on to stand firm above the tides of fashion.

Approaches to Collecting.—The approaches to collecting are as varied as are books themselves, and as all-inclusive or as specialized as their topics. In general, there are three types: the author collection, the subject collection and the cabinet collection. In the first, the collector sets out to gather the works of his chosen author in all the forms in which they have appeared before the public, or he may concentrate on only one phase of his career or even on only one or two of his works.

Subject collecting can range from a field as sweeping as Martin Bodmer's collection of monuments of world literature or as comprehensive as Waller Barrett's collection of American literature, to collections on chess, coffee, prize fighting, detective fiction or the development of nuclear energy. Two collections formed by George Arents and now in the New York Public library illustrate the variety possible in subject collecting: one is of books on tobacco, the other of books that were issued in daily, weekly or monthly parts. Each has its special points of interest, each marshals facts of significance in the history of society and human endeavour, and the published catalogues of each are of far wider potential use than the limitations of their particular subjects might suggest.

The third kind of collector limits his library to a small group or cabinet of choice specimens, although an author or a subject may form the basis of his collection. Whereas Sir Thomas Phillipps swept anything written by hand into his library, Henry Yates Thompson set himself the goal of gathering exactly 100 illuminated manuscripts, each the best of its type that he could find and afford; further manuscripts were to be added only upon the elimination of other manuscripts which they surpassed. This is a stern ideal, and one which Yates Thompson himself could not follow to the letter. But the principle of cabinet collecting has

always had its attractions for those whose resources are limited or whose library shelves are not indefinitely expandable. Bookbindings, publishing styles, fine printing, book illustration and many other topics lend themselves admirably to this approach. Many book lists famous in the annals of collecting represent the cabinet principle: the Grolier club's 100 books celebrated in English literature and 100 books in the history of science, A. Edward Newton's list of novels, and Merle Johnson's "high spots." The wise collector may profit by such examples, but he will not attempt to duplicate them, for books on such lists attain a celebrity that soon inflates their prices. Once again, it is advantageous for the collector to mark out his own path and avoid the most traveled roads.

Condition and Its Importance.—Condition is an important consideration common to all types of collecting. A very great difference of value separates a superlative copy of a book from a poor or even an average one. The factors determining condition vary widely among books of different kinds and periods. For most books since about 1770, when publishers' bindings began to be common, fine condition implies original boards or cloth closely approximating their freshness as they first stood on the bookshop shelf. For earlier books and others originally sold unbound, the collector's ideal is a good contemporary binding, or, failing that, a sound modern binding. Internally, the book should be complete and as clean and fresh as possible. Of course, some books are rare in any condition; a Caxton is a Caxton even if it lacks a number of leaves or is merely a fragment. The collector learns what condition can be reasonably expected for books in his field. If he is wise, he sets as high a standard as possible, avoiding the disheartening necessity of apologizing forever after for books in needlessly shabby condition.

Because of the interest and activity of private collectors, many books of every period have been preserved in original condition. No one will deny that the chief *raison d'être* of a book lies in its contents, but books may also be regarded as artifacts and documents in the history of the graphic arts. Most books in institutional libraries are intended for current use and are subject to normal wear and tear, though a few specimens may be set aside for special preservation. The private collector has generally assumed responsibility for books in fine condition, and has demonstrated that the unread book, far from being a paradox, has its place among the primary sources for cultural history.

Two Special Considerations.—Association is another important factor. A book annotated or otherwise inscribed by its author, or containing the markings of some other prominent or interesting person who has owned and used it, is particularly desirable to the collector. Entire collections have been built around these so-called association copies.

The study of provenance—the history of the successive ownership of individual volumes or collections—is more than an act of piety on the part of the bibliophile. For one thing, the taste and standards of certain former collectors guarantee the quality of almost any book traced to their collections. More important, a knowledge of provenance has often led scholars and collectors to books and manuscripts that otherwise would have been difficult or impossible to locate. An interest in provenance is an inevitable and a valuable concomitant of collecting.

Dealers and Catalogues.—The literature of book collecting abounds in tales of amazing finds in unlikely places. Such things do happen, particularly to the collector who has mastered his field and knows what he is looking for. But the core of every good collection comes through the normal channels of the book trade and the friendly intermediacy of specialist dealers. The collector obtains his books by private treaty, from dealers' catalogues, by the circulation of want-lists and at auction. In each of these transactions the dealer can play an important part, guaranteeing the *bona fides* of the books he handles, bringing to the collector's attention books he might otherwise never hear of, securing for him scarce titles he might otherwise have no chance to buy and generally making available a fund of experience and advice. Indeed, want-lists can hardly be circulated except through a dealer, and buying at auction is best handled by a professional. In England and continental Europe it is virtually impossible to purchase at auction except through a dealer, and in any event the commission is not an excessive price to pay for *expertise*. At every stage of his career, the collector has much to learn and much to gain from the dealer. When he is making a beginning, a reliable dealer can guide him past many pitfalls and teach him the rudiments of his hobby. When the collector is old in experience and perhaps knows more about his specialty than the dealer, the bookseller is still his faithful ally, guiding essential books to his shelves.

The beginning collector has an extensive vocabulary to learn in order to consult catalogues and bibliographies profitably. He must also know something of the anatomy of books and the different methods of their manufacture at different times. He has "points" to learn or to discover for himself in his chosen field. "Points" are the distinctive variations or marks that distinguish one printing or edition from another. He will find that some time-honoured "points" are ambiguous or even totally mistaken; for only in the mid-20th century did the powerful tools of modern bibliography begin to be used systematically, and many fields of interest to the collector remain to be scientifically explored. Scarce and valuable books may be legitimately repaired and restored or dishonestly faked with almost incredible skill, and the collector should be able to recognize the signs of such work. There are numerous excellent books to guide him through this maze, but no substitute for experience; and experience is happily available in the interest and advice of his fellow-collectors and of librarians, bibliographers, dealers and scholars in the fields of history, literature and art. They can direct him to the best books of reference, provide examples and demonstrations, warn of dangers, produce other copies of books for comparison and the like. And the crown of his career comes when he, too, can settle some moot point or even, like Geoffrey Keynes or Michael Sadleir, produce a definitive bibliography; or like Carl H. Pforzheimer or J. R. Abbey, sponsor a catalogue based on his own collection that ranks as a major work of reference.

HISTORY

The Beginnings of Book Collecting.—Books have been collected ever since there have been books to collect, and we may perhaps go back to the libraries of clay tablets of the middle east for the earliest historical examples. The papyri of Egypt and the scrolls of ancient Greece and Rome preceded the book in codex form familiar to us, and there were notable collections at many places in the ancient world—Ephesus, Alexandria, Antioch, Constantinople and Rome, to name a few. All these collections were scattered in ancient times, and they are known only through contemporary accounts. In any event, they belong more to the history of libraries than of book collecting as it is now understood. There was no widespread literacy. Books were few and costly in the days of manuscript transmission. Collecting was mostly limited to the princes of church and state and a few patrician magnates—a tendency prevailing through the middle ages and still perceptible as a survival today, for example, in the Vatican library and the royal and imperial foundations of other great European libraries. The collections attached to monastic foundations also expanded during the middle ages through the activity of the trained copyists provided by their own writing schools. But even with the spread of education, lesser private individuals necessarily collected on a very modest scale. Twenty books represented the height of ambition for Chaucer's Clerk in the 14th century.

Book collecting in the modern sense really began after the invention of printing in the middle of the 15th century, although there had been foreshadowings among the earlier humanists. The development of collecting was slow at first. The rapid multiplication of texts by printing, the lower price of books and the resulting increase in literacy all favoured its growth. But the absence of great public or semipublic libraries which might be consulted for reference purposes made it necessary for every large private collection to be in some degree a general library, and certainly during the 15th and 16th centuries the dominant purpose in book collecting was the formation of a working library. Even

very much later many private collections consisted of an antiquarian or artistic superstructure founded on a general or reference library. To be sure, the working library of one age is often the collector's library of the next. Voltaire's books, gathered by him without antiquarian intent, are a particular ornament of the State Public library in Leningrad. But only in the late 19th and the 20th centuries have collectors generally been able to rely extensively on public libraries and therefore to concentrate their energies and resources on specialties. Of course there are in every period exceptions to such a general rule.

Some Early Collections and Collectors.—The history of collecting is long and studded with illustrious names, and in a short account it is possible to select only a few persons representative of general tendencies. Some early collections have survived wholly or in part to modern times, so that trends and tastes can still be observed at first hand. Such, for example, was the library of Willibald Pirkheimer (1470–1530), German humanist and friend of Albrecht Dürer, purchased at Nürnberg more than 100 years after Pirkheimer's death by Thomas Howard, 2nd earl of Arundel. Arundel's grandson, the 6th duke of Norfolk, presented it to the Royal society in 1667, and the manuscripts were in turn sold to the British museum in 1831. Another collection, the Bridgewater library, begun about 1600 by Sir Thomas Egerton, descended for three centuries through the hands of direct and collateral relatives, growing the while, until it was purchased *en bloc* in 1917 by Henry E. Huntington of California; scattered volumes discarded by the Huntington library as duplicates have gone on to other collections. The descent of numerous other early libraries can also be traced, but these two may be taken as typifying the activities of royal and noble amateurs in the 16th and 17th centuries.

Distinguished collections which are now widely dispersed were formed by such men as Jean Grolier (1479–1565) and the French historian Jacques Auguste de Thou (1553–1617). Although they appreciated fine books as such, and had their libraries beautifully bound, they collected to a large extent for their own practical use. The words *et amicorum* ("and of friends") which Grolier and various others caused to be stamped on their books as part of the mark of ownership, symbolized the collector's willingness to share the use of his library with others of like interests. The day when men of learning and culture could consult public collections was still in the future, but already by the end of the 16th century public collections were beginning to grow. Sir Thomas Bodley established the library bearing his name in 1598, and soon others (for example, Richard Rawlinson) arranged to have their treasures added to it. Private collections were recognized as having public importance, and such libraries as the Harleian collection and that of Sir Hans Sloane became national property and a part of the newly founded British museum by purchase in 1753. At the same time a few specialist collectors flourished in the 17th century, such as Humphrey Dyson, who collected Elizabethan proclamations and reprinted some of them to fill out imperfect sets; and George Thomason, who collected the ephemeral publications of the Great Rebellion and interregnum as they came out, with careful notes as to price and exact day of issue. Thomason's pamphlets are one of the most valuable historical sources in the British museum.

Later Collections and Collectors.—In the early 18th century a new tendency in collecting appeared in England: for the first time anywhere a group of wealthy men began systematically and enthusiastically to collect early printed books. They were pioneers in forming antiquarian collections rather than working libraries; they first valued incunabula as such, and their collections provided reservoirs of early volumes still drawn upon by modern collectors. They included the 1st and 2nd earls of Oxford (the celebrated Harleys), the 3rd earl of Sunderland, the 1st duke of Roxburghe, the 8th earl of Pembroke and the 2nd duke of Devonshire. Their activities set a pattern for collectors ever since. Their collections were entirely or in great part dispersed over the two centuries following their deaths, and their sales often marked the genesis of important new collections.

Meantime an interest in 16th- and 17th-century literature was growing. Scholars and antiquaries such as Joseph Ames, William Herbert, George Steevens and Edmund Malone gathered and studied the printing and literature of the Elizabethan and Jacobean periods. Collecting in continental European countries followed (though not simultaneously) much the same pattern as in England, with the development of interest in incunabula leading to the collecting of the earlier national literatures. But in America most libraries were still working libraries, with only a few men such as Thomas Prince showing any antiquarian tendencies.

The early 19th century saw a resurgence of interest in incunabula that reached a climax at the Roxburghe sale of 1812, when George Spencer, then marquess of Blandford, paid a record price for the Valdarfer edition of Boccaccio (1471) and printed its description in his own catalogue in letters of gold. Perhaps the greatest collector of the generation was the 2nd Earl Spencer, whose books were headed by 56 Caxtons and first editions of all the Greek and Latin classics, and whose collection in 1892 became the nucleus of the John Rylands library in Manchester. Spencer's contemporary, Richard Heber, gathered an immense library, including continental literature and history but strongest in early English drama and poetry. The dispersal of his books in a long series of sales provided the opportunity for William Henry Miller to found his collection, which in turn passed on and continued to grow in the hands of a series of collateral descendants, forming the Britwell Court library, itself dispersed in a notable series of sales between 1916 and 1927. Another titan of the 19th century was Sir Thomas Phillipps, who during a long and contentious lifetime formed the greatest collection of manuscripts of all sorts ever owned by one man.

Book Collecting in the U.S.—Meanwhile collecting in the true sense had reached America, with the advent of James Lenox of New York, owner of the first Gutenberg Bible in the new world, whose books are a part of the foundation of the New York Public library; John Carter Brown, founder of the library of Americana bearing his name; and George Brinley, whose colonial Americana was dispersed at auction. A later generation of financial tycoons founded great institutional libraries now named for them: Henry Clay Folger, Henry E. Huntington and J. Pierpont Morgan. A fine library eventually dispersed by public sale was formed by Robert Hoe, whose taste and collection in some ways resembled that of his English predecessor Heber.

20th-Century Book Collecting.—After the heyday of these great collectors and others like them, there still remained a few giants of the book world but their number decreased. In the 20th century, collections tended to be smaller as limitations of space governed the collector's activities and as confiscatory taxes restricted his scope. Collections also tended to be more critically selective, in part because of great advances in the science of bibliography. More and better aids became available to the collector: where, for example, the 1930s hailed a book like Merle Johnson's *American First Editions*, an excellent check list containing much valuable information, the 1950s saw the launching of Jacob Blanck's multivolume *Bibliography of American Literature*, with its full apparatus and careful reappraisal of all important points. How bibliographer and collector work together is shown by Wilmarth S. Lewis' remarkable collection of Horace Walpole and Professor Allen Hazen's distinguished bibliographies of Walpole and the Strawberry Hill press, partly in aid of the collection and partly inspired by it. How the world of letters profits thereby may be seen in the definitive edition of Walpole's letters, a monument of scholarly achievement impossible without the combined efforts of collector and bibliographer. The same trend appearing all through the sphere of bibliophily has meant that the collector is encouraged and helped and even to some extent forced to develop his bibliographical *expertise*.

Finally, many classically popular fields of collecting have been largely drained off into permanent institutional collections. Favourable tax laws, coupled with more assiduous and more intelligent collecting by professional librarians, have promoted this tendency. J. K. Lilly's American literature collection is at Indiana university, Arthur A. Houghton's collection of John Keats at Harvard, Lessing Rosenwald's illustrated books at the Library of Congress and so on. But year by year, more books are published

than ever before, and imaginative collectors open new fields for their endeavours. Of the collecting of books, like the making of them, there is no end.

BIBLIOGRAPHY.—Introductions to collecting include John T. Winterich and David Randall, *Primer of Book-Collecting* (1946); and John Carter, *A B C for Book-Collectors* (1952), particularly valuable as a guide to the specialized vocabulary.

An essential book on bibliographical technique is Ronald B. McKerrow, *Introduction to Bibliography* (1927 and later impressions).

For a history of collecting in the United States, there is Carl L. Cannon, *American Book Collectors and Collecting From Colonial Times to the Present* (1941); in England, Seymour De Ricci, *English Collectors of Books and Manuscripts* (1930); in Europe, G. A. E. Bogeng, *Die grossen Bibliophilen,* 3 vol. (1922).

Trends in sale prices can be seen in the annual *American Book-Prices Current* (1895 *et seq.*) and the English *Book-Prices Current* (1886 *et seq.*) and *Book-Auction Records* (1902 *et seq.*); these also have their counterparts in France and Germany. The weekly *Times Literary Supplement* (London) often reports book sales and other bibliophilic matters.

The leading collector's journal in English is *The Book Collector* (1952 *et seq.*), a quarterly; the weekly *Antiquarian Bookman* (1948 *et seq.*) is also of value. (W. H. BD.)

BOOKKEEPING is the recording branch of accounting (*q.v.*). Accounting is the art of recording, classifying and summarizing transactions of an enterprise and interpreting the results thereof. To make a distinction between bookkeeping and accounting is difficult. Accounting includes bookkeeping but is a broader subject. For example, an accountant designs the system of records used by the bookkeeper. The bookkeeper accumulates the figures; the accountant summarizes and interprets these figures.

Nearly all accounting systems use "double-entry bookkeeping." This method of keeping records (described below) originated in the middle ages. An explanation of the process was printed in Italy as early as 1494 in a book on mathematics by a monk, Luca Pacioli. Historically, double-entry bookkeeping developed as the standard method by which the economic activities of privately owned and operated business concerns are recorded.

Stockholders, investors, credit grantors and the management of a business firm all require a knowledge of bookkeeping. Management needs a knowledge of bookkeeping to interpret the results of operations, to control costs, to budget for the future and to make financial policy decisions. Investors use a knowledge of bookkeeping to make decisions about buying, holding and selling securities; they need to have a knowledge of bookkeeping in order to interpret the results of operations of business firms. Credit grantors need the knowledge to analyze the financial statements of a business enterprise in deciding whether to grant a loan. As financial statements are the end results of the bookkeeping process, intelligent analysis of financial statements requires a knowledge of bookkeeping. Similarly, mercantile credit managers must have a knowledge of bookkeeping in order to make decisions about the size of credit limits.

History.—Financial and numerical records are found in nearly every civilization with a commercial background. Records of commercial contracts were found in the ruins of Babylon. Accounts for both farms and estates were kept in Greece and Rome. The double-entry method of bookkeeping began with the development of the commercial republics of Italy. The first double-entry books known to exist are those of the Massari of Genoa dating from the year 1340. As these books were in excellent double-entry form the system must have been in general use long before that time. Double-entry bookkeeping was also used by the members of the Hanseatic League, the banking houses of the Medici and the Fuggers, and by the great trading companies chartered by the governments of Great Britain, France, Holland and other countries; it was used by the monasteries, the papacy, and the individual merchants and adventurers in the early days of capitalism. Although the inherent nature of double-entry bookkeeping has remained the same, bookkeeping and accounting have adapted themselves to the demands made upon them.

Instruction manuals for bookkeeping were developed during the 15th century in various Italian cities, notably a work dated 1458 by Benedetto Cortrugli, a forerunner of his fellow citizen Luca Pacioli. The thoroughness of Pacioli's volume, with his extended discussion of debit and credit, establishes him as a pioneer in double-entry bookkeeping, although the practices had been followed in central and southern Europe for several centuries preceding his time.

Many books of instruction based on Pacioli's material appeared in Germany, England and Holland during the 16th and 17th centuries, with technical modifications to suit the needs of international trading operations. According to best available records the first German work was written by Herman Schreiber in 1523. Hugh Oldcastle, an Englishman, and Jan Ympyn Christoffel of Holland published treatises in 1543. In 1586 Don Pietra, a Benedictine monk, made a contribution by stressing the fact that a business enterprise was a separate economic entity, distinct from its owner or owners.

The first Scots publication on the subject of bookkeeping, by Robert Colinson, was dated 1683, and an Irish work by John Herman appeared in 1719. In 1741 John Mair of Scotland wrote a bookkeeping text which was standard for 50 years. No American text is known to have appeared before 1796, when William Mitchell of Philadelphia published such a work. But the public schools of Boston had provided classroom instruction in bookkeeping since 1682, relying on European writings for subject matter. James Bennett, a bookkeeping teacher in New York, was the author of *American System of Practical Bookkeeping,* first published in 1818.

The Industrial Revolution provided an important stimulus to accounting and bookkeeping. The rise of manufacturing, trading, shipping and subsidiary services made accurate financial records a necessity. The history of bookkeeping is a reflection of the history of commerce, industry and government.

Bookkeeping has responded to many demands. The increased complexity of business and the accompanying need for cost accounting, internal control and budgetary control has created the need for new types of records. The income tax and other taxes have had important effects on bookkeeping. Bookkeeping has developed to provide the information about an enterprise which is essential to management, investors, credit grantors, tax authorities and other government agencies.

Bookkeeping Processes.—The basic procedures which customarily are included in the bookkeeping process are outlined below. The purpose here is to give an over-all picture of the bookkeeping process. Some of these items will be dealt with in greater detail later in the article. Depending on the size of the business, some of these procedures are handled by machines.

Preparation of Basic Documents.—Cash slips, check books, stock cards, deposit slips, time cards, sales slips, sales invoices, credit memos and purchase invoices are some of the original documents with which the bookkeeper is concerned. Transactions that are similar in kind are often summarized and entered in total in the books. For example, the total daily cash sales are entered in the books rather than each individual cash sale.

Journalizing.—Transactions are analyzed and entered in a journal. The journal is the book used to make the first record of a transaction. There are many different forms of journals. One journal may be designed to take care of only one kind of transaction such as cash receipts or sales on account, for example. In a small business all transactions may be entered in one journal. Transactions are entered chronologically in the journal. The analysis of a transaction indicates which accounts are affected; an account contains entries affecting only one item. For example, all entries affecting cash are summarized in one account with the title cash.

Posting.—The process of transferring journal entries to the accounts in the ledger is known as posting. The various accounts of an enterprise comprise the ledger; the ledger contains an account for each financial item.

Preparation of the Trial Balance.—Entries are made in accounts in terms of debits and credits. A debit signifies an entry in the left-hand side of a ledger account. A credit, on the other hand, signifies an entry in the right-hand side of a ledger account. The debits for each entry in the journal are always equal in amount to the credits for that entry. Thus if no errors are made in posting, the total of all debit amounts in the ledger equals the total of

all credit amounts in the ledger. The trial balance is a method of testing the accuracy of posting by proving the equality of the debits and the credits in the ledger. Each account title and debit or credit amount is listed. If the two totals of the trial balance are equal, the posting of the journal is assumed to be correct. (*See* Table I.) The trial balance, however, cannot catch certain

TABLE I.—*ABC Company*
Trial Balance, December 31, 19—

Account titles	Debit balances	Credit balances
Cash in bank	$ 10,000.00	
Accounts receivable	4,000.00	
Inventory	7,000.00	
Building	25,000.00	
Equipment	3,400.00	
Accounts payable		$ 3,200.00
Mortgage payable		15,000.00
John Jones, capital		32,010.00
Sales		62,000.00
Cost of goods sold	37,000.00	
Wages and salaries	22,310.00	
Depreciation	2,000.00	
Utilities	1,500.00	
Total	$112,210.00	$112,210.00

errors such as the complete omission of an entry.

Preparation of the Financial Statements.—The management of a firm is interested in determining whether its operations have resulted in a profit or loss. They are also interested in the financial condition of the firm. Each month, as a general rule, an income statement and a balance sheet are prepared from the trial balance. The purpose of the income statement or profit and loss statement is to present an analysis of the changes that have taken place in the ownership equity as a result of the operations of the period. (*See* Table II.) Revenues are listed at the amount earned upon delivery of goods or performance of service. Expenses incurred in getting the revenue are deducted to arrive at the profit. The ledger includes accounts for revenue and expense items as well as balance sheet accounts.

The balance sheet shows the financial condition of a company at a particular date in terms of assets, liabilities and the ownership equity. In general, assets are things of value owned by a business or other economic unit. Cash, buildings, machinery, inventory and land are examples of assets. Liabilities are the debts of a business. They are claims against the business other than the claims of the owners. The ownership equity is the difference between the assets and the liabilities of the firm. It is customary at the end of the fiscal period to make entries to record changes that have occurred during the fiscal period but that have not yet been recorded in the accounts. It is not practical each day, for example, to record the amount of wrapping paper, typing paper and twine used. General journal entries that are made at the end of the accounting period to bring the asset, liability, revenue, and expense accounts up to date are known as adjusting entries. Adjusting entries are made to adjust the merchandise and supply inventories; they are made to record depreciation and also the write-off of insurance premiums paid in advance.

Final Procedure.—The adjusting entries are entered in the journal and posted to the proper accounts in the general ledger. Next, the closing entries are journalized and posted. Closing entries transfer the balances from the revenue and expense accounts to the ownership account; the revenue and expense accounts are used to determine the periodic profit and, therefore, must be closed out at the end of each accounting period. Finally, the accounts

TABLE II.—*ABC Company*
Profit and Loss Statement, May 19—

Sales		$21,900
Cost of goods sold		15,600
Gross margin		$ 6,300
Wages and salaries	$1,500	
Rent	400	
Utilities	120	
Depreciation	80	2,100
Net operating profit		$ 4,200
Other income	300	
Other expense	$ 100	200
Net profit		$ 4,400

are ruled and balanced and a final post-closing trial balance is taken.

Double-Entry Recording Process.—The financial condition of a business at any point in time can be expressed in the form of an equation which expresses the relationship between assets, liabilities and the ownership equity. This equation is important, for it is the basis for the double-entry recording process. The assets of any enterprise minus its liabilities must equal the ownership equity. That is, if the claims of outsiders other than the owners (liabilities) are subtracted from the things of value owned by the firm (assets) the result will be the value of the ownership equity. The basic equation is $A - L = P$, where A stands for assets, L for liabilities and P for the proprietorship or ownership equity.

However, the fundamental accounting equation is often stated in the form $A = L + P$. This equation states that the sum of the assets is equal to the sum of the claims against the assets. This equation is the same, algebraically, as the form $A - L = P$ except that we have moved the liabilities to the other side.

To illustrate, assume that Jones and Smith start a business to which Jones contributes $10,000 cash and Smith contributes merchandise worth $10,000 and fixtures worth $5,000. The business agrees to take over a $5,000 debt that Smith owes on the merchandise. The balance sheet equation would then show assets of $25,000, represented by the cash, merchandise, and fixtures; liabilities of $5,000, represented by the debt taken over by the business; and proprietorship of $20,000, represented by a $10,000 interest for Smith and a $10,000 interest for Jones. Assets ($25,000) equal liabilities ($5,000) plus proprietorship ($20,000).

Transactions are analyzed in terms of their effect on assets, liabilities and proprietorship. No matter how complex the transaction, the equation always stays in balance. The financial condition of a going concern is always changing as cash is collected, bills are paid and merchandise is purchased. These transactions must be analyzed in terms of their effect on the assets, liabilities and proprietorship. They must be recorded in the books of the enterprise. An account is established for each balance sheet item. As there are only two ways in which an item can change—increase or decrease—accounts are set up so that increases are placed on one side of the account and decreases are placed on the other side.

Complete recording of the effects of any transaction means that a double entry is made in the ledger accounts. For example, if John Jones put $10,000 more in his business, the accounts of the business would show an increase in an asset cash of $10,000 and an increase in the proprietorship account, Jones, capital, of $10,000. Purchase of merchandise for $2,500 cash would result in an increase in an asset merchandise for $2,500 and a decrease in an asset cash of $2,500. For every transaction, more than one item is affected. Certain rules are established for recording increases and decreases in accounts; these rules maintain the equality of the fundamental equation. Increases in assets are entered on the left side of the account; increases in liabilities and proprietorship are entered on the right side of the account. If increases are entered on one side, decreases must be entered on the opposite side.

Rather than speak of increases or decreases in accounts, bookkeepers state that an account is debited or credited. The term debit is used to indicate the left side of an account; credits indicate the right side. This is the only meaning of debit and credit in bookkeeping. Established rules for increases and decreases and for debits and credits result in the fact that for any transaction, the debits and credits must be equal. If the amount of debits do not equal the amount of credits for any individual transaction, the bookkeeper knows immediately an error has been made. At various points in the bookkeeping process, the equality of debits and credits are checked as a means of detecting errors to that point.

The periodic determination of profit is vitally important to the management of the firm. In order to determine profit, revenue accounts and expense accounts are established. Revenues are measured by the charge the firm makes for selling goods or performing a service. Expenses are measured by the costs incurred in securing the revenues. Profit is determined by subtracting expenses from revenue. Rules for debit and credit are consistent with the nature

of the revenue and expense accounts. Revenue accounts are ownership accounts; revenue accounts are credited for increases and debited for decreases like ownership accounts. Expense accounts are deductions from revenue; expense accounts are debited for increases and credited for decreases. Thus there are five kinds of accounts: assets, liabilities, proprietorship, revenue, and expense. At the end of the accounting period the expenses are deducted from the revenues to arrive at the periodic profit; the profit is then added to the ownership account. In each transaction the sum of the debits must equal the sum of the credits. The double-entry debit and credit mechanism maintains the equality of the fundamental balance sheet equation.

Form of the Account.—The basic requirement of an account is that it must have one side for increases and one side for decreases. A common form of account is shown in Table III.

As the cash in bank account is an asset account, increases are placed on the left side of the account and decreases in the right-hand side. In the illustration there was $10,000 cash at the start of the period. During the period $22,000 was deposited in the bank. The CR 7 indicates a reference to page 7 of the cash receipts journal. Checks were written for $8,000.00 as indicated on the right side of the account. This entry came from page 12 of the cash disbursements journal. The balance of $24,000 can be determined by subtracting the amount of the right side from that on the left side.

TABLE III.—*Form of Ledger Account*
Cash in Bank

Date	Explanation	Ref.	Amount	Date	Explanation	Ref.	Amount
1961							
Jan 1	Balance	—	$10,000.00	Jan 31		CD 12	$8,000.00
Jan 31		CR 7	22,000.00				

Ledgers.—A group of accounts is known as a ledger. The general ledger is the main book of accounts; it contains an account for each asset, liability, proprietorship, revenue, and expense account. The ledger contains the same information as the journals. However, in the journals each transaction is completely recorded as a unit. The entire effect of a transaction on the business is recorded in one place in the journal. Periodically the same information is posted to the ledger where it is accumulated according to individual items. The ledger includes all the basic accounts needed for the preparation of the financial statements.

Additional information is often desired concerning certain of the accounts in the general ledger. Groups of accounts called subsidiary ledgers are set up. Each subsidiary ledger contains detailed information concerning a general ledger account which is called a controlling account. For example, a department store would have an accounts receivable control account in the general ledger which would carry the total amount owed the store by its customers. A subsidiary accounts receivable ledger would also be maintained. In the subsidiary ledger there would be an account for each individual customer that owed the department store. Control is maintained by periodically adding the balances of the subsidiary accounts and checking to the total of the control account.

Balance Sheet.—The balance sheet is one of the important financial statements which results from bookkeeping procedures. The balance sheet shows the financial condition of an enterprise at a particular date. It is based on the fundamental equation that assets equals liabilities plus proprietorship. The balance sheet balances because the total dollar amount of liabilities and proprietorship of an enterprise must equal the total dollar value of assets. This does not mean that an individual creditor has a claim against any of the specific assets; the equality refers to the totals.

A balance sheet is illustrated in Table IV. Note that the assets are separated into two groups, current and fixed. Current assets include cash and other assets which will normally be converted into cash or used up within a short period of time (usually a year) in the operations of the business. Accounts receivable are considered to be current assets because they are usually collected in a short period of time; merchandise is listed as a current asset because it usually is sold within a year. Fixed assets include assets which yield services to the enterprise for a long period of time such as land, buildings and machinery. Patents and copyrights as well as long term investments are also listed in this category.

TABLE IV.—*A B C Company*
Balance Sheet, December 31, 19—

Assets		Liabilities and capital	
Current assets:		Current liabilities:	
Cash	$ 2,010	Accounts payable	$ 2,710
Accounts receivable	3,110	Notes payable	3,500
Merchandise	7,220	Total current liabilities	$ 6,210
Total current assets	$12,340	Long term liabilities:	
Fixed assets:		Bonds payable	$20,000
Land	$22,000	Total liabilities	$26,210
Building	30,000	Capital:	
Total fixed assets	$52,000	Capital stock	20,000
Total assets	$64,340	Retained earnings	18,130
		Total capital	$38,130
		Total liabilities and capital	$64,340

The first section on the right-hand side of the balance sheet contains the amounts owed to outsiders (liabilities). Current liabilities are those which are to be settled within a short period of time, usually one year. Accounts payable represent amounts owed for purchases of goods or services made on credit without a formal written contract. Notes payable represent the face value of promissory notes used in connection with bank loans or in connection with the purchase of goods or services.

Bonds payable are listed under long term liabilities because they represent amounts borrowed by the business for a relatively long period of time. The capital or proprietorship section represents the ownership equity in the business. The illustration is that of a corporation. The amounts contributed to the corporation by the stockholders are generally recorded in the capital stock account. In some instances a portion of the contribution is added to an account called paid-in surplus. The ownership equity of a corporation increases if operations are profitable. A portion of these earnings is customarily distributed to the stockholders in the form of dividends. The earnings of the corporation which have not been paid out in dividends are shown in the retained earnings account. The laws of the various states determine the amount of dividends that a corporation can pay. Before a corporation can pay a cash dividend it must have the legal right to do so—as determined by the ownership section of the balance sheet—and it must also have the cash.

The ownership equity sections of individual proprietorships and partnerships differ from that of the corporation. On the balance sheet of an individual proprietorship, the owner's interest is usually shown as one item such as John Jones, capital, $64,340. In a partnership, each partner's interest must be shown separately. Thus the capital section of the Jones and Smith partnership would show John Jones, capital, $32,170; George Smith, capital, $32,170.

Modern Developments.—During the last 50 years there has been a great expansion of industrial activity based largely upon the products of scientific research. This expansion, plus the widespread ownership of business, has placed greater demands on accounting for financial control and reporting. The emphasis on increased productivity has resulted in the development of mass production systems and has contributed to the rapid development of techniques of cost accounting (*q.v.*). An important trend toward greater government influence in the affairs of business through taxation and regulation has added to the amount of record keeping.

The bookkeeping procedures concerned with achieving economies of production and distribution have become more general through both large and small firms. Financial planning and budgeting are not just a luxury of the large firms. Interpretations of the data supplied by the bookkeeping mechanism have become more important in the management of all business.

The process of recording transactions has continued to benefit through greater mechanization and simplification. Labour-saving devices are found in the office as well as in the production areas. There has been a rapid expansion in the use of electronic tabulating and calculating machines. These machines are used for many tasks such as payroll accounting and preparing analyses of sales by commodities. (*See* OFFICE MACHINES AND APPLIANCES.)

Techniques of budgetary control have improved. Records of past experience are used to guide future plans of the enterprise. Budgets are used to determine cash requirements as well as production requirements for such things as raw materials and manpower. Bookkeeping is more and more concerned with accumulating and recording the basic data which becomes the raw material for reports which will be used in the control functions of management.

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BOOKKEEPING MACHINES: *see* OFFICE MACHINES AND APPLIANCES.

BOOKPLATE, or *ex libris,* is a label with a printed design intended to indicate ownership, usually pasted inside the front cover of a book. It may be produced by various methods, such as woodcut, wood engraving, line engraving, etching, lithography and modern photographic reproduction.

History.—The custom of using bookplates probably originated in Germany, where the three earliest known examples are found. The first of these, dated variously as about 1450 or about 1470, is a woodcut belonging to Johannes Knabensberg (known as Hans Igler). Found inside the cover of a Latin vocabulary, the design represents a hedgehog with a flower in its mouth, above it the punning motto *Hanns Igler das dich ein Igel kus* ("Hanns Igler may a hedgehog kiss you"). Other early examples are woodcuts inside books given to the Charterhouse of Buxheim, Swabia, by Hilprand Brandenburg of Biberach, about 1480, showing an angel holding a shield upon which is an ox with a ring through its nose. The third example is found in a book presented by Wilhelm von Zell also to Buxheim, about 1480, and represents the arms of the donor with those of his wife, with helmets and crests.

The earliest dated bookplates found in Europe are those of Hieronymus Ebner, 1516, Germany; of Jean Bertaud de Latour-Blanche, 1529, France; of those books given by Sir Nicholas Bacon to the University of Cambridge, 1574, England; of Lodovico Romano, 1575, Italy; of Thure Bielke, 1595, Sweden; and of Anna van der Aa, 1597, Holland. In America the bookplate of Thomas Dering, 1749, is the earliest dated example by an American engraver.

Early bookplates in Germany include examples by Albrecht Dürer, Hans Holbein the younger, Bartel Beham, Hans Sebald Beham, Lucas Cranach the elder, Virgil Solis, Jost Amman and Hans Burgkmair. The absence of bookplates in France and Italy before the 17th century was due to the fact that in those countries book bindings were decorated with the owners' coats of arms, making the label of ownership unnecessary. The earliest signed bookplate in France is that of Alexandre Bouchart, engraved in 1611 by Léonard Gaultier, while the bookplate of Sir Edward Littleton, engraved by William Marshall before 1641, is the first in England to bear the engraver's name.

Types of Bookplates.—*Armorial.*—Early armorial bookplates in England at first consisted of a simple shield without ornament, helmet with symmetrical mantling, crest, and scroll beneath for a motto or owner's name. They show none of the elaboration to be found in German plates of the same period. However, a group belonging to the middle of the 17th century has cartouchelike shields, encircled by wreaths, festoons and ribbons. At the time of the Restoration in 1660, mantling became more decorative and heraldic tinctures were indicated by Petra Sancta's system, used by French engravers for at least 20 years previously. In France the helmet and crest were gradually replaced by a coronet, shields became oval-shaped, within decorative borders, and were placed on an architectural plinth or a grassy bank.

The main characteristics of the bookplate in the early 18th century, rather misleadingly named "Jacobean," were a decorated frame, having the appearance of carved work, surrounding the shield; the space between the shield and the edge of this frame was ornamented with a pattern of fish scales or a trellis; and the whole design was often placed upon a conventional support. The scallop shell appeared as a decorative feature and figures such as *putti,* angels, "Fame" and "Victory" were also used. In Germany the design tended to be purely armorial, while in France the development was much the same as in England.

The middle 18th century saw the development of the rococo in England, a taste reflected in the bookplates called "Chippendale." Whereas in a Jacobean plate the shield was always regularly shaped, in the Chippendale it was broken into by the incurving of the decorative surround, the shield itself often being oblique or pear-shaped. The border lost its solid appearance and was composed of open shellwork, outside which were sprays of natural flowers not arranged in conventional festoons. This style developed earlier in France and spread into Germany and other European countries. The heraldic helmet, if used, was of a debased form, while mantling had usually disappeared. Instead, crest and torse were placed directly on top of the frame. By 1760–80 the design became exuberant with festoons, animals and figures and with supporters no longer supporting the shield but introduced into the design, often in unusual attitudes.

Beginning about 1770 there was a return to simpler, semiclassical motifs. The first was the "Wreath and Ribbon": the shield was spade-shaped and surrounded by wreaths or sprays of foliage, loosely bound by ribbons at the centre of the base. Another form was the "Festoon," with sprays hung from rings or hooks on either side of the shield. The urn, a feature popular in decoration and on funerary monuments, also appeared: usually the shield was placed on the urn, which was often accompanied by a weeping female figure and a willow tree. Lastly there were landscape bookplates, where the shield leaned against the trunk of a tree or hung from its branches. In France, where many of the bookplates had been pictorial rather than armorial, there was a desire, after 1789, to remove from them all signs of noble rank until Napoleon I introduced a new form of heraldic insignia.

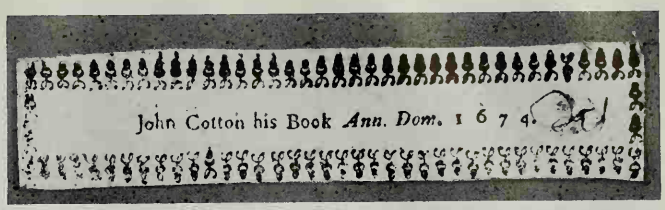
The heraldic bookplate in America followed much the same development as in Europe, although it was not common until the early 18th century. During the first three decades of the 19th century, bookplate design in Europe fell generally to a very low order, often being the product of heraldic stationers, and it did not improve until the revival of interest after 1880, mainly in the nonheraldic plate.

Pictorial.—The pictorial plate had also been used from comparatively early times. Examples include portraits of Willibald Pirkheimer, engraved by Dürer in 1524; of John Hacket, bishop of Lichfield and Coventry, engraved by William Faithorne in 1670; and of Samuel Pepys, engraved by Robert White. Other popular devices were arrangements of piles of books and views of libraries and landscapes. Allegorical bookplates were in favour in France during the reign of Louis XV and in England by mid-18th century. On these appeared personifications of the Christian cardinal virtues and other abstract ideas, such as Truth, Justice, Wisdom, Hope and Faith. Also introduced into the design were symbols of the interests and occupations of the book's owner, such as scales of justice, naval and military trophies, palettes and so on. In most of these heraldry played only a subordinate part.

Toward the end of the 19th century, German designers began to use nude figures as a major motif of bookplate design, and this fashion was followed in Europe and the United States. Figures were treated naturalistically, sometimes with erotic intention. With the revival of interest in the bookplate during the last two decades of the 19th century, many new ones were produced, some of the heraldic plates being well designed and engraved. However, due to the introduction of photographic printing processes, the pictorial bookplate, although many well-known artists designed them, gradually deteriorated, the style becoming confused, contrived and self-conscious. This decline, with few exceptions, went on until the 1920s, after which interest in the bookplate was not so great, though a high standard was achieved in many.

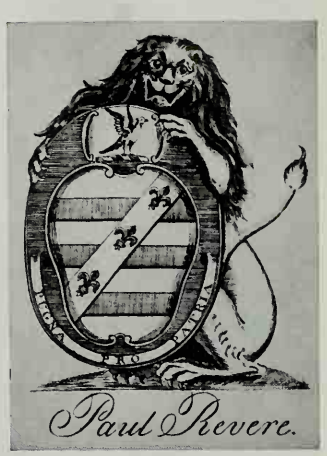
Bookplate Artists, Designers.—From early times artists were interested in bookplate design and engraving, and among them were: (17th century) Faithorne, Marshall, Gaultier, J. de Courbes, I. Briot, Hans Sibmacher, R. Sadeler, J. von Sandrart and the Kilians; (18th century) William Hogarth, George Vertue, Francesco Bartolozzi, Giovanni Cipriani, C. Audran, H. Gravelot, Jean

15th-century woodcut, early German bookplate from a book given to the Charterhouse of Buxheim, Swabia, by Hilprand Brandenburg about 1480



American bookplate bearing the date 1674 and belonging to John Cotton, one of the earliest-known examples in letterpress from the U.S.

Woodcut bookplate belonging to Johannes Knabensberg (Hans Igler). Dated about 1450 or 1470, it is one of the three earliest-known German examples



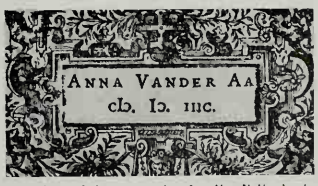
Early American bookplate belonging to Paul Revere. Although it is not signed, it is thought to have been engraved by Revere about 1775

English pictorial bookplate in the book-pile style; dated 1760 and belonging to James Steer of London

George Washington's bookplate, an armorial engraving in the Chippendale style; probably dating between 1765 and 1775

Engraved plate by Albrecht Dürer, 1524, an early German portrait bookplate of Willibald Pirkheimer, councilor to emperors Maximilian and Charles V

18th-century English armorial bookplate, Chippendale style, belonging to Nicholas Bacon (not to be confused with Sir Nicholas Bacon, 16th century)



Bookplate of Anna van der Aa, the Netherlands. Earliest-known Dutch bookplate, it bears the date 1597

EARLY BOOKPLATES OF EUROPE AND THE U.S.

BY COURTESY OF (TOP LEFT, CENTRE LEFT) THE VICTORIA AND ALBERT MUSEUM, (CENTRE TOP, BOTTOM LEFT, CENTRE BOTTOM) THE TRUSTEES OF THE BRITISH MUSEUM, (TOP RIGHT, CENTRE RIGHT) THE AMERICAN ANTIQUARIAN SOCIETY, (CENTRE) THE METROPOLITAN MUSEUM OF ART, GIFT OF WILLIAM ALEXANDER SMITH, 1907, (BOTTOM RIGHT) THE METROPOLITAN MUSEUM OF ART, FLETCHER FUND, 1919

BOOKPLATE

Pictorial bookplate designed by J. Winfred Spenceley; U.S.

Landscape bookplate designed for Edith Heath Rossiter by Sidney L. Smith; U.S.

Bookplate, dated 1893, designed by Edwin Davis French; U.S.

Pictorial bookplate, dated 1895, designed for Elizabeth Anne Bostock by George W. Eve; English

Bookplate belonging to Samuel Courtauld, designed by Paul Nash; English

Armorial bookplate dated 1904, signed by C. W. Sherborn; English

Bookplate with Pegasus, designed in 1914 by Eric Gill for Sir Francis Meynell; English

Jane Patterson's bookplate designed by Robert Anning Bell; English

Bookplate belonging to Friedrich Perutz signed by Alfred Cossmann; Austrian

Bookplate designed by Sidney Hunt; English

BOOKPLATES BY 19TH- AND 20TH-CENTURY DESIGNERS

BY COURTESY OF (TOP LEFT, CENTRE AND RIGHT) THE AMERICAN ANTIQUARIAN SOCIETY, (CENTRE LEFT AND RIGHT, BOTTOM RIGHT) THE TRUSTEES OF THE BRITISH MUSEUM, (CENTRE, BOTTOM CENTRE LEFT AND RIGHT) THE VICTORIA AND ALBERT MUSEUM, (BOTTOM LEFT) SIR FRANCIS MEYNELL

Michel Moreau le jeune, François Boucher and, in America, N. Hurd, P. R. Maverick, Paul Revere and H. Dawkins. In the early 19th century Thomas Bewick produced his landscape plates. Later, as a result of the revival of interest, the list includes H. Stacy Marks, R. Anning Bell, Walter Crane, Randolph Caldecott, Sir John Millais, Charles Ricketts, Sir Frank Brangwyn, Gordon Craig, Kate Greenaway, Eric Ravilious, Eric Gill, Robert Gibbings, Stephen Gooden, Paul Nash, Paul Gavarni, Toulouse-Lautrec, Bac, Jules Chéret, Edouard Manet, Lucien Pissarro, Emil Orlik, Hans Thoma, Georg Barlösius, Mark Severin, Max Klinger, Alejandro de Riquer, Edwin Abbey, Rockwell Kent, J. Taylor Arms, McKnight Kauffer. Among bookplate specialists are C. W. Sherborn, G. W. Eve, Lord Badeley, Sidney L. Smith, Alfred Cossmann, Karl Haselböck, Sidney Hunt, J. Vineycomb, J. A. C. Harrison, Franz von Bayros, Paul Voigt, Louis J. Rhead, J. W. Spenceley, Antonello Moroni, Bruno da Osimo, Willi Seiger, E. H. Garret and E. D. French.

The Fashion for Bookplates.—J. B. L. Warren's *Guide to the Study of Book-Plates* (1880) first made a general classification of styles. This led to a wave of interest and people began collecting bookplates. Many books on the subject were published and societies formed in Europe and the U.S., some of them lasting for many years. After World War I there were several attempts to revive interest and publish periodicals, but they were nearly all short-lived. Collectors often exchanged their own bookplates with others to swell their collections. Two large collections are to be found in the British museum, London, and Yale university library, New Haven, Conn.

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(J. F. PH.)

BOOK SCORPION (FALSE SCORPION), a small arachnid (order Pseudoscorpiones), somewhat resembling tailless scorpions. Book scorpions occur widely throughout the world, living under stones, beneath bark or in vegetable detritus. Some are found in books and old chests, while others, mostly blind, live in caves. They feed upon minute insects and mites. *See* also ARACHNIDA.

BOOKSELLING. The trade in books is very ancient, the oldest reference to it occurring in Egyptian literature. The early poets and orators recited their effusions in public to induce their hearers to buy written copies of them. Frequently they were taken down from dictation, and transcripts sold to such as were wealthy enough to purchase. The scribes who copied the texts were, in fact, the earliest booksellers and supplied copies as they were demanded. Aristotle, it is said, possessed a somewhat extensive library; and Plato is recorded as having paid the large sum of 100 minae for three small treatises of Philolaus the Pythagorean. When the Alexandrian library was founded about 300 B.C., various expedients were resorted to for the purpose of procuring books, and this appears to have stimulated the energies of the Athenian booksellers.

In Rome, toward the end of the republic, it became the fashion to have a library; and the booksellers (*librarii* or *bibliopolae*) carried on a flourishing trade.

Their shops were chiefly in the Argiletum and in the Vicus Sandalarius; on the door, or on the sideposts, was a list of the books on sale. In the time of Augustus the great booksellers were the Sosii. According to Justinian (ii, 1, 33), a law was passed securing to the scribes the property in the materials used; and in this, perhaps, may be traced the first germ of the modern law of copyright.

The spread of Christianity naturally created a great demand for copies of the Gospels and other sacred books, and later on for missals and other devotional volumes for church and private use. The traveling bookseller was a typical medieval figure. Among the Jews bookselling was well recognized in the middle ages.

"The trade in bookselling seems," says Henry Hallam, "to have been established at Paris and Bologna in the 12th century; the lawyers and universities called it into life. It is very improbable that it existed in what we call the dark ages. The dealers were denominated *stationarii,* perhaps from the open stalls at which they carried on their business, though *statio* is a general word for a shop in low Latin. They appear, by the old statutes of the University of Paris, and by those of Bologna, to have sold books upon commission, and are sometimes, though not uniformly, distinguished from the *librarii,* a word which, having originally been confined to the copyists of books, was afterwards applied to those who traded in them."

GREAT BRITAIN

Before the Reformation, the text writers or stationers (*stacyoneres*) who sold copies of the books then in use—the A B C, the Pater Noster, Creed, Ave Maria and other manuscript copies of prayers—in the neighbourhood of St. Paul's, London, were, in 1403, formed into a guild. Some of these stationers had stalls or stations built against the very walls of the cathedral itself, in the same manner as they are still to be found in some of the older continental cities. In Henry Anstey's *Munimenta Academica* a glimpse may be caught of the "sworn" university bookseller or stationer, John More of Oxford, who apparently first supplied pupils with their books and then acted the part of a pawnbroker. Besides the sworn stationers there were many booksellers in Oxford who were not sworn; for one of the statutes, passed in the year 1373, expressly recites that, in consequence of their presence, "books of great value are sold and carried away from Oxford, the owners of them are cheated, and the sworn stationers are deprived of their lawful business." It was therefore enacted that no bookseller except two sworn stationers or their deputies should sell any book exceeding half a mark in value, under pain of imprisonment or, if the offense were repeated, of abjuring his trade within the university.

The modern system of bookselling arose soon after the introduction of printing. The earliest printers were their own editors and booksellers; but being unable to sell every copy of the works they printed, they had agents at most of the seats of learning. Anton Koberger, who introduced the art of printing into Nürnberg in 1470, had, we are told, agents for the sale of his books in every city of Christendom, besides his own 16 shops. Wynkyn de Worde, who succeeded to William Caxton's press in Westminster, had a shop in Fleet street.

The Reformation created a great demand for books; but in England neither Tudors nor Stuarts could tolerate a free press. The first patent for the office of king's printer was granted to Thomas Berthelet by Henry VIII in 1530, but only such books as were first licensed were to be printed. Even the purchase or possession of an unlicensed book was a punishable offense. In 1557 the Company of Stationers was incorporated and extensive powers were granted in order that obnoxious books might be repressed. In the following reigns the Star Chamber exercised a pretty effectual censorship; but, in spite of all precaution, many polemical books were printed abroad and surreptitiously introduced into England. Queen Elizabeth I interfered but little with books except when they emanated from Roman Catholics or touched upon her royal prerogatives; and toward the end of her reign and during that of her successor bookselling flourished. Archbishop William Laud introduced many arbitrary restrictions, but they were all, or nearly all, removed during the time of the Commonwealth.

An order of parliament in 1643 provided that no book should be printed or "put on sale" "unless the same be first approved of and licensed" by the persons appointed by the government. It was against this order that Milton wrote his *Areopagitica* (1644). The Restoration also restored the officer of licenser of the press, which continued until 1695.

In the first English Copyright act (1709), which specially related to booksellers, it is enacted that, if any person shall think the published price of a book unreasonably high, he may thereupon make complaint to the archbishop of Canterbury and to certain other persons named, who shall thereupon examine into his complaint and, if it be well founded, reduce the price; and any bookseller charging more than the price so fixed shall be fined £5 for every copy sold. Apparently this enactment remained a dead letter.

For later times it is necessary to make a gradual distinction between booksellers and publishers, whose business involves the production of the books from the author's manuscript and who are the intermediaries between author and bookseller; in the 19th century this distinction became fundamental. The article on publishing (*q.v.*) deals more particularly with this second class, who gradually took a higher rank in the book trade and whose influence upon the history of literature has often been great. The convenience of this distinction is not impaired by the fact either that a publisher is also a wholesale bookseller or that a still more recent development in publishing (as in the instance of the direct sale in 1902, by the *Times* [London], of the supplementary volumes to the 9th edition of the *Encyclopædia Britannica*, which were also "published" by the *Times*) started a reaction to some extent in the way of amalgamating the two functions. The scheme of the Times Book club (started in 1905) was, again, a combination of a subscription library with the business of bookselling; and it brought the organization of a newspaper, with all its means of achieving publicity, into the work of pushing the sale of books in a way which practically introduced a new factor into the bookselling business.

The wholesale bookseller is the important distributing agency between the publisher and the retail bookseller; it is to him that the latter looks for his miscellaneous supplies, as it is impossible for him to stock half of the books published. For more than 100 years up to 1940 (when it was practically demolished by bombing) the centre of the wholesale industry in London was 41, Paternoster row. At one of these establishments more than 1,000,000 books were constantly kept in stock. It was there also that the publisher called first on showing or "subscribing" a new book, for on the number thus subscribed might depend the success or failure of the book.

Underselling was rife in the 19th century in the retail book trade. One of the most notable attempts to stamp it out took place in 1852 when a booksellers' association bound its members not to sell books under the published price. But the then popular cry of "free trade" was raised and, after arbitration, judgment was given against the association by Lord Campbell. The association was dissolved and underselling went on as before. In 1890 a London booksellers' society was established to protect the retail booksellers: it aimed to restrict discounts to 25%, to arrange prices generally and to control all details connected with the trade. In 1895 the society widened its field of operations and became known as the Associated Booksellers of Great Britain and Ireland. In 1899 the association concurred in the Net Book agreement, which had previously been adopted by the Publishers' association. The agreement came into force on Jan. 1, 1900. The scheme protected the booksellers from undercutting and made certain that a book should be sold at its fixed published price, no more and no less. By the acceptance of this charter the long price war came to an end.

The trade in antiquarian and secondhand books is in a sense a more specialized class of business, requiring a knowledge of bibliography. Transactions are with individual books rather than with a number of copies; and in the antiquarian sense with copies of first editions and fine examples of binding, printing or illustration.

The periodical trade grew up during the 19th century and was in its infancy when the *Penny Magazine*, *Chambers' Journal* and similar publications first appeared. The growth of this side of the retail business was greatly promoted by the abolition of the newspaper stamp and of the duty upon paper and the facilities offered for purchasing books by installments.

(C. D. My.; E. Rh.)

20th Century.—During the 20th century the sale of new books separated itself from the sale of secondhand and antiquarian books just as, in the 19th century, publishing had separated itself from bookselling.

The practice of selling new books at a discount, which had been steadily ruining the trade during the 19th century, was halted by the introduction of the Net Book agreement in 1900. This agreement, as noted above, was in fact a statement of the conditions upon which publishers were prepared to supply books at trade prices. (Publishers could choose which books they were to issue "net"; in practice most books sold in bulk, *e.g.*, school textbooks, were issued "non-net," and booksellers could give discounts on these.) The Net Book agreement became subject to the provisions of the Restrictive Trade Practices act, 1956.

The development of the retail trade in new books (indicated by the fact that signatories of the Net Book agreement increased from about 3,000 in 1900 to between 6,000 and 7,000 in the mid-1950s), which was helped by the stabilizing effect of the net-book system, resulted from the increase in the reading public and from the dispersal of the population. Most communities have their bookshop; but outside London, the university towns and the larger provincial cities, there are few centres where the demand is sufficient to maintain a shop selling books exclusively. The sale of new books is therefore often allied to the sale of other goods, usually stationery or newspapers.

New books are bought outright from the publisher, and stock is returnable only in exceptional circumstances. The general bookseller has therefore to exercise great skill in buying if his profit is not to be offset by the depreciation of his unsold stock. His task of selection is made more difficult by the large number of new titles, reprints and new editions which appear each year (there were 20,719, for example, in 1957). Since there are well over 200 publishers of some importance, representing all shades of opinion and specialized knowledge, the bookseller has a great responsibility in maintaining a balanced exhibition of new books.

The Booksellers Association of Great Britain and Ireland (the name was changed in 1948) organizes correspondence and lecture courses throughout the country for booksellers' assistants; successful students are awarded the diploma in bookselling. The association also operates the book-tokens scheme, which enables the public to buy gift vouchers in one bookshop for honouring in any other bookshop in membership of the association.

In 1949 the Retail Bookselling and Stationery Trades Wages council was established; and the statutory minimum wage for managers, assistants and other workers in the trade was laid down by a wages regulation order.

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(P. B. Hn.; G. R. Ds.)

UNITED STATES

The Colonial Period.—Early in the history of the book trade the functions of the printer on the one hand and of the publisher and bookseller on the other became separated. This distinction began early in the American colonies, where all its elements showed themselves fully developed in Boston by the second half of the 17th century. At the same time there existed a more primitive condition in which the functions of printer, binder, publisher and bookseller were united in a single person. This structure was normal to the book trade throughout the country virtually to the end of the colonial period.

The first bookseller of the colonies was Hezekiah Usher of Boston. Outside Boston, the first individual to describe himself as bookseller seems to have been Evan Jones of Annapolis, Md. William Bradford, pioneer printer of Philadelphia and New York,

and Benjamin Franklin were among the colonies' most prominent booksellers.

The booksellers in colonial America lived largely from the sale of imported books. Greek and Roman classics, the favourite standard English works in history, theology, philosophy and letters and the current English authors were to be found on the shelves of booksellers from Massachusetts to Virginia. From the start, pure bookshops were rare. Along with books one would find cough medicine, sealing wax, chocolate, lemons, stationery and fiddle strings on the shelves of the typical small-town colonial printer-publisher-bookseller. More discriminating were the bookselling departments of printing houses located in the larger cities, such as those of Franklin and Hall in Philadelphia, Hugh Gaine in New York city and Isaiah Thomas in Worcester, Mass.

Three other methods of distribution familiar in the European practice of the time were adapted to American conditions. The first, bookselling by subscription, began to assume extraordinary importance in the marketing of books in the 18th century. The older system of the single patron does not seem to have rooted itself firmly in the colonies. A notable exception, however, was the publication of Thomas Bacon's *Laws of Maryland*, printed by Jonas Green of Annapolis in 1765. Failing for political reasons to obtain the support of the assembly for his project, Bacon procured subscriptions from Lord Baltimore and some 20 gentlemen and merchants of the province. Before publication, Baltimore withdrew his subscription of £100 sterling from the general fund and gave that sum outright to Bacon in consideration of the proposed dedication to himself of the great book of laws. When William Parks published his collection of Virginia laws, he obtained subscriptions not only from local patrons but also from lawyers and officials throughout the middle and southern colonies, from many ship captains of London and Bristol and from merchants and gentlemen in various parts of England. Certain books which in England would have been published in the regular course of trade were published by subscription in America to assure a reasonable sale in advance of publication in communities containing a relatively small number of cultivated people.

The second method was the hawking of books by chapmen and peddlers, a picturesque trade that prevailed in rural America of the colonial days and still prevailed there to some extent at mid-20th century. When in 1713 the Massachusetts assembly passed an act against "Hawkers, Pedlars, and Petty Chapmen," Cotton Mather wrote in his diary (vol. II, p. 283): "I must also assist the Booksellers, in addressing the Assembly, that their late Act against Pedlars, may not hinder their Hawkers from carrying Books of Piety about the Country." A considerable portion of the output of the colonial press, in the form of small books or pamphlets which carried ballads and tracts and were called chapbooks (*q.v.*), went to the chapmen. They included among their ranks publisher Mathew Carey's celebrated agent, Parson Weems, creator of the story of George Washington and the cherry tree. Later on, Johnny Appleseed is reported to have carried books in his knapsack.

The third method, sale of books by auction, started early in the 18th century. Up to the end of that century about 860 auctions had been held in the colonies. Contrary to 20th-century practice, no fewer than 50 of these were held for the purpose of dispersing new books or mixed lots of new and old.

19th Century.—On June 25, 1788, George Washington had written a letter to Mathew Carey in which he referred to newspapers and magazines: "I consider such easy vehicles of knowledge as more highly calculated than any other to preserve the liberty, stimulate the industry and meliorate the morals of an enlightened and free people." This priority of the periodical press over the book became the most distinctive character of the American book trade as compared with that of other countries and continents. The European press primarily nourished thought, the American press action. Almost from the start printing became a prime agent of colonization in the active westward expansion of the nation. As a result, book-trade conditions in the United States never proved so generally favourable as to allow the universal and permanent establishment of regular bookshops, exclusively or primarily devoted to books, such as existed in all large European cities and many small ones. Many 20th-century book-trade problems are rooted in this fundamental factor of social history.

The early 19th century saw significant changes in the centres of gravity of the U.S. book trade. Boston was gradually losing its position of uncontested leadership; Philadelphia and New York city became serious rivals. By 1850 the book trade had unquestionably found its centre in New York. Boston and Philadelphia were approaching equality; Baltimore and Charleston, S.C., were advancing; and the west was beginning to surpass the south.

Publishers at first continued to use their own retail bookstores as primary distribution agencies. In the second quarter of the century, publishing and bookselling became more specialized and developed as separate occupations. Methods of distribution changed little from colonial days. The auction business, divided between Philadelphia, Boston and New York, tended toward concentration in the latter city. Advertising of books through printed catalogues (with lists of importations and locally printed titles) became a regular feature of the trade. A 32-page catalogue issued about the year 1790 by Benjamin Guild of Boston offered nearly 1,000 titles of books of English, French and classical origin; about 40 pieces of music, principally instrumental; and 17 charts of Nova Scotia and New England waters from the *Atlantic Neptune* of J. F. W. Des Barres. John West's *A Catalogue of Books Published in America* (1797) is the earliest American book trade bibliography known. The first professional organization was founded by 14 Boston firms in 1801, followed the next year by groups in Philadelphia and Boston. Kentucky and Ohio printers met in Lexington in 1805 to organize a similar group on the frontier. Book fairs after the model of the famous Leipzig and Frankfurt fairs in Germany were started by Mathew Carey. His efforts, while they failed to achieve permanency, led to the establishment of the first national booksellers' organization of the country, the American Company of Booksellers. This organization offered gold medals as rewards for the best American-made ink, paper, binding, leather and printing, anticipating the endeavours of the American Institute of Graphic Arts by more than a century.

The 20th-century diversity of book outlets was clearly foreshadowed in 19th-century America. A large portion of U.S. books reached the public by way of the dry-goods houses and supply stores, at the newsdealers, stationers and in all sorts of mixed merchandise stores. Boston with its old corner bookstore and its retail centre on Cornhill maintained the old tradition of the trade. In New York city the section around Madison square, with Dutton's and Putnam's great bookshops on 23rd street, and Scribner's and Brentano's nearby on Fifth avenue, was one of the retail bookselling centres of the world. Apart from the older communities along the Atlantic coast it was particularly in the near west and in the middle west, in the days after the Civil War, that a good many bookstores were started. Missouri, Michigan, Illinois and Wisconsin were well provided with retail outlets, and Ohio exceptionally so. Cincinnati, which had become the most important book-trade centre west of the Alleghenies, was a popular convention place where in 1873 influential and long-lived book-trade associations were founded. In Chicago, vigorous retailing was practised by a group of firms which also engaged in publishing and acted as wholesalers. In the far west, too—in California and in what was then Washington territory—there were of course "booksellers and stationers." Anton Roman moved his bookstore from Shasta City to San Francisco in 1857, where he operated also as a large-scale importer and wholesaler, covering besides the city about a dozen interior counties. In his lavishly equipped store in the Lick House block, he announced, the "noble hall has its long tables covered with the choicest mental food culled from all climes and served up in the most magnificent style of binding." The southern states of the union, and the southwest in those years did not have as many bookstores.

The booksellers bought their supply either directly from the publishers or from a small number of strong and energetic wholesalers scattered regionally about the country. Books also were

sold directly from publisher to customer, mainly by subscription. The absence of a well-developed, evenly distributed network of retail outlets (the same thing which in the 20th century aided the phenomenal growth of the book clubs) made subscription selling feasible and necessary. Mark Twain was quick to recognize its special advantages. His connection with Elisha Bliss, Jr., of the American Publishing company in Hartford, resulted in a vigorous and spectacularly successful sales campaign for *The Innocents Abroad*, closely co-ordinated with the lecturing schedule of the author, and later for *Roughing It* and *The Adventures of Tom Sawyer*. Mark Twain showed keen appreciation for the value of publicity and acquired a detailed knowledge of subscription selling methods. In spite of eventual abuses, such as high-pressure selling of cheap sets at exorbitant prices or working off antiquated works in new guise, subscription selling survived into the 20th century as a legitimate and generally accepted sales method.

The second half of the 19th century saw an important change in the function of the book auctioneer. He now became the agent for the American bibliophile, then affecting the auction field as its greatest factor. The Parke-Bernet galleries, New York city, leading book auctioneers at mid-20th century, could trace their history back, via the American Art association and the Anderson galleries and many earlier links, to the firm of Cooley and Bangs of the 1830s. Closely linked with the rise of the great collectors and the founding of great libraries were the rare book dealers. Joseph Sabin, bibliographer and distinguished Americana expert, Robert H. Dodd, James F. Drake, George D. Smith and Luther S. Livingston were some of the leading figures of the 19th and the early 20th centuries. They were followed in the first half of the 20th century by Charles Sessler and A. Edward Newton, Thomas F. Madigan, specialist in autographs, Gabriel Wells, Ernest Dawson, Lathrop C. Harper, specialist in incunabula, Charles E. Goodspeed and A. S. W. Rosenbach. Separated from the rare book trade, the secondhand trade found its centre on lower Fourth avenue, New York city, where Schulte's bookstore set the pace in the lower-priced field. (*See* also BOOK COLLECTING.)

20th Century.—The number of titles and the sales of novels increased early in the new century. The struggle for price maintenance continued to play an important role in bookselling. Department stores had looked on books as "loss leaders," to be sold at cut rates to attract customers. In 1914 the supreme court decided in favour of R. H. Macy & Co., New York department store, against the American Publishers' association, on the grounds that the association's price-maintenance agreement with the American Booksellers association violated federal antitrust legislation. In 1934 a code of fair trade was adopted by the book trade under the National Recovery administration. In May 1935, the supreme court declared the NRA codes unconstitutional, and in October of that year prices were so low that some New York bookshops canceled orders with publishers and went to the loss-leader department stores to buy stock. There were continuing attempts to prevent underselling. In 1952 the McGuire Fair Trade bill was passed to validate fair-trade price-maintenance contracts for signers and nonsigners alike, in interstate commerce among states authorizing fair-trade price agreements.

The distribution of retail bookstores over the country remained uneven, the "strong" region extending along the Atlantic seaboard from Maine to New Jersey, and through Pennsylvania and Ohio as far west as Wisconsin and Illinois, with Minnesota, Iowa and Missouri as "border" territories in the trade. The other parts of the country, with the exceptions of California and Texas, were "weak."

The continuing activities of stores dating from the 19th century were supplemented by the establishment of enterprising new stores, and by the mid-century development of such big-city chains as Doubleday and Womrath in New York city, Burrows in Cleveland, the expansion of Brentano's in several cities, and Fred Harvey's chain in the west and southwest. In the 1960s department stores accounted for a large percentage of U.S. book sales. A number of "personal bookshops" were started, especially in college communities. Professional education for the book trade had sporadic encouragement from institutions of higher learning. The 20th century saw the revival of the book fair, the inception of book weeks, and the rise of book and author luncheons, autographing parties and many other methods of book sales promotion.

Book clubs were the major innovation in bookselling in the 1920s. The success of the Book-of-the-Month club, started by Harry Scherman in 1926, was immediate; and within two years several other clubs were flourishing, including the Literary Guild, which was organized in 1927. By the early 1960s about 90 clubs were operating.

The mass distribution of inexpensive paperback books revolutionized bookselling in the 1940s and 1950s. Pocket Books, Inc., developed the idea of utilizing established magazine distributors as well as outlets in drugstores, chain stores, supermarkets, bus, train and airport waiting rooms, hotel lobbies and newsstands to reach the mass market; and in 1939, its first year, sold about 1,500,000 books. By the early 1960s the annual sales of 30 paperback book publishers exceeded 250,000,000 copies through more than 100,000 retail outlets. Western stories and mysteries led in popularity, but more and more works of nonfiction, self-help and how-to-do-it books, contemporary novels and literary classics were appearing. Sales of higher-priced paperback books and low-priced hard-cover reprints, primarily through traditional bookstore channels, had increased substantially by mid-century. Paper-bound textbooks had clearly found a market in the colleges.

Books for children became increasingly popular, with total sales of juveniles amounting to about half the total for adult fiction and nonfiction combined. Although one-half or more of juvenile books were sold to school and public libraries, juveniles represented a new class of books for the bookstores. Textbooks were sold primarily directly to school systems, and most technical books were sold by mail. Most general encyclopaedias and some professional (legal and medical) sets of reference works were sold by salesmen as subscription books direct to the customer on a time-payment plan. (*See* PUBLISHING: *Subscription Books.*)

Total book sales in the United States amounted to over $700,000,000 annually in the early 1960s. Among the estimated 4,500 stores selling hard-cover books, probably not more than 1,500 attempted to offer general book services or derived a major source of income from book sales. It was estimated that 60% of all bookstore sales were made in 25 cities which included 20% of the country's population.

In spite of many staggering internal and external difficulties (chief among the latter being competition from the various mass media of communication), the book trade continued to grow from year to year. In spite of its relatively small importance in the national economy (with total annual sales in the early 1960s amounting to about .2% of the gross national product) bookselling was of major importance; since the nation's cultural heritage and the rights and freedoms of the people require for their preservation a free and independent, courageous and relatively prosperous book trade.

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BOOKWORM, the name given to various insects, moths, beetles, etc., whose larval (or adult) forms injure books by gnawing the binding and piercing the leaves with small holes. There is, however, no single species which may properly be called the bookworm, for a large number of the many insects that feed upon dry, starchy material or paper may cause damage to books. Among the most widely known bookworms are the silverfishes (order Thysanura) and the booklice (order Psocoptera or Corrodentia).

See also INSECT: *Thysanura* and *Corrodentia.* (R. L. WL.)

BOOLE, GEORGE (1815–1864), English logician and mathematician, famous for his development of symbolic logic and, in mathematics, for his appreciation of the way in which the symbols of operation could be separated from those of quantity and treated as distinct objects of calculation. He was born at Lincoln on

Nov. 2, 1815, the son of a tradesman of limited means, and became assistant master in schools at Doncaster (from about the age of 16) and at Waddington, near Lincoln. He opened his own school in Lincoln, then became headmaster of Waddington and eventually, in 1840, moved this school to Lincoln. Meanwhile he had contributed his first published work, "Researches in the Theory of Analytical Transformations," to the *Cambridge Mathematical Journal* for 1839 (1841). Further contributions to learned periodicals led to his appointment in 1849 as professor of mathematics in Queen's college, Cork, Ire. He died at Ballintemple, near Cork, on Dec. 8, 1864.

Boole's well-known *Treatise on Differential Equations* (1859; posthumous supplement, 1865) was followed by a *Treatise on the Calculus of Finite Differences* (1860), designed as a sequel to it. In the 16th and 17th chapters of the *Differential Equations* there is a lucid account of the general symbolic method, the bold employment of which led to Boole's chief discoveries; and of a general method in analysis, originally described in his famous memoir in the *Philosophical Transactions* for 1844.

With the exception of Augustus De Morgan (*q.v.*), Boole was probably the first English mathematician since John Wallis to write upon logic. His ideas concerning a calculus of reasoning were first published in a pamphlet called *Mathematical Analysis of Logic* (1847); but Boole later regarded this as an imperfect exposition of his logical system and desired that his much larger work, *An Investigation of the Laws of Thought, on Which Are Founded the Mathematical Theories of Logic and Probabilities* (1854), should alone be considered as a mature statement of his views. He did not regard logic as a branch of mathematics, as the title of his earlier pamphlet might seem to imply; but he pointed out such a deep analogy between the symbols of algebra and those which can be made, in his opinion, to represent logical forms and syllogisms that we can hardly help saying that logic is mathematics restricted to the two quantities, 0 and 1. By unity Boole denoted the universe of thinkable objects; literal symbols, such as x and y, were used with the elective meaning attaching to common adjectives and substantives. Thus, if x=horned and y=sheep, then the successive acts of election represented by x and y, if performed on unity, give the whole of the class *horned sheep*. Boole showed that elective symbols of this kind obey the same primary laws of combination as algebraical symbols, whence it followed that they could be added, subtracted, multiplied and even divided, in almost exactly the same manner as numbers. Thus, $1-x$ would represent the operation of selecting all things in the world except *horned things;* that is, *all not horned things;* and $(1-x)\ (1-y)$ would give *all things neither horned nor sheep*. By the use of such symbols propositions could be reduced to the form of equations; and the syllogistic conclusion from two premises was obtained by eliminating the middle term according to ordinary algebraic rules.

(W. S. J.; X.)

Although his first concern was to provide an appropriate symbolism for Aristotle's logic of general terms, Boole saw that his algebra could be applied also in reasoning about the relations of propositions; and he devoted much thought to its use in the mathematical theory of probabilities. He was, indeed, one of the first mathematicians after Leibniz to consider seriously the presentation of a deductive system in an abstract fashion. The opening remarks of his *Mathematical Analysis of Logic* in which he set out his view of an abstract calculus were amply justified by later events, since the algebra which goes by his name (Boolean algebra) has found many applications of which he never dreamed (*e.g.*, in the theory of switchgear for telephone circuits and in the design of electronic computers). It is not, however, as his admirers once thought, the whole of logic. *See* Logic; Logic, History of.

Bibliography.—Boole's *Mathematical Analysis of Logic* was republished, together with some later papers and a selection of notes on logic from his manuscripts in the library of the Royal society, under the title *Studies in Logic and Probability* (1952). For further details about his life and his contribution to logic *see* R. Harley, "George Boole, F.R.S.," *British Quarterly Review*, vol. 87 (July 1866); William Kneale, "Boole and the Revival of Logic," *Mind*, 57:149–175 (April 1948); and the series of commemorative papers in the *Proceedings of the Royal Irish Academy*, vol. 57, sec. A, no. 6 (1955). (W. C. K.)

BOOLEAN ALGEBRA: *see* Logic, History of: *Algebra of Logic;* Set Theory (Theory of Aggregates).

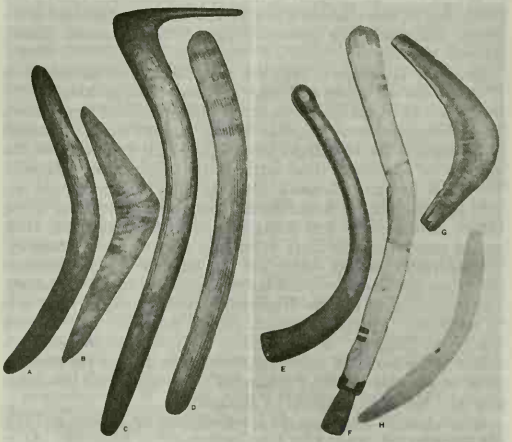
BOOMERANG, a curved throwing stick used chiefly by the natives of Australia for hunting and warfare. The Australian aborigines used two kinds of boomerangs and many varieties of boomerang-shaped clubs.

The returning boomerang (the name is from the native word used by the Turuwal tribe in New South Wales) is light, thin and well balanced, 12–30 in. long, $1\frac{1}{2}$–3 in. wide, $\frac{3}{16}-\frac{3}{8}$ in. thick and up to 12 oz. in weight. It varies in shape from a deep, even curve to almost straight ends of the same or unequal length. Usually, one side is flat, but both may be convex. The edges are sharp or rounded. The ends are twisted or skewed in opposite directions (forward and backward) either as the boomerang is being made or after it has been heated in ashes.

The boomerang is thrown with a vigorous action in which the thrower may run a few steps to gain greater impetus. It is held at one end, above and behind the thrower's shoulder, with the concave edge to the front, and swung forward rapidly with the flatter side underneath. Just before release, added impetus is given by a strong wrist movement. If thrown downward or parallel to the ground, it sweeps upward to a height of 50 ft. or more. When thrown so that one end strikes the ground it ricochets into the air at terrific speed, spinning endwise. It completes a circle or oval 50 yd. or more wide and then several smaller ones, up to five, as it drops to the ground near the thrower. A figure-of-eight course may be followed. The returning boomerang is a plaything used to train men in dodging weapons and in tournaments to see who can make it weave the greatest number of circles or return nearest a peg. Hunters spin it above flocks of ducks, parakeets and pigeons to imitate a hawk and to drive the birds into nets strung from trees.

Returning boomerangs were used in eastern Australia and in Western Australia only. Early students believed that air, pressing on the lower flat surface and passing over the upper rounded face, explained the boomerang's comeback flight, but T. L. Mitchell, in 1846, gave the real explanation; he said that it was caused by the skew combined with the spinning motion. The returning boomerang is generally considered to have developed from the nonreturning types which swerve in flight.

The nonreturning boomerang has a shallow curve in relation



COURTESY OF THE TRUSTEES OF THE AUSTRALIAN MUSEUM, SYDNEY

(LEFT) AUSTRALIAN BOOMERANGS: (A, B) RETURNING BOOMERANGS, W. AUSTR.; (C) HOOKED, NONRETURNING BOOMERANG, NORTHERN TERRITORY; (D) NONRETURNING, FLUTED BOOMERANG, CENTRAL AUSTR. AND NORTHERN TERRITORY. (RIGHT) BOOMERANGS FROM OTHER COUNTRIES: (E) NONRETURNING BOOMERANG, SOUTHERN INDIA; (F) RABBIT-KILLING MISSILE, HOPI INDIANS, ARIZONA; (G) NONRETURNING BOOMERANG, NEW HEBRIDES; (H) MODEL OF ANCIENT EGYPTIAN FOWLING MISSILE

to its length, 2–3 ft., and it weighs up to 1½ lb. With it animals are maimed and killed, while in warfare it causes serious injuries and death. It is thrown in the same way as the returning boomerang. One variety has a picklike hook at one end.

All boomerangs drop to the ground when they strike a man, animal, tree or other object. They are also beaten together as musical clapsticks, their sharp ends are useful for digging and in the Northern Territory one type was used for tribal rituals. Mulga, myrtle and mangrove are commonly used timbers for making boomerangs. They were not made in Cape York, Arnhem Land and parts of Western Australia.

Boomerang-shaped, nonreturning weapons were used by the ancient Egyptians and are still used by the Indians of California and Arizona and in southern India (where some are made of metal) for killing birds, rabbits and other animals.

(F. D. McC.)

BOONE, DANIEL (1734–1820), famous American hunter and pioneer, was born near the present city of Reading, Pa., probably on Nov. 2, 1734. He had very little formal schooling but learned to read and write. As a youth he moved with his family to the Yadkin valley on the North Carolina frontier. He served as a teamster in Gen. Edward Braddock's disastrous expedition of 1755. Most of his life was spent as a wandering hunter and trapper. He went as far south as Florida in 1765 and possibly as far west as the Yellowstone river in 1814.

Many white men had traversed the "dark and bloody ground" of Kentucky before Boone, so the legend that he was the discoverer and founder of Kentucky needs qualification. He first went a short way through the Cumberland gap (at the extreme southwestern border of Virginia) to hunt in the fall of 1767. Then, guided by John Finley, he and several companions returned to the Kentucky country to trap and hunt in the years 1769–71. Twice during this long hunt he was robbed of his furs and hides by Indians, and once he was captured by them, but he managed to escape. He returned to his wife in North Carolina with little material gain to show for his strenuous efforts. But he was rich in information because he had explored the valleys of the Kentucky and Green rivers and north-central Tennessee so thoroughly that he knew the region better than any other white man.

In 1773 Boone undertook to lead his own and several other families to the western country, but the pioneer band was attacked by Cherokee Indians in the Cumberland gap. Two of the party, one of them Boone's son James, were tortured and murdered, whereupon the survivors turned back, against Daniel Boone's wishes.

Governor Dunmore of Virginia sent Boone into Kentucky in 1774 to warn surveyors of Indian dangers. Then in March 1775 Boone and 28 companions were employed by Richard Henderson's Transylvania company to blaze a trail through the Cumberland gap. Despite Indian attacks they built a road and prepared the way for the opening of three settlements at Boonesboro, Harrod's Town and Benjamin Logan's. In Aug. 1775 Boone brought his wife and daughter to Boonesboro. They were, except for a few Indian prisoners, the first white women in Kentucky, and their arrival may be said to mark permanent settlement in Kentucky.

Henderson's project called for the purchase of an immense tract from the Cherokees, and the establishment of a 14th colony. The project failed because Henderson could not obtain valid title to his lands. Instead of a 14th colony Kentucky was made a county of Virginia. Boone became a captain in the county's militia and a leader in defending Boonesboro against the Indians. Once he was able to rescue unharmed his daughter and two other girls who had been kidnaped by Indians.

Boone himself was captured a second time by Indians in 1778. He was adopted as a son by the Shawnee chief, Blackfish. After five months he escaped to warn Boonesboro settlers of an impending attack. When the attack by British and Indians came in Sept. 1778 Boonesboro successfully withstood a ten-day siege.

Boone was a courageous and resourceful Kentucky leader, but he did not prosper. He established extensive land claims, but could rarely make them good. After the American Revolution he worked as a surveyor along the Ohio river. He settled for a few years in Kanawha county, Va., (now West Virginia). Then in 1799 he followed his son, Daniel Morgan Boone, to Missouri, which was then under Spanish rule. Boone continued his familiar hunting and trapping pursuits in the Ozarks and had further land troubles after the Louisiana purchase.

When Boone died in St. Charles county, Mo., probably on Sept. 26, 1820, he was even then a legendary hero. The bodies of Boone and his wife were later moved to Frankfort, Ky.

See R. G. Thwaites, *Daniel Boone* (1903); John Bakeless, *Master of the Wilderness, Daniel Boone* (1939). (T. A. Ln.)

BOONVILLE, a city in central Missouri, U.S., on the right bank of the Missouri river, 150 mi. N.W. of St. Louis and the seat of Cooper county. (For comparative population figures *see* table in Missouri: *Population.*) Named after Daniel Boone, it was settled in 1810, incorporated as a village in 1839 and chartered as a city in 1896. During pioneer days, it was an important trading post on both the Missouri river and the Santa Fe trail. During the American Civil War, it was in hotly contested territory and an engagement took place there June 17, 1861.

The natural resources of the region include rich agricultural land, clays and shales, stone and coal. Industries include a chicken hatchery, dairies, a stone quarry, a shoe factory, bottling plants and a walnut veneer plant. The Missouri Training School for Boys (1889) and Kemper Military academy (1884) are there. There are three Indian mounds in Harley park. (C. St.)

BOORDE (Borde), **ANDREW** (1490?–1549), English physician and author of the first English guide book to Europe, was born at Borde hill, Cuckfield, Sussex. He was educated at Oxford and admitted as a member of the Carthusian order while still a minor. In 1521 he was "dispensed from religion" to act as suffragan bishop of Chichester, though he never filled the office, and in 1529 he was freed from his monastic vows, not being able to endure, as he said, the "rugosyte off your relygyon." He visited the universities of Orleans, Poitiers, Toulouse, Montpellier and Wittenberg, saw "much abhominable vyces" at Rome and went on pilgrimage to Santiago de Compostella. In 1534 Boorde was again in London at the Charterhouse and Thomas Cromwell seems to have entrusted him with a mission to find out the state of public feeling abroad about Henry VIII's policies. In 1536 he was studying and practising medicine at Glasgow. About 1538 Boorde traveled extensively, visiting nearly all the countries of Europe except Russia and Turkey and later making his way to Jerusalem. He settled for a time at Montpellier and before 1542 had completed his *Fyrst Boke of the Introduction of Knowledge*, in prose and "ryme dogrell" (1548), which ranks as the earliest continental guide book, his *Dyetary of Helth* (1542?) and his *Brevyary* (1552). He probably returned to England in 1542. He made his will in the Fleet prison in April 1549. His writing is unpolished, but lively and full of interesting lore and anecdote.

See F. J. Furnivall's reprint of the *Introduction* for the Early English Text Society, extra series no. x (1870, reissued 1906). (X.; N. D.)

BOOS, MARTIN (1762–1825), Bavarian Roman Catholic priest, who started a movement among Catholics closely allied to the pietist movement in the Lutheran churches, was born on Dec. 25, 1762. He pursued his propaganda from about 1799 to 1812 in Austria, but repeated accusations in consistorial courts compelled him to return to Bavaria. The Prussian government gave him a professorship at Düsseldorf in 1817, and in 1819 a pastorate at Sayn, near Neuwied. He died on Aug. 29, 1825.

See J. Gossner, *Martin Boos, der Prediger der Gerechtigkeit* (1826).

BOOT, JESSE: *see* Trent, Jesse Boot.

BOOT: *see* Shoes.

BOÖTES, a constellation of the northern hemisphere (Gr. *bootes,* "herdsman," from *boos,* "ox"). The ancient Greeks symbolized it as a man walking, with his right hand grasping a club, and his left extending upward and holding the leash of two dogs, which are apparently barking at the Great Bear (Ursa Major). The brightest star is Arcturus (*q.v.*). Another interesting star is ε Boötis, a beautiful double star composed of a yellow star of magnitude 3 and a blue star of magnitude 6½. *See* Constellation.

BOOTH, a family whose name is intimately connected with

the founding and early development of the Salvation Army (*q.v.*).

William Booth (1829–1912), founder of the Salvation Army, was born in Nottingham, Eng., on April 10, 1829. His father, an unsuccessful builder, apprenticed him to a pawnbroker because the profession often enriched those who engaged in it. The early contact with human misery that pawnbroking gave him roused Booth to a lifelong passion of anger against the poverty and degradation in which far too many 19th-century Englishmen lived. In 1844 he experienced, in a Wesleyan chapel, religious conversion, and in 1846, influenced by the American evangelist, James Caughey, he seriously ratified his dedication by beginning to preach. He became a Methodist "local preacher" in 1847 and always retained his love for the Methodist Church. His apprenticeship over in 1848, he vainly sought work in Nottingham before going to live in London, where he was finally employed by a pawnbroker in Walworth. Long hours at a distasteful and tiring job did not lessen his religious zeal. His official lay preaching did not give him enough evangelical work to do, so he began to hold open-air meetings. This caused friction with his minister, and he attached himself to the Methodist New Connexion, in which, after a period of study, he was ordained (1858). In the meantime, he had married in 1855 a remarkable woman, Catherine Mumford (*see* below). He conducted ardent evangelical campaigns in various parts of the country, during which he evolved the methods afterward used to great effect by the Salvation Army. Though successful as a regular minister, he resigned in 1861 to dedicate himself to his true vocation, itinerant evangelism.

In 1865 the family moved to London, and in July of that year William Booth was invited to speak at, and then lead, open-air and tent meetings in the Whitechapel district. From this attempt to reach the churchless masses came the Christian mission, renamed (1878) the Salvation Army. Booth was forced by the numbers of his converts to found the religious organization of which he became first general, and within ten years all England was stirred. There was violent persecution from ignorant and alcohol-crazed roughs; in 1882, for instance, 669 Salvationists (251 of them women) were "knocked down, kicked, or brutally assaulted," and 56 properties either wholly or partially wrecked. Some magistrates also prosecuted his followers; in 1884 no fewer than 600 Salvationists were sent to prison for preaching the gospel. The disorder gradually ceased, and Booth even received friendly overtures from the Church of England, though these did not lead to any close union. Converts carried the work to the United States in 1879, and to Australia in 1880. Booth's eldest daughter Catherine (called "la maréchale") began preaching in Paris in 1881. By 1890 the Salvation Army was established in most European countries, in India, in South Africa and in South America. In 1890 appeared the most influential of Booth's many books, *In Darkest England and the Way Out,* in which he had the help of W. T. Stead (*q.v.*). It contained concrete proposals for relieving pauperism and fighting vice; homes for the homeless; training centres to prepare emigrants for overseas countries; rescue homes for women and girls in moral danger; homes for released prisoners; legal aid for the poor; practical help for the alcoholic. There was vast public support, and much of the scheme came into operation.

Toward the end of the century, Booth's religious and social genius began to be recognized. London made him a freeman of the city, Oxford university gave him an honorary doctorate. He was officially invited in 1902 to the coronation of Edward VII, and he opened a session of the United States senate with prayer. His life was saddened by the death of his wife in 1890, and by the defection of two of his sons and a daughter, who, after having played leading roles in the phenomenal progress of the army, resigned because of personal differences and disciplinary disagreements. Increasing blindness could not prevent Booth's continuing his evangelical and social activities until he was over 80. He died in London on Aug. 20, 1912.

Booth had a passion for righteousness and for social justice, coupled with a genius for organization and leadership. His theology has been described as simple. Though by no means superficial, it certainly concentrated on essential matters, clearly expounded for the understanding and inspiration of the common man. His outstanding gifts as a preacher and leader inspired a movement that resulted not only in scenes of religious enthusiasm but also in practical Christian social work of immense value and far-reaching influence.

Catherine Booth (1829–1890), wife of the founder of the Salvation Army, herself an eloquent preacher and untiring social worker, was born on Jan. 17, 1829, at Ashbourne, Derbyshire, Eng. Her father was a carriage builder and sometime Methodist lay preacher, her mother a deeply religious woman of Puritan type. Catherine, in adolescence an invalid, was educated principally at home, and early acquired some competence in the theology of her day. The family moved to London in 1844 and she became an active member of the Wesleyan Methodist church in Brixton. When this church expelled a group of "reformers," she and her future husband joined them. They were married in 1855, and Catherine became her husband's most fearless critic and most devoted helper, giving much time to visitation among the very poor. It was largely because of her influence that William Booth left the assured career of a Methodist minister for the uncertainties of itinerant evangelism.

Catherine Booth was a convinced believer in women's right to preach the gospel, and her pamphlet *Female Ministry* (1859) is still cogent. She herself began to preach in her husband's church at Gateshead in 1860. She became a notable orator, and in 1880–84 conducted highly successful meetings in various halls in the West End of London. In 1885 she took part in a campaign that secured the passing of the Criminal Law Amendment act, designed to protect young girls. She died of cancer at Clacton on Oct. 4, 1890. She did not believe that the sacraments are essential to salvation. Her views were not lightly adopted, but were based on her study of Holy Scripture and theology, and on an examination of the practical effects of the sacraments on church unity and in the personal life of church members. Although the evolution of the sacramental attitude of the Salvation Army must not be wholly attributed to Catherine Booth, her beliefs were undoubtedly influential.

William Bramwell Booth (1856–1929), second general of the Salvation Army and eldest son of William and Catherine Booth, was born at Halifax, Eng., on March 8, 1856. He became an active full-time collaborator in 1874, and from 1880 was the Army's chief organizer. He carried into practice the social services plans outlined by his father. In 1885, together with W. T. Stead, he stood trial at the Old Bailey on a technical charge connected with the successful attempt to secure legislation protecting young girls in moral danger, but was acquitted. The trial—and Stead's vigorous press campaign—proved to a skeptical public that in 19th-century England girls could be bought and sold for immoral purposes, not only without their consent but against their will. An able speaker, a tireless exponent of the doctrine of Christian perfection, a fine writer—he published nine books, of which *Echoes and Memories* (1925) and *These Fifty Years* (1929) are perhaps the best known —William Bramwell Booth was also an enthusiast for religious work among young people. He became general on his father's death, and died on June 16, 1929, in London.

Evangeline Cory Booth (1865–1950), seventh child of William and Catherine Booth, was born at Hackney, Eng., on Dec. 25, 1865. From her youth she took an active part in the organization of the movement. In 1896 she went to Canada and in 1904 took over command of the Salvation Army in the United States, where she remained until 1934, when she was elected general. She retired in 1939, and died in New York on July 17, 1950.

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(Wi. K.)

BOOTH, CHARLES (1840–1916), English shipowner and social reformer who made significant contributions to knowledge of social problems and to the methodology of statistical measurement. He was born at Liverpool on March 30, 1840. His chief work, *Life and Labour of the People in London* (17 vol., 1903), contains a series of celebrated maps in which various colours show

the degrees of poverty found street by street. Booth's purpose was to describe the conditions under which various classes lived and to show the relationship between poverty and depravity on the one hand and regularity of income and resulting standards of living on the other hand.

The lot of the aged poor also engrossed his attention. He was a member of the royal commission on the poor law (1905–09), and although ill health forced him to retire, he published his views separately as *Poor Law Reform* (1910). His achievements earned him a privy councilorship, a fellowship of the Royal society and doctorates of the universities of Cambridge, Liverpool and Oxford.

Booth died on Nov. 23, 1916. In 1871 Booth married Mary Macaulay, a niece of Thomas B. Macaulay, the historian. She was the author of *Charles Booth, a Memoir*, published in 1918.

(A. W. M.)

BOOTH, EDWIN THOMAS (1833–1893), U.S. actor and one of the outstanding 19th-century Shakespearean tragedians, was born Nov. 13, 1833, near Belair, Md. His father, the Anglo-U.S. actor Junius Brutus Booth (born in London, 1796), moved to the United States in 1821 and became a favourite on the American stage, continuing the successes achieved in London, where he was regarded as a serious rival to Edmund Kean.

Edwin Booth's stage debut was made at the Boston museum on Sept. 10, 1849, as Tressel to his father's Richard III. in Colley Cibber's version of the Shakespeare play. Two years later at the National theatre, New York city, when his father refused to perform one night, Edwin took his place in the character of Richard III. It was not until after his father's death in 1852, however, that Edwin won renown for himself. Between 1852 and 1856 he played in California, Australia and the Sandwich Islands. In 1857 he appeared as a star in Boston, Mass., and New York city, and at the end of three years challenged and overcame the dramatic supremacy of Edwin Forrest.

In 1863 Booth became comanager of the Winter Garden theatre, New York, presenting there a series of Shakespearean productions of unprecedented grandeur and finish. There the three Booth brothers, Junius Brutus (1821–83), Edwin and John Wilkes (*q.v.*), appeared together as Cassius, Brutus and Mark Antony, respectively, in a memorable performance of *Julius Caesar*. From Nov. 26, 1864, to March 22, 1865, Edwin played Hamlet for 100 consecutive nights. His triumph was dashed when in 1865 his brother John Wilkes Booth assassinated Pres. Abraham Lincoln. Edwin's reputation, though not his spirit, eventually recovered from this blow, which caused his retirement until Jan. 3, 1866, when he reappeared at the Winter Garden as Hamlet.

Booth then built his own theatre, at 23rd street and Sixth avenue, New York city, which he opened in 1869. There he produced practically his entire repertory of Shakespearean and other plays. He used the true text of Shakespeare, anticipating by years a similar reform in England, and his productions were outstandingly good. Booth had little business acumen, however; his trust in ill-chosen financial advisers cost him his theatre and brought him to bankruptcy in 1874. But by hard work, acting from this time under the management of others, he again earned a fortune.

In 1861 Booth had played in London, which he revisited in 1880 and 1882, playing there and in the provinces with moderate success. At Henry Irving's invitation, he alternated with Irving in the parts of Othello and Iago at the Lyceum theatre, London. In 1883 he toured Germany, where his acting was received with immense enthusiasm, and this German engagement he considered the peak of his career. In 1886 Booth formed a highly successful business and acting partnership with Lawrence Barrett. During April and May 1886 Booth and Tommaso Salvini played together in *Othello* and *Hamlet*, and in the season of 1889–90 Booth appeared opposite Helena Modjeska. His last appearance was as Hamlet, in 1891 at the Academy of Music, Brooklyn, N.Y.

Booth died on June 7, 1893.

Booth's genius was for tragedy. He was small, slight and dark, with a magnificent voice. His acting developed from the bombastic style characteristic of the early 19th century into a quieter, more natural manner that foreshadowed the realism of 20th-century acting. Hamlet was generally considered his finest role. In later life he largely confined himself to playing Hamlet, Lear, Macbeth, Iago, Othello, Brutus, Shylock and Richard III, of Shakespeare; and to the title role in *Richelieu* by Bulwer-Lytton, and Bertuccio in Tom Taylor's *The Fool's Revenge*.

His public life, except for the disaster of his brother's crime, was splendid, but his personal life was consistently sad. The nobility of his character, his achievement in his art and his zeal to improve both the moral and social standing of actors combined to make him one of the great figures of the American stage. In 1888 he founded and became the first president of a club, the Players, New York city, where he made his home in his last years.

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(E. R.)

BOOTH, JOHN WILKES (1838–1865), U.S. actor, the assassin of Pres. Abraham Lincoln, was born in Hartford county, Md., in 1838. He was the son of Junius Brutus Booth and brother of Edwin Thomas Booth (*q.v.*). He sympathized with the south in the American Civil War, and in 1865 organized a conspiracy to assassinate the president, the vice-president and members of the cabinet.

On the night of April 14, 1865, while Lincoln was watching a play, *Our American Cousin*, from a box at Ford's theatre in Washington, D.C., Booth stealthily entered the box and discharged a pistol at the head of the president from behind, the ball penetrating the brain. Brandishing a huge knife, the assassin leaped down upon the stage, shouted "*Sic semper tyrannis!* The south is avenged!" and escaped from the building. He was pursued, and 12 days later was shot in a barn near Bowling Green, Va., where he had concealed himself.

BOOTHIA PENINSULA, the northernmost portion of mainland Canada, reaching 71° 58′ N. Area 11,741 sq.mi. Pop. (1956) 143, mostly coastal and seminomadic. Administratively within Franklin district, the peninsula is a treeless, plateaulike arm of the Canadian shield, rising to 2,000 ft. It is truncated on the north by the navigable Bellot strait, merges in the south with Boothia isthmus and is flanked on the northeast and west by limestone lowlands. Spence bay and Thom bay are the only settlements. The peninsula was named in honour of Sir Felix Booth, who financed the Ross expedition which discovered and partly mapped it in 1829–33, and established the location of the north magnetic pole. *See* ARCTIC, THE: *Exploration of Arctic Regions.* (H. R. TN.)

BOOTLE, a municipal, county (1888) and parliamentary (1918) borough in southwest Lancashire, Eng. Pop. (1961) 82,829. It contains the northern part of the Mersey river docks which employ many of its inhabitants. A great variety of other industries include engineering, wire-rope works, tin-box factories, electrical works, dye works, flour mills and large timber yards. Bootle has also large storage accommodations for cotton, grain, etc. The town possesses many parks and recreation grounds, including a golf course and sports stadium. A proposal to merge Bootle in the adjacent city of Liverpool was rejected by parliament in 1903. From 1918 Bootle returned one member to parliament.

BOOTLEGGING. This term, which came into general use in the midwestern states of the United States in the 1880s to denote the traffic in illegal whisky, apparently derived from the practice of carrying flasks concealed in boot tops. It became one of the most familiar terms in the American vocabulary during the era of national prohibition (1920–33), and is sometimes used to describe illegal dealings in other commodities, such as prohibited books or nonexportable currencies. After repeal of prohibition the bootlegging of liquor continued to represent a formidable problem. According to Licensed Beverage Industries, Inc., the public relations agency of the U.S. distillers, this traffic was operating at a rate

of about $1,000,000,000 a year in the early 1960s; 40,000 to 60,000 persons were engaged in the operation of unlicensed stills; and there were about 150,000 distributors of the illegal product. (*See* also Liquor Law; Narcotics, Laws Relating to; Opium.)

Historical Background.—In U.S. history, violators of liquor laws have ranged from colonial merchants rebelling against taxation without representation to the gangsters associated with the prohibition era. In frontier days, the illegal traffic in whisky with the Indians caused outbreaks of violence, and created resentment on the part of white settlers against the entire liquor trade. Anti-liquor sentiment became associated with the religious revival of the early 19th century, and gradually became an organized movement.

Local option, permitting each community to regulate or forbid the sale of liquor, was adopted in 1829 by Maine, and within a few years by several other states, including New York and New Jersey. In 1880 Kansas became the first state to incorporate prohibition in its constitution. It was in this state, according to the 1891 edition of the *Cyclopedia of Temperance and Prohibition,* that the term "bootlegger" became current.

By 1906, 40% of the population of the U.S. lived in localities in which the sale of liquor was outlawed. A corresponding increase in bootlegging was attributed to the fact that liquor was being smuggled from "wet" communities into the "dry" ones, and the campaign for universal prohibition was intensified.

National Prohibition and Bootlegging.—The 18th amendment, writing prohibition into the federal constitution, was ratified Jan. 16, 1919, effective a year later. (*See* Prohibition.) In preparation for the new era, a prohibition unit was organized in the treasury department. This unit was exempt from civil service, and appointments to it were a form of political patronage. In their first five weeks on the job, five of the new agents were arrested on charges of taking bribes from bootleggers or going into the business themselves.

In the early phase of the prohibition era, the efforts of most bootleggers were concentrated on getting a supply of genuine liquors. Their activities included smuggling across the Canadian and Mexican borders and in ships under foreign registry. Favourite sources of supply were the Bahamas, Cuba and the French islands of St. Pierre and Miquelon, off the southern coast of Newfoundland. Great quantities were also obtained from government-supervised warehouses, supposedly for medicinal use or for export, by those who possessed strong political connections.

In addition to the medicinal whisky that reached the bootleg market in wholesale consignments, millions of bottles were sold across drugstore counters on real or forged prescriptions. Less than five months after the 18th amendment had gone into effect, the federal administrator for Illinois estimated that 300,000 spurious prescriptions had been filled in Chicago alone. By mid-June of the first year the courts were already congested with cases awaiting trial, and Chicago had a backlog of more than 500 cases. Officials of the prohibition unit complained in July that the law was being disregarded in the big cities, and that their force of 1,550 agents was inadequate to cope with the situation. The 9,500 illicit stills that were seized during the first six months were admittedly only a small fraction of those in operation.

The first group of sea captains to go into the business of smuggling liquor included such stalwarts as Capt. William McCoy, who had never been on the wrong side of the law before and took pride in having his cargo known as "the real McCoy." Only a few skippers of this type survived, for the agents with whom they had to deal had many ways of tricking them out of their cargoes, sometimes even taking these at gun point. The later recruits to the rum-running fleet were of the same breed as the gangsters with whom they did business. Many of them carried narcotics and illegal immigrants as a sideline.

A favourite rendezvous of the rum-running ships was a point opposite Atlantic City, N.J., just outside the three-mile limit beyond which the government lacked jurisdiction. They anchored in this area and discharged their loads into high-powered craft that were built to outrace coast guard cutters.

In May 1924 the U.S. authorities negotiated a treaty with Great Britain that permitted the halting and searching of ships within one hour's steaming distance from the coast. The bootleg fleet now made a practice of anchoring 20 mi. offshore. Some of the small boats making the run from this point were caught, and others dumped their cargoes overboard when the chase became too hot. However, profits were so great that the bootleggers could afford these occasional losses.

Smuggling became increasingly expensive when the coast guard began trailing the small boats with fast launches of its own. Most of the bootleggers now placed their reliance on the alchemy of the 1920s—a process in which industrial alcohol that had been more or less "washed" of noxious chemicals, plus tap water and colouring matter and perhaps a dash of real liquor for flavour, became a valuable commodity. In the big cities, thousands of bootleggers delivered such wares to the homes of their private clientele or to "speak-easies"—cellars, apartments and simulated business establishments. In these, guards watched from slots in the barred doors, admitting only those whose faces or credentials were familiar. In 1930 Mayor Fiorello LaGuardia of New York estimated that 22,000 speak-easies were operating in that city. Practically all of the traffic with these establishments came under gangster control.

The most notorious gangster of the era was "Al" Capone, who rose from the ranks of petty crime to a position of dominance in the bootleg traffic of Chicago. The New York market was shared by such underworld characters as "Waxey" Gordon, "Dutch" Schultz, and "Legs" Diamond. In the late 1920s, many of the New York night clubs came under the partial or complete ownership of veteran criminals of this type. These highly publicized gangsters, in turn, deferred to the authority of such behind-the-scenes manipulators as Arnold Rothstein and Frank Costello, who had powerful political connections.

Conditions in New York and Chicago were duplicated in many other communities. The Anti-Saloon League of Iowa stated in May 1925: "Dubuque boasts of 41,000 citizens and 1,000 bootleggers." Gradually local and intercity co-operation was practised by the bootleggers in their defense against hijackers and against honest enforcement agents. Underworld organization reached a high degree of efficiency, and was applied not only to bootlegging but to the narcotics traffic, gambling rackets, and organized prostitution and extortion.

In *The Wrecking of the Eighteenth Amendment* (1943), Ernest Gordon maintained that prohibition had the compliance of a great majority of citizens during the first years, and that widespread disrespect for the law developed only after it became known that federal officials were conniving with bootleggers. Those officials who were seriously trying to enforce prohibition met with steadily increasing frustrations. In 1921 they began to apply for court orders permitting the padlocking of premises that had been used for some phase of bootlegging. Many offenders simply moved to new places of business.

The small-scale bootlegger was usually not a gangster, although he could not have operated without paying tribute, directly or indirectly, to gangsters. To his customers he was a glamorous personality—a genial adventurer who was taking great risks in order to provide "stuff right off the boat." To eliminate this familiar character from the New York scene, according to Mayor LaGuardia, would require a force of 250,000 policemen—and a second force, almost as big, to watch the first. If this statement was an exaggeration, it was one that reflected the prevailing mood.

Repeal of the 18th amendment in Dec. 1933 left the states free to return to individual regulation. Some of the states permitted the sale of liquor only in government-operated package stores; others instituted local option or various other types of limitation. Wherever a restriction existed, bootleggers were ready to close the gap—and some of them operated even in nonprohibition areas, making huge profits by putting liquor of their own concoction into bottles bearing expertly counterfeited tax stamps and brand labels.

Although bootlegging is generally associated with the U.S., other nations have also encountered the problem. When the Soviet government came into power in Russia in 1917, the sale of vodka had been forbidden as a war measure, and the Communist regime continued the prohibition. However, bootlegging was widespread

until the government legalized vodka and took over its sale in 1925. Among other experiments in prohibition that stimulated bootlegging and were abandoned were those of Norway and Iceland.

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(J. Av.)

BOPP, FRANZ (1791–1867). German philologist, born at Mainz on Sept. 14, 1791, educated at Aschaffenburg in Bavaria. In 1812 he went to Paris to study Sanskrit. In 1816 he published, at Frankfurt am Main, *Über das Conjugationssystem der Sanskritsprache*. The object of Bopp's researches was to trace the common origin of the grammatical forms or inflections of Sanskrit, Persian, Greek, Latin and German, a task which had never before been attempted. By a historical analysis of those forms, as applied to the verb, he furnished the first trustworthy materials for a history of the languages compared.

Bopp visited London and brought out, in the *Annals of Oriental Literature* (London, 1820), an essay entitled, "Analytical Comparison of the Sanskrit, Greek, Latin and Teutonic Languages," in which he extended to all parts of the grammar what he had done in his first book for the verb alone.

In 1821 Bopp was appointed to the chair of Sanskrit and comparative grammar at Berlin, and was elected member of the Royal Prussian academy in the following year. He brought out, in 1827, his *Ausführliches Lehrgebäude der Sanskrita-Sprache*, on which he had been engaged since 1821. At the same time he compiled a Sanskrit and Latin glossary (1830) in which, more especially in the second and third editions (1847 and 1867), account was also taken of the cognate languages. His chief activity, however, centred on the elaboration of his *Comparative Grammar*, which appeared in six parts (1833–52) as *Vergleichende Grammatik des Sanskrit, Zend, Griechischen, Lateinischen, Litauischen, Altslawischen, Gothischen, und Deutschen*, Eng. trans. by E. B. Eastwick (1856). Two other essays (on the "Numerals," 1835) followed the publication of the first part of the *Comparative Grammar*. The Old Slavonian began to take its stand among the languages compared from the second part onward. A second German edition, thoroughly revised (1856–61), comprised also the Old Armenian. Bopp tried in his grammar to give a description of the original grammatical structure of the languages as deduced from their intercomparison, to trace their phonetic laws and especially to investigate the origin of their grammatical forms. He also wrote monographs on the vowel system in the Teutonic languages (1836), on the Celtic languages (1839), on the Old Prussian (1853), and Albanian languages (1854), on the accent in Sanskrit and Greek (1854), on the relationship of the Malayo-Polynesian with the Indo-European languages (1840) and on the Caucasian languages (1846). He died on Oct. 23, 1867, at Berlin.

See M. Bréal's translation of Bopp's *Vergleichende Grammatik* (1866), introduction; T. Benfey, *Geschichte der Sprachwissenschaft* (1869); A. Kuhn in *Unsere Zeit*, Neue Folge, iv, 1 (1868); Lefmann, *Franz Bopp* (1891–97).

BOQUERÓN, the largest department of Paraguay, occupies the heart of the Paraguayan Chaco. It is a region of scrub forest and grassland on a gently dipping plain of sand and clay debris swept eastward from the Andes, and is crossed by a network of unstable river courses. It has a humid, tropical climate. Although its area of 64,876 sq mi. makes it larger than England and Wales, its population was estimated to be only 45,234 in 1960. Quebracho, cut for hardwood and extraction of tannin, is exported by narrow-gauge railways to Puerto Sastre, Puerto Casado and Puerto Pinasco on the Paraguay river. Mariscal Estigarribia, the capital, is named after the general whose strategy in the Chaco War (1932–35) established Paraguayan sovereignty over the area, which was set up as a department in 1944. (G. J. B.)

BOR, a Yugoslav town, lies in eastern Serbia. Pop. (1961) 18,612. A French company began mining copper at Bor in 1904 and continued until 1944. The town is linked by a narrow-gauge railway with Zajecar and Paracin. It has its own power station, and there are a high school and a mining college. More than 3,000 persons are employed in mining and nearly 2,000 in other industries. (V. De.)

BORA: *see* WIND: *Local Winds*.

BORACITE, a mineral composed of magnesium, boron, oxygen and chlorine, which typically occurs as colourless or white crystals (often with a gray, yellow or greenish tinge) embedded in sedimentary deposits of anhydrite, gypsum and halite. A massive variety known as stassfurtite, however, is found as nodules in the carnallite and kainite layers of the salt deposits at Stassfurt, Ger., where it has been mined as a source of boron. The mineral was first observed in 1787 as small crystals, bounded on all sides by sharply defined faces, in the salt deposits in the district of Lüneburg, Ger.

Typical crystals are pseudo-isometric in external form, their internal structure being actually orthorhombic. Cubelike shapes predominate, the cube form being sometimes modified by the presence also, in different degrees of development, of dodecahedral or tetrahedral faces, or both. Heated above 265° C. the internal crystalline structure inverts relatively instantaneously to a truly isometric type; cooled below 265° C. it inverts back to the low-temperature orthorhombic form.

A ferrous variety (huysennite) is distinguished by the substitution of appreciable amounts of iron (up to 7% by weight) for magnesium, the colour then becoming dark green with increased iron content. The variation in density, from 2.91 to 3.10 for different crystals, has been attributed to the variation in their iron content. The hardness of boracite is 7 to 7.5 on Mohs' scale; its lustre is vitreous. Cleavage is generally presumed to be absent, although a poor cleavage parallel to the two (pseudo-isometric) tetrahedra is occasionally reported.

Boracite, which has the formula $Mg_3B_7O_{13}Cl$, is slowly but completely soluble in hydrochloric acid and even more slowly decomposed by water. Under the mineralogist's blowpipe it fuses readily to form a clear, yellowish bead, which becomes opaque white on cooling. Artificial crystals may be produced by cooling a fusion of magnesium oxide and boric acid in the presence of a great excess of magnesium chloride and sodium chloride.
(F. D. B.)

BORAGE, an herb (*Borago officinalis*) with bright blue flowers and hairy leaves and stem, grown as a potherb, medicinal and honey plant. It is used also in salads and as a flavouring in claret cup and other drinks to which it imparts a cool, cucumberlike bouquet. A native of the eastern Mediterranean region, borage has become naturalized in various parts of Europe, Great Britain and North America. *See* also BORAGINACEAE.

BORAGINACEAE, a family of plants, rough-haired annual or perennial herbs or, especially in the tropics, shrubs or trees. Few of the species of the Boraginaceae are widely known or have any special economic importance. The best-known members of the family are the garden heliotrope (*Heliotropium arborescens*, of coastal Peru) and the true forget-me-not (*Myosotis* species, chiefly European). Also garden plants, but less well known, are the Chinese forget-me-not (*Cynoglossum amabile*, from southwestern China), large-leaved forget-me-not (*Brunnera macrophylla*, of the Caucasus mountains), large-flowered bugloss (*Anchusa azurea*, of southern Europe), Bethlehem sage (*Pulmonaria saccharata*, of Europe) and the Virginia bluebell (*Mertensia virginica*, of eastern United States). The borage (*Borago officinalis*) is a European species with a long history as a folk medicine. It is sometimes used as a salad plant. The comfrey (*Symphytum asperrimum*), originally from southern Russia, is a nutritious cattle food and has been tested at various times as a possible forage crop.

These plants belong to the sympetalous section of the dicotyledons, and are a member of the series Tubiflorae. The leaves are generally alternate and usually entire. The inflorescence is a specialized one-sided cyme or, less commonly, in paniculate cluster. The scorpioid cyme of the herbaceous species is a special type that is common and well developed only in the related family Hydrophyllaceae. The corolla is white or blue, sometimes yellow or orange, but seldom red. It is usually regular and has a definite, short to very elongate, tube. The throat may be partially closed by five hairy areas or five faucal appendages.

PHOTOGRAPH, J. HORACE MCFARLAND CO.

FIG. 1.—FORGET-ME-NOT (MYOSOTIS PALUSTRIS)

The ovary, composed of two carpels, is seated on a ringlike nectary. In the woody tropical members of the family the fruit is usually drupelike, but among the herbaceous members the fruit is dry and usually four-parted, each of the lobes (known as nutlets) representing only one-half of a carpel. The style arises independently at the centre of the flower between the four lobes of the fruit, a very unusual position duplicated in only two other families, the Verbenaceae and Labiatae. The nutlets, small to large, are usually one-seeded. They vary in attachment and direction, surface or margin. The many very diverse types of fruit in the Boraginaceae provide useful characters in dividing the family into major groups and in distinguishing and defining its genera and species, many of both not being identifiable with precision when fruit is lacking.

PHOTOGRAPH, J. HORACE MCFARLAND CO.

FIG. 2.—BORAGE (BORAGO OFFICINALIS) SHOWING THE HAIRY LEAVES AND STEMS TYPICAL OF MANY MEMBERS OF THE BORAGINACEAE FAMILY

The family contains more than 1,800 species and 90 genera classified under four subfamilies. The least highly evolved members of the family belong to the subfamilies Cordioideae, Ehretioideae and Heliotropioideae, of which the most important genera are *Cordia*, *Ehretia*, *Tournefortia* and *Heliotropium*. These are predominantly trees and shrubs confined to the tropics, where they occur, not in the primeval forest, but chiefly in disturbed areas. The highly evolved members of the family and the majority of its species belong to the subfamily Boraginoideae. Most of these are herbs and range outside the tropics. They are represented by one or a few native species in practically every part of the temperate zone. Several even range north of the Arctic circle. The greatest variety of genera and the greatest concentration of species, however, occur chiefly in areas with semiarid or desert climate, especially the Mediterranean region, the near and middle east, the drier mountains and plateaus of northern India, eastern China and central Asia, and the drier parts of western America, particularly California and Chile. (I. M. J.)

BORAH, WILLIAM EDGAR (1865–1940), U.S. senator from Idaho for over 30 years, was born at Fairfield, Ill., June 29, 1865. His formal education was limited, terminating before the end of his freshman year at the University of Kansas, but as he was always a serious student and a prodigious reader, he continued his education to the end of his life. Admitted to the bar in 1889, he practised in Lyons, Kan., but soon moved to Boise, Ida., where in a few years he became a leading attorney and took an active part in Republican politics. In 1906 he won his first election to the U.S. senate. Re-elected five times by large majorities, he remained in the senate until his death (Jan. 19, 1940).

Senator Borah was in the lead in pushing the constitutional amendments for a national income tax and the popular election of senators and the statute to establish the children's bureau. He was successful in promoting reclamation legislation and was often active on other matters of interest to farmers. From 1924 to 1933 he was chairman of the senate committee on foreign relations. An individual performer rather than an expert in the arts of the conference room, his legislative record is less impressive than a senator of his intelligence and industry might have been expected to make. He was perhaps most widely known for his large part in preventing the United States from joining the League of Nations and World Court, and for his persistent advocacy of the recognition of the Soviet Union. His "God has made us neighbors; let justice make us friends" speeches in advocacy of a fair deal for Mexico during the "oil confiscation" controversy (1926–28) entitle him to a high place on the list of authors of the Good Neighbor policy. In the years of repression following World War I, he urged an amnesty for the war's political offenders. He maintained that free speech was the right of all men except those who counseled the immediate commission of crime or violation of law.

See Claudius O. Johnson, *Borah of Idaho* (1936). (C. O. J.)

BORAN: *see* GALLA.

BORÅS, a town of Sweden, in the *län* (county) of Älvsborg, 73 km. (45 mi.) E. of Göteborg by rail, is pleasantly situated on the Viskan river. Pop. (1960 est.) 66,457. It was founded in 1622 by King Gustavus Adolphus. The town has many old timber houses, a modern town hall (1957), a city hall and local museum. In the west of the town there are the *Ramnasjön* with bathing facilities, the *Ramnaparken* and the wooden Kinnarumma church with a curious painted ceiling. Based on the old domestic craft, the town has become the biggest centre of the textile and ready-made clothing industry in Sweden with cotton and woolen mills, dye works, hosiery factories and a textile school. Borås also is a rail and road junction.

BORAX, a colourless crystalline substance, found in major quantity in the salt deposits of California and also in Chile, Tibet, Peru and Canada. It has an alkaline taste and is moderately soluble in water. When heated borax foams vigorously, losing the water shown in its formula ($Na_2B_4O_7.10H_2O$), and melts to form a clear glass. Molten borax dissolves many metallic oxides or salts to form boron glasses, some of which have characteristic colours.

Borax is used for the removal of oxide slags in metallurgy and in welding or soldering, for the detection of metals and for the production of coloured glazes on pottery. It is an important ingredient in many glasses and in enamels for ironware. It also finds application as a soap supplement or water softener. The discovery of the role of boron in plant nutrition led to the extensive use of borax in fertilizers.

Major quantities of borax are found as tincal, $Na_2B_4O_7.10H_2O$, in the salt crusts of dry lakes, especially Searles lake in California. Brines from wells drilled through the crust average 1.51% $Na_2B_4O_7$, which is separated from other salts by selective crystallization. The mineral rasorite, $Na_2B_4O_7.4H_2O$, which occurs in great deposits near Kramer, Calif., also is a major source of borax. For many years prior to the 1930s, the chief supply of borax was obtained by treating the mineral colemanite, $Ca_2B_6O_{11}.5H_2O$ (*q.v.*), from Death Valley, Calif., with a solution of sodium carbonate. The insoluble calcium carbonate was removed and the borax crystallized after evaporation. During the decade 1930–40 this source was largely supplanted by rasorite and the Searles lake brines. About 90% of the world production of borate minerals comes from California and about 4% from Argentina, Chile, Turkey and Italy.

The common decahydrate form of borax is obtained as monoclinic prisms by crystallization from solution at ordinary temperatures. Above 60° C., the crystals which form are the octahedral pentahydrate, $Na_2B_4O_7.5H_2O$ ("Jewelers' borax"). Electrolysis of a borax solution, or treatment with hydrogen peroxide, yields sodium "perborate" (peroxyborate), $NaBO_3.4H_2O$, used as a bleaching or oxidizing agent. Although molten borax acts as an acid toward metal oxides, because of the excess of boron oxide in the formula (empirically $2NaBO_2.B_2O_3$), the aqueous solution is alkaline because of hydrolysis. The equilibrium constant of the reaction, $B_4O_7^{=} + HOH \rightleftarrows HB_4O_7^{-} + OH^-$, is 10^{-5}, a basicity comparable to that of ammonia or soda ash. Equilibriums among the various polyboric acids in solution permit the easy formation of borax by neutralization of boric acid; any metal ion forms the least soluble of its possible borates.

All polyborates of known structure contain the BO_3 unit, in which a boron atom is at the centre of an equilateral triangle outlined by three oxygen atoms. Such units share oxygen atoms to form condensed systems. Thus in pyroborates such as $Co_2B_2O_5$, the anion is $(O_2BOBO_2)^{4-}$; in $K_3B_3O_6$ there is a plane six-membered B_3O_3 ring; and $Ca(BO_2)_2$ contains an infinite BOBO chain. In potassium pentaborate, $KH_4B_5O_{10}.2H_2O$, two pyroborate ions share pairs of oxygen atoms with a central boron atom in a spiran (complex ester) situation. (A. B. Bg.)

BORDA, JEAN CHARLES DE (1733–1799), French mathematician and nautical astronomer, who was associated with J. B. J. Delambre and P. F. A. Méchain in the attempt to determine an arc of the meridian—the greater number of the instruments employed in the task being designed by him—was born at Dax in the Landes and died at Paris.

Entering the army at an early age Borda transferred later to the navy. In 1782 he was taken prisoner at sea by the English, but was immediately released on parole. He contributed a long series of valuable memoirs to the Academy of Sciences. His researches in hydrodynamics were highly useful for marine engineering, while the reflecting and repeating circles, as improved by him, were of great service in nautical astronomy.

BORDEAUX, a city and port of southwestern France, the capital of the *département* of Gironde, lies on the left or west bank of the Garonne, 24 km. (15 mi.) above its junction with the Dordogne and 96 km. (60 mi.) from its mouth, in a plain east of the wine-growing district of Médoc, 578 km. (359 mi.) S.S.W. of Paris. Pop. (1954) 250,306; with suburbs 415,763.

The Garonne (550–750 yd. wide), sweeping northward in a broad curve, separates the city proper from the suburb of La Bastide on the right bank. It is crossed by only one bridge for pedestrian and vehicular traffic, the early 19th-century Pont de Bordeaux, which is 1,534 ft. in length and has 17 arches, and by a railway bridge. From the Pont de Bordeaux, the view westward embraces a crescent of wide quays five miles long with a background of tall warehouses, factories and mansions. The streets and squares of the central portion of the city are symmetrically planned in the 18th-century manner. Outside this quarter, which contains most of the important buildings, the streets are narrow and quiet and bordered by the low white houses characteristic of Bordeaux.

The whole city is surrounded by a semicircle of boulevards, beyond which lie the suburbs of Le Bouscat, Caudéran, Mérignac, Talence and Bègles. In the 18th century the city lost its fortifications, but several of the old gateways remain.

Near the centre of Bordeaux is the Allées de Tourny, between which and the river is the Place des Quinconces. The latter, planted with plane trees, contains two huge statues, of Montaigne and Montesquieu, and terminates upon the quays with two rostral columns decorated with the prows of ships which serve as lighthouses. On its west side is a monument to the Girondist deputies proscribed under the convention in 1793. At its southwestern corner the Place des Quinconces opens into the Place de la Comédie, the heart of the city, which contains the Grand Théâtre (1775–80, restored in 1864 and 1881). The Rue Sainte Catherine enters the Place de la Comédie on the south. The Pont de Bordeaux is continued by the Cours Victor Hugo, leading to a square

BY COURTESY OF THE CITY OF BORDEAUX, PHOTO BY MARCO PILLOT

CHURCH OF STE. CROIX, BORDEAUX, BUILT IN THE 12TH AND 13TH CENTURIES

in which stands the cathedral of St. André with its richly decorated north and south façades. The Pey Berland bell tower, named after the archbishop of Bordeaux who erected it in the 15th century, is a separate building standing near the east end. The broad nave of the cathedral, begun in the 12th century, contrasts with the lofty 14th-century Gothic choir. Of the numerous other churches of Bordeaux the most notable are St. Seurin (dating from the 11th century), with a finely sculptured south door; Ste. Croix (12th and 13th centuries), which is remarkable for its romanesque façade; and St. Michel (14th and 16th centuries), which stands near the Quai des Salinières and has three sculptured portals. The bell tower of St. Michel (15th century) has the highest spire (357 ft.) in southern France and also stands apart from its church. The prefecture, the bourse and the customs house are all 18th-century buildings standing along the river bank south of the Place des Quinconces. The hôtel de ville, close to the cathedral, was formerly the archiepiscopal palace built in 1770–81 and restored in 1862. To the south are the law courts and the hospital of St. André (founded 1390) dating from the early 19th century. The Palais Gallien, which consists of remains of a Roman amphitheatre, is to the west of the public gardens, in which are palms and exotic plants, a botanical garden and a museum. The large Municipal stadium was built in 1939.

Bordeaux is the seat of an archbishop, the centre of an *académie* (educational division) and the seat of a court of appeal. A court of assizes is held there, and there are tribunals of first instance and of commerce, a council of trade arbitrators and a chamber of commerce. The university, southeast of the cathedral, was founded in 1441. The tomb of Montaigne is located there. There are several museums, chief among which is the Musée des Beaux Arts, a library with over 600,000 volumes, and numerous learned societies.

Commerce and Industry.—The trade of Bordeaux, one of the biggest of the French ports, is chiefly carried on by sea. Its port, eight miles long, is formed by the basin of the Garonne and divided into two by the Pont de Bordeaux. There are large marshal-

ing yards and two wet docks, and railways serve both banks of the river. Five ports below Bordeaux are administered by the city. The city trades chiefly with Great Britain, Spain, Argentina, Portugal and the United States. It is the centre of the trade in "Bordeaux" wines, and the wine cellars of the quays are one of its principal sights. Other important exports are brandy, fruit, walnuts, turpentine, chemicals, petroleum products and timber. The chief imports are coal, gasoline, pyrite, grain, oilseeds, sugar, coffee, tropical timbers and raw materials for chemicals.

A large fleet leaves annually for the codfisheries of Newfoundland and Iceland. Important industries are shipbuilding and marine engineering; warships as well as merchant vessels are constructed. Railway coaches are also built. The industries subsidiary to the wine trade, such as wine-mixing, cooperage and the making of bottles, corks, straw envelopes and wooden cases, employ many persons. Other works include chemicals, fruit and vegetable canning, brewing and distilling and tobacco processing.

Bordeaux is on the main railway line from Paris to Spain. Other lines run to Toulouse and Narbonne, Limoges, La Rochelle, Le Verdon, Blaye and Miramont. From the airport at Mérignac (10 km., 6 mi. W.) there are regular services to Paris and to other major cities in Europe and north Africa.

History.—The dry soil of Médoc attracted settlement as early as the Bronze Age and, at least since Roman times, Bordeaux has been a flourishing town and port, with connections particularly with Spain and Great Britain. As Burdigala it was the chief town of the Bituriges Vivisci. Under the Roman empire it became a commercial city and in the 4th century it was made the capital of Aquitania Secunda. Ausonius, a contemporary native writer, describes it as a square walled-city and one of the greatest educational centres of Gaul. It declined after the disintegration of the empire and did not recover until the 10th century. Along with the old French province of Guienne it belonged to the English from 1154 to 1453 and was for a time the seat of the court of Edward the Black Prince, whose son Richard was born in the city. Commerce developed between Bordeaux merchants and their fellow subjects in London, Hull, Exeter, Dartmouth, Bristol and Chester and various privileges were granted by the English as trade increased. The influence of Bordeaux increased still further when several neighbouring towns, *e.g.*, St. Emilion and Libourne, united in a federation under its leadership. The defeat of the English at the battle of Castillon in 1453 ended their domination in the province. The privileges of the city were at once curtailed and only partially restored under Louis XI, who organized the *parlement* of Guienne and the university. In 1548 the inhabitants rebelled against the salt tax.

The reformed religion found numerous adherents at Bordeaux, and after the massacre of St. Bartholomew's Day (*q.v.*) in Paris nearly 300 of its inhabitants lost their lives. The 17th century was a period of disturbance. The Fronde (*q.v.*) insurrection found great support among the populace. In the 18th century, a period of commercial and architectural activity for Bordeaux, the marquis de Tourny, *intendant* of Guienne, made the city a beautiful town with fine public and commercial buildings and squares. It was the headquarters of the Girondists during the Revolution and in the Reign of Terror suffered severely. (*See* GIRONDINS.) The city's commerce was much reduced under Napoleon I and this led it in 1814 to declare for the Bourbons. Louis XVIII afterward gave the title of duc de Bordeaux to his grandnephew.

After the coming of the railways, the great improvements to the port and the increase in trade with west Africa and South America led to increased prosperity. In 1870 the French government was transferred to Bordeaux from Tours on the approach of the Germans to the latter city, and the government was at Bordeaux when Paris was threatened by the Germans in Aug. 1914. In June 1940, during World War II, when a German advance became again a menace to Paris, the French government moved first to Tours and later to Bordeaux. There Premier Paul Reynaud led a minority in the government favouring "war to the finish." Among his supporters were Charles de Gaulle and Georges Mandel. Reynaud sent appeals for immediate help to the United States and Great Britain. He was overriden by the opposition, however, and resigned on June 16, two days after the Germans entered Paris. Bordeaux was severely bombed before its occupation by German troops and again, by the Allies, when it was an important German air and submarine base. The city was reoccupied, largely by French patriot forces, in Aug. 1944.

Since 1945 Bordeaux has continued to expand. New suburbs have been built, and with the surrounding districts the total population in 1960 was nearly 450,000 inhabitants.

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BORDEN, SIR FREDERICK WILLIAM (1847–1917), Canadian statesman, was born in Cornwallis, Nova Scotia, on May 14, 1847. He was educated at King's college, Windsor, and at Harvard medical school, and for some years practised medicine at Canning, Nova Scotia. In 1874 he was elected to the Canadian parliament as a Liberal member for King's county and, except for the years 1882–86, represented this constituency until his defeat in 1911. Borden served as minister of militia and defense in the Liberal administration from 1896 to 1911. Although he improved its standards of training and discipline, the militia remained unspecialized and poorly equipped. His department accepted greater responsibilities when Canada took over the administration of the naval establishments at Halifax and Esquimalt and undertook to build a Canadian navy. Mainly as a result of his insistence, the practice of appointing a British officer to command the Canadian militia was abandoned. Borden died at Toronto on Jan. 6, 1917.

(H. B. NE.)

BORDEN, GAIL (1801–1874), U.S. inventor who developed the first commercial method of condensing milk, was born in Norwich, N.Y., on Nov. 9, 1801. As a youth he helped survey the future city of Covington, Ky., taught school in southern Mississippi, and emigrated to Texas in 1829. There he prepared the first topographical map of Texas, helped write the first state constitution, was co-founder of the first permanent Texas newspaper and laid out the city of Houston.

Borden's chief interest, however, was invention. After unsuccessful experiments with other foods, including a meat biscuit which won a gold medal at the Great Council exhibition in London in 1851, he developed a condensed milk process, receiving U.S. and British patents in 1856. His invention received little notice until the Civil War focused attention on its advantages. By the time of his death in Borden, Tex., on Jan. 11, 1874, he was wealthy and had a reputation as a philanthropist. The dairy company founded by Borden and named after him has continued to expand and diversify.

See Joe B. Frantz, *Gail Borden, Dairyman to a Nation* (1951).

(J. B. Fz.)

BORDEN, SIR ROBERT LAIRD (1854–1937), Canadian prime minister during the World War I era, was born at Grand Pré, Nova Scotia, on June 26, 1854; his parents were of English and Scottish origin. He was educated at Acacia Villa seminary near his home. After two years as a teacher of classics and mathematics he took up the study of law and was called to the bar in 1878; four years later he became a junior partner in a leading Halifax legal firm, Graham, Tupper and Borden. Although his family was traditionally Liberal, Borden was alienated from the Liberal party by its campaign of 1886 for Nova Scotia's secession from Confederation and by its advocacy of unrestricted reciprocity with the United States in the election of 1891. He took no active part in politics until persuaded to contest a Halifax seat for the Conservatives in the federal election of 1896. He was successful and in 1901 agreed, reluctantly, to assume the leadership of the Conservative party, provided that he be relieved at the end of a year.

The first decade of the 20th century was a very difficult one for the Conservative party; it had held office for 18 years, prior to 1896, and had little experience of effective opposition; moreover, it now lacked colourful leaders of the stamp of John Macdonald and Charles Tupper, and a thorough rebuilding of the party was required. On the other hand, the Liberal party was

favoured by the leadership of the personally popular Wilfrid Laurier (*q.v.*) and by unprecedented national expansion and prosperity, and had a firm hold on the voters. Defeated in Halifax in the Liberal sweep of 1904, Borden was re-elected in 1905 in a by-election in Carleton, Ont. Re-elected in Carleton in 1908 and also winning Halifax, he chose to represent Halifax and continued to do so until 1917. He was returned as a member for King's, Nova Scotia, in 1917, which he represented until his retirement. Despite much internal criticism and some intrigue against his leadership, Borden persevered in his efforts to strengthen the party. A new platform adopted in 1907 emphasized civil service reform, public ownership of the telephone and telegraph, and imperial preferential trade. In 1911 the Conservatives were at last presented with an issue on which they could attack the Liberals decisively, when Laurier announced a reciprocity agreement with the United States. Although some of his followers at first thought that opposition to the agreement might be politically unwise, Borden had no doubts and soon united the party around this issue. He had the support of powerful manufacturing and railway interests who were averse to having their position in the Canadian economy disturbed; this group included a number of prominent Liberals in eastern Canada who bolted their party. The majority of the electors were persuaded that reciprocity was a threat to Canadian political independence, and in the election of 1911, which was fought mainly on this issue, they supported Borden in his rejection of the policy. The Conservatives made some gains in every section of the country, even in Quebec where they formed a loose alliance with the Nationalists under Henri Bourassa. Co-operation between the Conservatives and the Nationalists was short-lived, for the pro-British character of the Conservative party, whose strongest support came from Ontario, was fundamentally uncongenial to the French Canadians. During the long naval debate, Nationalist support for the Conservatives dwindled rapidly and ended when Borden introduced conscription.

Once in office, Borden proceeded to deal with a question which had been the second issue in the election—naval policy. Britain's attempt after 1909 to meet the challenge of a growing German navy and its desire to secure assistance from the dominions precipitated a vigorous debate on imperial relations in Canada. Borden rejected Laurier's plan for a separate Canadian navy as inadequate; his discussions with the committee on imperial defense in Britain during the summer of 1912 convinced him that Britain faced a defense crisis and that Canada must make an emergency contribution to the British navy. He proposed that Canada contribute $35,000,000 for the construction of three capital ships for Britain's naval forces, a measure which would not preclude the eventual building of a Canadian navy. At the same time he argued for the development of co-operative control of imperial foreign policy and defense in which the dominions would have a voice. Borden's naval bill was debated. Responding to the Liberal opposition's tactics, the government introduced rules for the application of closure to end debate. The senate's Liberal majority then rejected the measure. Borden did not reintroduce his bill and Canada entered World War I without a positive naval policy.

Borden directed the mobilization of Canada's resources in a war effort which was remarkable for a nation of 8,000,000 persons. It was characterized by rapid industrialization, a great extension of government activities, the institution of the income tax and the transformation of Canada from a debtor to a creditor nation. Although there were scandals connected with supplying the armed forces, and some public outcry against the large fortunes which were undoubtedly accumulated by some during the war, the program was carried forward creditably. By the early summer of 1917 Borden was convinced that the 500,000 men he had pledged to put into the fight could not be provided under the existing system of voluntary enlistment and that conscription of manpower was essential. He knew that this measure would be highly unpopular, not only in Quebec, but also among farmers and organized labour, although large sections of the population were demanding conscription as the only fair means of securing equality of sacrifice. Thus the dictates of political strategy and patriotism combined to convince Borden that the conscription issue must be removed from partisan politics. He invited Laurier to join a coalition in which the two parties would have equal representation; when this offer was rejected the government introduced a conscription bill which received the approval of the house of commons in July 1917; a minority of the Liberals supported the measure. Borden shortly renewed his efforts to form a coalition and his patience and diplomacy were rewarded in Oct. 1917, when representative Liberals from every section of the nation except Quebec entered a Union government which won the overwhelming approval of the electorate outside of Quebec in the election of Dec. 1917.

The conduct of so great a war effort inevitably raised complications in Canada's relations with Britain. Borden was irritated by the failure of British statesmen and military leaders to take him and his Canadian colleagues more fully into their confidence; at the same time he rejected any form of consultation which might involve imperial centralization during or after the war, and his views on this subject were embodied in Resolution IX of the imperial conference of 1917. These war-time difficulties were remedied to a considerable extent by the establishment of the imperial war cabinet and imperial war conference in 1917.

The war produced a marked increase in national feeling and Borden was an impressive spokesman for the new Canadian nationalism. At the end of the war he argued for, and won, separate status for Canada among the nations, similar to that enjoyed by the smaller independent powers. Thus Canada and the other dominions had representation in the British delegation at the Paris Peace conference of 1919. They signed the peace treaty and were granted separate representation in the League of Nations and the International Labour organization. Borden still believed that a common imperial foreign policy was desirable and possible; this was not the direction which subsequent developments took, but as one of the architects of dominion autonomy he had no essential quarrel with the later development of the British Commonwealth.

Borden was plagued by ill-health throughout the war and was forced to retire from public life in July 1920. Once free of the burdens of office his health was restored. He represented Canada at the Washington Disarmament conference of 1921, was chancellor of Queen's university, 1924–30, president of the League of Nations society, 1922, and president of the Canadian Historical association, 1931. He renewed his study of Canadian constitutional questions and published *Canadian Constitutional Studies* (1922) and *Canada in the Commonwealth* (1929). He died on June 10, 1937. His nephew, Henry Borden, edited the *Memoirs* which Borden had been preparing for some years, and they were published in 1938. *See* also CANADA: *History*. (M. E. P.)

BORDES, CHARLES (1863–1909), French composer, choirmaster and musicologist who played an important part in reviving Renaissance polyphonic choral music. Born at La Roche-Corbon, near Vouvray (Indre-et-Loire), May 12, 1863, he was a pupil of César Franck. In 1890 he became chapelmaster of St. Gervais, Paris, and made it the centre of the study and practice of 15th-, 16th- and 17th-century vocal music. With the organist Alexandre Guilmant and Vincent d'Indy, he founded (1894) the Schola Cantorum, a society that in 1896 became a school for church music with Bordes as professor. Its publication, *La Tribune de St. Gervais* (1895), became the main organ of French musicology. He also began publication of the *Anthologie des maîtres religieux primitifs*, which provided choral societies with invaluable material. By 1905 he had moved to Montpellier, where he started a provincial branch of the Schola Cantorum.

Also interested in folksong, Bordes toured the Basque country in 1889 to collect traditional melodies, 100 of which were published in *Archives de la tradition basque* (1889–90). As a composer, he achieved particular success with his songs. He also wrote piano music, sacred and secular choral works, a *Suite basque* for flute and strings, *Danses béarnaises* and a symphonic poem for orchestra. He died at Toulon, Nov. 8, 1909. (F. E. G.)

BORDET, JULES (1870–1961), Belgian physician and bacteriologist who won the Nobel prize for medicine in 1919 for his discoveries in immunology, was born at Soignies, June 13, 1870. In 1892 he graduated as doctor of medicine at the University of

Brussels. From 1894 to 1901 he worked at the Pasteur institute at Paris; then he returned to Brussels to found and direct a Pasteur institute for the province of Brabant. He was also appointed professor of bacteriology at the University of Brussels.

His early studies showed that human blood normally contains a group of chemical substances called "complement," alexin, cytase or end-body. He showed that complement is absorbed and made inactive, or "fixed," by the complexes formed when antigens unite with their specific antibodies. Thus if a foreign protein such as a disease germ has entered the blood stream of a person who has acquired antibodies as a result of immunization or previous exposure to the disease, then free complement will not be present in the blood or will be present in below-normal amounts. Complement fixation became the basis for the laboratory identification of many disease organisms, including those of syphilis, typhoid fever, tuberculosis and glanders.

Bordet also studied the formation of anaphylactic poisons and coagulin. He and Octave Gengou in 1906 isolated the bacillus later known as Bordetella pertussis and laid the basis for the generally accepted opinion that this organism causes whooping cough. He died in Brussels on April 6, 1961.

BORDIGHERA, a resort of Imperia province, region of Liguria, Italy, is on the coast of the Riviera di Ponente, with stony mountains rising to the northward, 5 km. (3 mi.) E.N.E. of Ventimiglia by road. Pop. (1957 est.) 9,861 (commune). Bordighera is a well-known winter resort with fine coast scenery and gardens. The Institute of Ligurian Studies, formerly Bicknell museum, contains a unique collection of the flora of the Riviera, and the English library contains about 25,000 volumes. Bordighera is on the main coastal railway from Genoa to Ventimiglia and France. Apart from tourism, there is a large export trade in flowers; Bordighera's gardens also supply palm branches for St. Peter's at Rome and other churches for Palm Sunday.

BORDONE, PARIS (1500–1571), Venetian painter of the Renaissance, who painted religious pictures, mythological scenes, allegories, nymphs, cupids and subjects from Ovid's fables, but excelled as a portraitist, was born at Treviso. He entered the *bottega* of Titian at an early age but did not spend many years there, according to Vasari, who knew him. He was invited to France either by Francis I in 1538 or by Francis II in 1559; he painted many portraits at the French court, though no trace of them is to be found in French collections, the two portraits at the Louvre being later acquisitions. He also is said to have visited Augsburg and worked for the Fuggers, probably in 1548.

His pictures are of unequal merit. They have a harmony of colour derived from Titian and a certain nobility of style, but his figures are sometimes coarse and not very penetrating. His principal historical painting, signed and dated 1540, is the "Fisherman and Doge" at the Venice academy. The National gallery, London, has a "Daphnis and Chloe" and a portrait of a lady.

Other important works are the "Madonna" in the Tadini gallery at Lovere, the "Adoration of the Shepherds" in the Duomo of Treviso, two mythological pictures at the Villa Borghese and the Doria palace in Rome, the "Chess Players" in Berlin, "Christ among the Doctors" in the Gardner museum at Boston and a "Baptism of Christ" in Washington, D.C. Bordone died in Venice on Jan. 19, 1571.

BORE, in physical geography, a high tidal wave occurring where incoming tidal water is forced into a narrow estuary or tidal river, causing the water to rise with a high, abrupt front; examples are found in the Amazon and Severn rivers and the Bay of Fundy. *See* also TIDES: *General Description of Phenomena.*

BOREAS, in Greek mythology, a personification of the north wind. He was said to have carried off the beautiful Oreithyia, a daughter of Erechtheus, king of Athens, when he found her leading the dance at a festival or gathering flowers on the banks of the Ilissus. He had before wooed her in vain and now carried her off to his home in Thrace, where they lived as king and queen of the winds and had two sons, Calais and Zetes (*q.v.*).

To show his friendliness for the Athenians, Boreas wrecked the fleet of Xerxes off the promontory of Sepias in Thessaly, in return for which they built him a sanctuary or altar near the Ilissus and held a festival (*Boreasmos*) in his honour.

In works of art Boreas was represented as bearded, powerful, draped against cold, and winged. On the Tower of the Winds at Athens he is figured holding a shell, such as is blown by Tritons. Boreas carrying off Oreithyia is the subject of a beautiful bronze relief in the British museum, also of many painted Greek vases.

BOREL, (FÉLIX ÉDOUARD JUSTIN) ÉMILE (1871–1956), French mathematician who made important contributions to several branches of analysis and to the theory of probability, was born on Jan. 7, 1871, at St. Affrique, Provence. After an appointment in the University of Lille (1893–96), the remainder of his professional life was passed in Paris at the Sorbonne and the École Normale.

As the creator of the first effective theory of the measure of sets of points he shares with his contemporaries R. Baire and H. Lebesgue the distinction of having launched the modern theory of functions of a real variable and, although not the first to define a conventional sum of a divergent series, he was the first to conceive and develop a systematic theory of such series. Following his discovery in 1896 of the so-called elementary proof of C. E. Picard's theorem, he created a theory of integral functions and the distribution of their values which largely dominated the theory of functions of a complex variable during the next 30 years.

His other achievements include his introduction of the notion of enumerable probabilities, thus inaugurating an important new chapter in that theory. He sat in the chamber of deputies (1924–36) and was minister of the navy (1925). He died in Paris on Feb. 3, 1956. (E. F. Co.)

BOREL, PETRUS (real name JOSEPH PIERRE BOREL, later BOREL D'HAUTÉRIVE) (1809–1859), French poet, novelist and critic, who called himself *le lycanthrope* ("the wolfman"). The most notorious of the young writers of the 1830s, he outlived his reputation, but his work foreshadowed and inspired Baudelaire. Born at Lyons, June 29, 1809, he was the 12th of an ironmonger's 14 children. After training as an architect, he turned to literature, becoming the most important member of *le petit Cénacle* (1829) and organizing *La Bataille d'Hernani* (1830). After the victory of the Romantics, he became leader of the eccentric and advanced writers known as *les Bousingos,* among whom were Gérard de Nerval and Théophile Gautier; with the classical revival his supremacy waned and he fell into extreme poverty. He tried to retrieve his fortunes with the horror novel *Madame Putiphar* (1839), but it failed, and he struggled to make a living by contributing to and himself founding several eccentric and unsuccessful journals. In 1847, through the influence of Gautier, he became *inspecteur de la colonisation* in Algeria. He was not successful, however, being proud, touchy and inefficient, and was dismissed in 1855. He had built himself a Gothic mansion at Mostaganem, and continued to live there, working on the land. Little remained of the daring leader of the 1830s, who had seemed to contemporaries like a Spanish grandee, but who now resembled a decrepit Don Quixote with unkempt gray beard and bald pate, dressed in rags. He died at Mostaganem, July 17, 1859.

His works, belonging to the period of horror and melodrama, include *Rhapsodies* (1832), a collection of poems showing originality in subject and treatment, which influenced the early Baudelaire; short stories, *Champavert, contes immoraux* (1833), which enjoyed a *succès de scandale* and had in it much of the Baudelairean mood; and the mistimed *Madame Putiphar,* with a prologue in verse which is his finest poem and foreshadows Baudelaire's spiritual style.

See A. Marie, *Petrus Borel* (1922); E. Starkie, *Petrus Borel en Algérie* (1950) and *Petrus Borel, the Lycanthrope* (1954). (E. St.)

BORELLI, GIOVANNI ALFONSO (1608–1679), Italian physiologist and physicist who was the first to explain muscular movement and other body functions according to the laws of statics and dynamics, was born at Naples on Jan. 28, 1608. He was appointed professor of mathematics at Messina in 1649 and at Pisa in 1656. In 1667 he returned to Messina but in 1674 went to Rome, where he lived under the protection of Christina, queen of Sweden, and died on Dec. 31, 1679. His best-known work is *De motu animalium* (1680–81), in which he sought to explain

the movements of the animal body on mechanical principles; he thus ranks as the founder of the iatrophysical school.

In a letter, *Del movimento della cometa apparsa il mese di decembre 1664,* published in 1665 under the pseudonym Pier Maria Mutoli, he was the first to suggest the idea of a parabolic path; and among his many astronomical works was *Theorica mediceorum planetarum ex causis physicis deducta* (1666), in which he considered the influence of attraction on the satellites of Jupiter.

BORENIUS, TANCRED (1885–1948), Finnish art historian, born July 14, 1885, at Vyborg (Wiborg), began his studies at Helsinki and went from there to Italy, where he laid the foundations of his profound knowledge of Italian painting. In 1914 he was appointed lecturer and in 1922 professor of the history of art at University college, London. When Finland became independent, he acted as secretary to the diplomatic mission (1918) and in 1919 was the temporary diplomatic representative of Finland in London. His works include *The Painters of Vicenza* (1909); *Catalogue of the Collections of Sir Frederick Cook,* vol. i, "Italian Schools" (1913); *Catalogue of Viscount Lee of Fareham's Collection* (1923); *Four Early Italian Engravers* (1923); *English Primitives* (1924); *Florentine Frescoes* (1930); catalogues of the collections of the earl of Harewood (1936) and Sir Robert Mond (1937); *English Painting in the XVIIIth Century* (1938); and *Field-Marshal Mannerheim* (1940). He died Sept. 2, 1948, near Salisbury.

BORGA: *see* Porvoo.

BORGERHOUT, a municipality and dormitory suburb on the eastern outskirts of Antwerp, Belg., from which it is separated by no distinguishable boundary. Pop. (1955 est.) 49,959. Originally a village lying between Antwerp and Deurne, its early history is mainly connected with the latter parish. It was occupied by German forces during World Wars I and II. In 1936 Borgerhout celebrated 100 years existence as an independent town of mainly Flemish character. It has bleaching and dye works and manufactures candles, tobacco and tapestries. Gallo-Roman burials (urn type) were discovered in the vicinity.

BORGHESE, a noble Italian family, of Sienese origin, which settled in Rome during the 16th century and quickly rose to distinction in wealth and property when Camillo Borghese was chosen pope in 1605, taking the title of Paul V.

Paul showed particular favour to his nephew, Marcantonio (d. 1658), whom he created prince of Vivaro and on whom Philip III of Spain conferred the title of prince of Sulmona. Marcantonio carried the family to an eminent place among the Roman nobility by his territorial acquisitions, by his marriage with Camilla Orsini and by the marriage of his son Paolo (d. 1646) with Olimpia, heiress of the Aldobrandini. Once established, the family preserved its position until the fall of the value of land as a result of the agricultural crisis in the 1890s.

In 1803 Camillo Filippo Ludovico, 6th Prince Borghese (1775–1832), married Marie Pauline, sister of Napoleon and widow of Gen. Jacques Leclerc (*see* Bonaparte). He was made duke of Guastalla in 1806 and acted as governor of the Piedmontese and Genoese provinces for a few years. He was induced to sell the great Borghese art collection to Napoleon but recovered part of it in 1815. The Borghese palace, one of the most magnificent buildings in Rome, contained a splendid gallery of pictures; most were transferred to the Villa Borghese outside the Porta del Popolo, now the property of the Italian government.

Bibliography.—A. von Reumont, *Geschichte der Stadt Rom,* vol. iii (1870); J. H. Douglas, *The Principal Noble Families of Rome* (1905); L. von Pastor, *History of the Popes From the Close of the Middle Ages,* vol. xxv, ch. 2 (1937); G. Borghesio, *Le grandi famiglie romane,* vol. 10, *I Borghese* (1954).

BORGIA, SAINT FRANCIS (Francisco de Borja y Aragón) (1510–1572), 4th duke of Gandía and third general of the Society of Jesus, was born in Gandía, Valencia, Spain, on Oct. 28, 1510. He was educated at Saragossa under his uncle, the archbishop Juan de Aragón. Presented to the court of Charles V in 1528, he married in 1529 Eleanor de Castro, a Portuguese noblewoman and childhood friend of the empress Isabel. After holding court appointments, in 1539 he was made viceroy of Catalonia, where he tried to carry out badly needed social and economic reforms. He resigned in 1543, when he succeeded to his father's dukedom.

After his wife's death in 1546, Borgia entered the Society of Jesus. He founded the Jesuit college in Gandía, which was made a university by papal bull in 1547. In 1550 he went to Rome, where he was received by St. Ignatius Loyola and his entry into the society was made public. Early in 1551 he returned to Spain, where he was ordained to the priesthood. He devoted himself to the religious and social improvement of Guipúzcoa. In 1552 the emperor recommended him to Pope Julius III for the cardinalate, a choice seconded by the pope and acceptable at first to Borgia but opposed by Loyola. The latter named him commissary general of the Spanish provinces in 1554, the appointment being renewed by Diego Laínez on his election as second general of the society in 1558. After Laínez' death in 1565 the second general congregation chose Borgia general of the order. His tenure of office was marked by the erection of new provinces and numerous colleges in Europe, the sending of the unsuccessful mission to Spanish Florida and the establishment of the provinces of Peru and New Spain. Internally he strengthened and formalized the institute of the order. His generalate coincided almost exactly with the reign of Pius V, whom he urged to adopt two important policies regarding the foreign missions: first, to centralize their government through a Roman congregation similar to the later Congregation for the Propagation of the Faith; second, to insist that the civil rulers treat the natives humanely in order to win them to the faith. In 1571 Pius V sent him to Spain, Portugal and France to strengthen the league against the Turks. He fell ill on the return journey, and died in Rome during the night of Sept. 30–Oct. 1, 1572. He was canonized in 1671, and his feast day is Oct. 10.

A selection of Borgia's letters was edited in *Monumenta historica societatis Jesu, S. Franciscus Borgia,* 5 vol. (1894–1911).

See C. Sommervogel, *Bibliothèque de la compagnie de Jésus,* vol. i (1890); P. Suau, *Histoire de S. François de Borgia* (1910); M. Yeo, *The Greatest of the Borgias* (1936). (E. J. Bs.)

BORGIA, CESARE (1475 or 1476–1507), known to 16th-century Italy as the Duca Valentino from his French title of duc de Valentinois, the Renaissance captain whose motto was *Aut Caesar aut nihil* ("Either Caesar or Nothing"), whose greatest real achievement was the execution of his father's temporal policy for the papal state, but who is also remembered both as his father's associate in bringing the church to the extreme of worldliness and as Niccolò Machiavelli's political hero. He was the second son of the Spanish cardinal Rodrigo Borgia (Borja), later pope as Alexander VI, and his Roman mistress Vannozza dei Catanei. Alexander VI made him archbishop of Valencia in 1492 and then cardinal, with the title of Santa Maria Nuova, in 1493. In June 1497, however, Cesare's elder brother Giovanni, duke of Gandía and of Benevento, was killed in mysterious circumstances (perhaps with Cesare's complicity); and in Aug. 1498 Cesare renounced his cardinalate and was released from holy orders to enter secular politics. The pope obtained for him the duchy of Valentinois from Louis XII of France in return for the annulment of that king's first marriage and a dispensation for his second. Having gone to France on this occasion (1498), Cesare in May 1499 married Charlotte d'Albret, sister of the king consort of Navarre. The pope then made him "gonfalonier and captain-general of the Holy Roman Church."

Alexander VI, with whose plans Cesare was always to be engaged, wanted to see his son established in a principality either in the kingdom of Naples or in papal territory. His designs on Naples were obstructed by the Aragonese dynasty there, but within the papal dominions he had good reason for taking action against his insubordinate vassals or temporal vicars in Romagna and in the Marche. Though Venetian hostility prevented the Borgias from profiting fully from their alliance with Louis XII, Cesare began the conquest of central Italy in order to carve a state for himself there. He took Imola in Dec. 1499, and Forlì and Forlimpopoli in Jan. 1500 and secured the submission of Cesena. Returning to Rome, he was in March 1500 made vicar of Romagna.

In July an attempt was made on the life of his sister Lucrezia's husband, Alfonso duke of Bisceglie, one of the last members of the Neapolitan house of Aragon, and in August the duke was murdered. Cesare's responsibility for this is clearly stated by the Venetian ambassador Paolo Cappello. Apart from the Borgias' designs on Naples, the crime served to set Lucrezia free for another political marriage, but it may have been simply an act of blind malevolence, like others of which the Borgias were accused.

Resuming his campaign in central Italy, Cesare took Rimini and Pesaro in Oct. 1500. At Pesaro, where the people were exasperated by Giovanni Sforza's tyranny, Cesare was welcomed as a liberator, and the great humanist Pandolfo Collenuccio was frankly on his side. In Faenza, however, which Cesare took, despite Venetian objections, in April 1501, the people were devoted to their *signore*, Astorre (Astorgio) Manfredi, who was taken to Rome and there, in Jan. 1502, foully murdered. Cesare meanwhile took the title of duke of Romagna. The peak of this policy of brutal aggression and duplicity was reached with the seizure of Urbino (June 2, 1502) and Camerino (July). Under the dynasties of Montefeltro and Varano these two duchies had been well administered and both moreover had regularly paid their dues to the papacy, so that the usual pretext that the pope found to justify his son's action could hardly be offered in this case. Venice and Florence were now directly threatened by the expansion of the Borgia duchy in Romagna and Val di Chiana. Both states accordingly sympathized with the conspiracy of La Magione (so called from the plotters' meeting place) in Oct. 1502. In this, some of Cesare's officers combined with certain *signori* in a plan to combat the growing power. Cesare, however, entered into relations with some of the conspirators individually and then succeeded in decoying four of them, Vitellozzo Vitelli, Oliverotto da Fermo, Paolo Orsini and Francesco Orsini, duke of Gravina, to Senigallia (Dec. 31, 1502), where he treacherously seized them. Vitellozzo and Oliverotto were killed at once, the Orsini some time afterward. This ruthlessness shocked even 16th-century Italy. Meanwhile in Rome the pope, feigning hostility to Cesare, subdued the remaining Orsini opposition and was preparing to desert the French alliance for the Spanish when he died suddenly on Aug. 18, 1503.

Alexander VI's death meant the ruin of Cesare, though by now he had recovered from the setback caused by the conspiracy of La Magione and had occupied Città di Castello, Perugia, Città della Pieve and some lands in the Siena region.

All the dispossessed despots of the Romagna raised their heads, and after Pius III's brief pontificate Giuliano della Rovere, a relative of the Montefeltro family of Urbino and the most implacable enemy of the Borgias, became pope as Julius II. At the same time the Venetians, whom Louis XII's attitude had hitherto prevented from resisting the rise of Cesare, began to seize lands in the Romagna. Cesare in vain implored the new pope to put him at the head of fresh troops to keep Romagna in subjection. Instead he was arrested (Nov. 1503). Released in April 1504, he went to Naples under a safe-conduct from the viceroy, Gonzalo de Córdoba, but in May the viceroy had him arrested on the order of the Spanish king Ferdinand of Aragon. After two years of captivity in Spain, first at Chinchilla, then at Medina del Campo, Cesare escaped in Oct. 1506 and took service with his brother-in-law, the king of Navarre. He was killed at the siege of Viana, in Navarre, on March 12, 1507.

Cesare has been wrongly praised as a great soldier, as a great statesman and as a great patron of the arts, and he was idealized by Niccolò Machiavelli in the seventh chapter of *Il Principe*. In fact he merely carried out his father's rapacious policy, in which "reasons of state" meant only dynastic aggrandisement and in which perfidy and assassination were the principal methods. Though many of the crimes popularly ascribed to the Borgias may be figments of morbid imagination, their playing off of France against Spain, their seizure of Urbino and their coup at Senigallia set an example of such turpitude in politics that the conduct of the Venetians stands out by contrast as especially praiseworthy.

As for his military qualities, Cesare contributed no new ideas either to strategy or to tactics; his conquests were largely the result of fifth-column activity and treason against his opponents; and his troops pillaged the cities that fell to them without any constraint from discipline. Contemporaries estimated his army at 15,000 men and his expenditure on it at 60,000 ducats per month (in 1510 the total revenue of the papal states was 350,000 ducats). To maintain these troops the Borgias could only resort to extortion, confiscation and simony: Alexander is said to have seized 100,000 ducats from the property of the victims of Senigallia, and in May 1503 he raised 50,000 by the sale of new church offices.

Apart from his having terrorized his subjects into silence, Cesare's fragile reputation for efficient government rests only on two actions: the killing, without trial, of Ramiro de Lorqua, who as his governor of the Romagna had accumulated on his own head all the hatred provoked by Borgia oppression; and the belated institution of the tribunal of the Rota in the Romagna.

Men of genius such as Leonardo da Vinci, Michelangelo, Pietro Torrigiano, Antonio da San Gallo, Pandolfo Collenuccio and, above all, Machiavelli are sometimes described as Cesare's protégés. Collenuccio was indeed closely attached to him, but for the most part Cesare's court was a conglomeration of insignificant people, with which Leonardo and Michelangelo had only occasional contacts. His relations with Machiavelli are of greater interest. In his *Legazioni* (the reports that he made to the Florentine government on his embassies to Cesare), Machiavelli shows him degraded and bewildered after Alexander's death, but in *Il Principe* he presents him as a man with a great mind and a noble aim. This portrayal gave rise to the myth of Cesare as a statesman whose ideal of a united Italy, or at least of a united central Italy, was frustrated only by an unlucky chance. In reality he was a political adventurer whom circumstances enabled to rely on France just as the despots of Romagna whom he overthrew had relied on Venice.

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BORGIA, LUCREZIA (1480–1519), by her last marriage duchess of Ferrara, was born at Subiaco in the papal state in April 1480, the daughter of the Spanish cardinal Rodrigo Borgia, later pope as Alexander VI, and his Roman mistress Vannozza dei Catanei. Though legend has associated her with her father and her brother Cesare in extremes of iniquity, she can in fact hardly be accused of more than resignation to their will.

Lucrezia's first betrothal (Feb. 1491), to the Spanish nobleman Cherubin de Centelles, was broken off within two months, when she was betrothed instead to another Spaniard, Gaspar de Aversa, count of Prócida. On becoming pope (Aug. 1492), her father planned greater things for her, the commitments with Gaspar were overruled and Lucrezia was married, in June 1493, to Giovanni Sforza, lord of Pesaro. At this moment Alexander VI was relying on the support of the Sforzas of Milan against the Aragonese dynasty of Naples. The subsequent political realignment, when the Milanese took the side of Charles VIII of France and the pope allied himself with the Neapolitans, alarmed Giovanni, who used every available pretext to absent himself from Rome, evaded military action on the Neapolitan side and corresponded with Milan (privately alleging incestuous relations between the pope and Lucrezia). Finally, in Dec. 1497, the marriage was annulled, on the grounds of nonconsummation. Lucrezia is thought to have given birth to a child by another man in March 1498.

In July 1498 Lucrezia was married to Alfonso of Aragon, duke of Bisceglie, an illegitimate son of Alfonso II of Naples. Next year, however, the papal-Neapolitan alliance, which this marriage was supposed to cement, collapsed when Alexander and Cesare came to an understanding with Louis XII of France, and in Aug.

1499 Alfonso fled from Rome. He returned with Lucrezia in October. Then, on July 15, 1500, as he was leaving the Vatican, he was attacked by assassins, and on Aug. 18, as he was recovering from his wounds, he was murdered in his house, apparently at Cesare's behest. Grief-stricken, Lucrezia retired for a time to Nepi.

Finally Alexander arranged Lucrezia's marriage to Alfonso d'Este, son of Ercole I, duke of Ferrara (Dec. 30, 1501). With Alexander's death in 1503 she ceased to be an instrument of policy. Alfonso succeeded his father as duke in 1505, and the court of Ferrara became a centre for poets, painters and humanists, including Ariosto, Titian, Dosso Dossi, Pietro Bembo and Aldus Manutius. Apart from the murder of the poet Ercole Strozzi in 1508, allegedly ordered by the duke in jealousy of Strozzi's attentions to her, the rest of Lucrezia's life was tranquil, being devoted to charitable works and to the education of her children. By Alfonso of Bisceglie she had one son, Rodrigo of Aragon (1499–1512). By Alfonso of Ferrara she had seven children: Alessandro (Sept.–Oct. 1505), Ercole II (1508–59), Ippolito (1509–72), Alessandro (1514–16), Leonora (1515–75), Francesco (1516–78) and Isabella Maria (June–Nov. 1519). Lucrezia died on June 24, 1519.

See M. Bellonci, *Lucrezia Borgia* (1939; abridged Eng. trans., 1953).

BORGLUM, (JOHN) GUTZON (DE LA MOTHE) (1867–1941), U.S. sculptor, created in the Mount Rushmore memorial in South Dakota colossal portrait sculptures. He was born of Danish parents near Bear Lake, Ida., March 25, 1867. His brother and pupil, Solon (1868–1922), was also a distinguished sculptor. After a boyhood schooling in Nebraska and at St. Mary's college, Xavier, Kan., Gutzon studied art in San Francisco, Calif., then in Paris at Julien's academy, 1890–93. Both his painting and his sculpture were admitted to the salon there. In England he received important commissions and royal recognition.

In 1901 Borglum established himself in New York city. A bronze group called "The Mares of Diomedes," showing a wild stampede, was the first piece of American sculpture bought for the Metropolitan Museum of Art, New York city. He poured forth with prodigal versatility such small bronzes as his "Dying Nero" and "Portrait of Ruskin"; such heroic figures as the twelve apostles for the Cathedral of Saint John the Divine, New York city, portrait statues of Lincoln, John P. Altgeld, Woodrow Wilson, Thomas Paine, two equestrian statues of Gen. Philip H. Sheridan, and many other civil and military figures; also memorial groups of soldiers and pioneers as well as figures from mythology and poetry. But his genius turned toward what his wife, Mary Montgomery Borglum, a scholar in cuneiform and other oriental lore, described as "the emotional value of volume." From a six-ton block of marble he executed the colossal head of Lincoln in the capitol rotunda at Washington, D.C. This suggested to southern women a similar head of Robert E. Lee. But Borglum was moved to begin instead a titanic procession of Lee and his staff and soldiers marching in the Stone mountain memorial (*q.v.*) in Georgia. Disputes stopped what might have proved one of the wonders of sculpture. He was then engaged on a government stipend to turn another mountain into a monument.

In the Mount Rushmore National memorial Borglum carved with sublimity the heads of Washington, Jefferson, Lincoln and Theodore Roosevelt. His engineering genius invented new methods. He died on March 6, 1941 in Chicago, Ill., leaving the last details to be completed by his son, Lincoln.

The patriotic exaltation that gave these huge works spiritual grandeur was also expressed in his exposures of corruption in airplane manufacture during World War I, and in ardent political activities. (Ru. H.; X.)

BORGOGNONE, AMBROGIO (Ambrogio di Stefano da Fossano) (*fl.* 1473–1524), Italian painter, who represented the tendencies of Lombard art anterior to the arrival of Leonardo da Vinci, was born at Fossano in Piedmont. He was approximately contemporary with Leonardo, but represented, at least during a great part of his career, the tendencies of his predecessors Vincenzo Foppa and Bernardino Zenale, which he had adopted and perfected. His fame is principally associated with that of one great building, the Certosa, at Pavia. He seems to have lived there from 1486 to 1494, when he returned to Milan. Only one known picture, an altarpiece at the church of S. Eustorgio Milan, can with probability be assigned to a period of his career earlier than 1486.

For two years after his return to Milan Borgognone worked at the church of S. Satiro in that city. From 1497 he was engaged for some time in decorating with paintings the Church of the Incoronata in the neighbouring town of Lodi. In 1508 he painted for a church in Bergamo; in 1512 his signature appears in a public document of Milan; in 1524—and this is the last authentic record—he painted a series of frescoes in the portico of S. Simpliciano at Milan illustrating the life of St. Sisinius.

The National gallery, London, has two fair examples of Borgognone's work. His serenity and conservatism are salient characteristics of his work.

BORGU (Borgou), an inland region of west Africa, included partly in Dahomey and partly in Nigeria, and bounded northeast and east by the Niger, south by the Yoruba country and northwest by Gurma country. Its name probably comes from the aquatic grass called *borgu*, a valuable cattle food. The pagan Negro tribes of the region were formerly dependent mainly on the sultan of Borgu (resident at Nikki) and the chief of Bussa. In 1894 Borgu was the subject of a territorial dispute between France and Great Britain until the convention of 1898 declared the western part French and the eastern British. (J. D.)

BORIC ACID, known also as boracic acid, a water-soluble, white crystalline substance found in trace quantities throughout the living and inanimate world and concentrated in certain minerals. It is a mild antiseptic used in salves and bandages for burns and wounds and especially in eye lotions. It stops the growth of some microorganisms (notably fungi), but is tolerated by others; for the latter reason and because of its poisonous effects its use as a preservative in foods and cosmetics has been generally prohibited or discouraged. Fabrics impregnated with boric acid become resistant to fire; it also protects wood against friction (as on dance floors) and against the effects of bacteria and weather. It is used in solutions for electroplating nickel and as an ingredient in catalysts for numerous organic chemical reactions.

The discovery of boric acid is credited to W. Homberg (1702), who made it by the action of sulfuric acid on borax (*q.v.*) and called it *sal sedativum*. It forms leaflike laminar crystals of triclinic structure, soft and soapy to the touch and having a pearly lustre. The molecular formula is H_3BO_3.

For many years the chief commercial source of boric acid was the volcanic waters (hot springs, steam jets or *soffioni* and muddy lagoons) in Tuscany, Italy, where the natural heat was more than adequate for the concentration of the very dilute (less than 0.1%) solutions by evaporation. With increasing demand, more of it was obtained by the action of sulfuric acid on borax. The solubility of boric acid in water at 0° C. is 2.6%; at 107° C., 37%. It may therefore be purified by recrystallization and, because of its volatility, by distillation in a current of steam, the boric acid constituting 2.8% of the saturated vapour.

Upon heating, boric acid partially vaporizes and loses water to form metaboric acid (HBO_2) and finally boron oxide (B_2O_3). Boron oxide forms mixed oxides with silica and if added to glass in proportions up to 12% improves the working qualities, durability, insolubility and resistance to crystallization. It is a constituent of the heat-resistant borosilicate glasses such as Pyrex. The use of boric acid and its salts as fluxing ingredients in glazes for crockery dates back to ancient times.

Intermediate polyboric acids are not definitely recognizable, although their salts are known; on the other hand true salts of boric acid are not known. Most of the metaborate and polyborate salts except those of nitrogen bases or alkali metals are nearly insoluble. The glassy boron oxide, known also as boric anhydride, can be combined with other oxides to form mixed anhydrides of the type $(RCO_2)_3B$ or mixed oxides such as $ScBO_3$, B_2SO_6, $B_2S_2O_9$, BPO_4 and $BAsO_4$. The so-called boron phosphate and arsenate are structurally like some forms of silicon dioxide, and have similarly high melting points.

Boric acid is recognized chemically by its action upon curcumin

(turmeric yellow) to give a bright red colour. A slight trace of a volatile boron compound imparts a green colour to a flame.

The acidity of boric acid is too weak for complete reddening of litmus, and its titration by a strong base is not feasible. However, the titration becomes quite satisfactory if a polyhydroxyl organic compound, such as mannitol, glycerol or certain sugars, is used to increase the acidic ionization. This effect, which is the basis of the usual method of quantitative analysis for boron, is ascribed to the formation of complex esters called spirans. Evidence for such structures was found by the preparation of an asymmetric spiran and the separation of its optical isomers (J. Boeseken and J. A. Mijs, 1925). Similar spiran structures may occur in the polyboric acids which are thought to be present with boric acid in concentrated solutions, accounting for abnormally high acidity in such solutions. Spiran formation also occurs when boric acid is used to enhance the acidity of leather-tanning agents.

The formation of borospirans by many sugars may help to explain the beneficial effects of boric acid upon the germination, growth and yield of many plants (H. Agulhon, 1910). Most plants require at least 0.2 mg. of boron per litre of nutrient solution (or per 10 kg. of soil); without it there is little transport of sugars from the leaves, and growth is seriously hindered.

The seed itself often contains enough boric acid for a start, but boron-deficiency symptons (dry rot, stunted growth or sterility) appear later and are cured only by the addition of boric acid or borax to the soil or stem. Too much boron (10–100 mg. per litre) is toxic to plants, although some species develop tolerance during growth.

Numerous volatile esters of the type formula $B(OR)_3$ may be made by the reactions of alcohols with boron oxide, or with boric acid in the presence of sulfuric acid. Such esters react with Grignard reagents, RMgX, and with proper control of conditions organic boric acids of the type $RB(OH)_2$ may be obtained. Some of these compounds, especially the derivatives of phenylboronic acid, $C_6H_5B(OH)_2$, have been suggested for use as antiseptics. All such compounds easily lose water to form anhydrides of the type $(RBO)_3$, in the structure of which boron and oxygen atoms alternate to form a six-atomic ring analogous to the B_3N_3 ring in borazole (*see* Boron). The same B_3O_3 ring is found in potassium metaborate.

For a bibliography, *see* Boron. (A. B. Bc.; X.)

BORIDES, a class of hard substances in which boron (*q.v.*) is chemically combined with various metals, usually forming crystal structures of the metallic type (*see* Metals). The chemical formulas are governed by the possible structural patterns rather than by any simple rules of valence (*see* Alloys); indeed, some borides have slightly variable compositions because of systematic defects of structure. The structural types range from those in which the boron atoms are separately imbedded in lattices formed of metal atoms through boron chain, ribbon and layer structures to the class in which the metal atoms are isolated within boron lattices. The borides usually are harder, higher melting, chemically less reactive and electrically more resistant than the corresponding pure metallic elements; such enhancement of properties is slight for the isolated-boron type, but increases sharply for more and more complex boron patterns. Some of the borides are among the hardest and most heat-resistant of all known substances, and find important uses based upon these extreme characteristics.

Preparation.—Most of the borides can be made by direct union of the elements or by reactions involving boron oxide (*see* Boron; Boric Acid) with a metal oxide or salt and a strong reducing agent such as an active metal. The temperatures required for such reactions range from 1,000° to 2,000° C., and it is expedient to employ an electric furnace of the carbon-arc or the induction type, with an inert gas to protect the charge against oxidation.

Borides can also be made by electrolysis of molten mixtures of boron oxide with metal oxides, often with some added fluoride, at 1,000° to 1,200° C. (J. L. Andrieux, 1929). All known borides of the formula type MB_6 have been made by this method, as well as the MB_2 borides of Ti, Zr, V, Nb, Ta, Cr, Mo and W, and certain of the MB type as well. Finely powdered boron is usually present in the product, but can be removed by a careful treatment with nitric acid, toward which the crystalline boride is often almost inert.

K. Moers (1931) made crystalline wires of borides of titanium, zirconium, hafnium and vanadium by mixing the vapour of a volatile halide of the metal with hydrogen and boron bromide and leading the mixture across a glowing metal filament of diameter 0.05 mm. The boride built up on the filament, which was afterward dissolved. The products were of low-boron types, having electrical resistances almost as low as the metals themselves. The zirconium boride, in fact, became superconducting below 3.0° K.

Probably the longest-known and most easily made of all borides is the compound AlB_{12}, a dull-metallic crystalline material which was long mistaken for boron itself. It is made from metallic aluminum and boron oxide, with sulfur present to raise the temperature by reaction with the excess metal. It is extremely hard and chemically unreactive, but can be converted to the far more reactive AlB_2 by heating with aluminum.

Structure and Properties.—Investigations of metal boride structures by X-ray methods (*see* Crystallography), summarized at an early stage by G. Hägg (1929) and at a more advanced stage by R. Kiessling (1950), show a definite series of types to which most borides conform. In the tetragonal borides of formula type M_2B, the metal atoms form layers of packed tetrahedrons, leaving holes wherein each isolated boron atom is uniformly surrounded by eight metal atoms. In such borides of Ta, W, Mo, Mn, Fe, Co and Ni, the radii of the holes range from 1.11 to 0.96 Å, always far larger than any reasonable radius for the boron atom, and permitting a structural looseness which accounts for the relative softness of these borides. In the MB-type borides, the metal atoms form triangular prisms which pack together in any of three different ways, resulting in three types: (1) MnB, FeB, CoB; (2) MoB, WB; (3) NbB, TaB, CrB—in each of which there is a boron atom at each prism centre.

The boron atoms form infinite zigzag chains, with B-B bond distances greater than would be expected of regular single bonds; the valence electrons of boron evidently are shared liberally with the metal lattice. One of these borides, MnB, is reported to be ferromagnetic, with a Curie point of 300° C. Nickel boride has a hardness below 8 Mohs.

In the borides Nb_3B_4, Ta_3B_4, Mn_3B_4 and Cr_3B_4 pairs of parallel boron chains, lacing through triangular prisms of metal atoms, are cross-linked through alternate boron atoms in each chain by B-B double bonds, forming ribbons of hexagonal rings embedded in the metal lattices. At this stage of organization of boron, the hardness increases sharply, but some of the metal softness persists.

Graphitelike sheets of boron atoms, forming alternate-layer structures with metals, are found in the hard but chemically reactive AlB_2 and MgB_2 and in the more refractory MB_2 compounds of Ti, Zr, V, Nb, Ta, Cr, Mo and possibly W. Here the B-B distances, in the hexagonal-ring mosaic planes, are abnormally long, indicating true participation of boron in the electron-deficient metallic bonding. The compounds Mo_2B_5 and W_2B_5 have similar boron planes.

The hardest and least metallic of the borides are those of the boron-lattice types, of which the MB_6 variety offers the greatest number of examples. In these, the boron atoms pack together in groups of six, forming regular octahedrons which join together at their vertices to form an infinite cubic array. This lattice provides truncated-cubic holes in which any of the metals Ca, Sr, Ba, Y, La, Ce, Pr, Nd, Gd, Er, Yb and Th can be placed, with 24 equidistant boron neighbours.

In UB_{12} each uranium atom also has 24 equal boron neighbours, at the vertices of a cubically truncated octahedron. In C_3B_{12}, known as boron carbide, regular icosahedral B_{12} units alternate with linear C_3 units in a simple cubic lattice. All of these borides are nearly as hard as diamond and almost as electrically resistant as boron itself. Boron carbide (*see* Carbides) has been used to make mortars for grinding especially hard materials, such as emery.

Calcium boride has been used as an additive to steel, in which it acts at high temperatures to convert oxides to a borate slag. For making very hard machine tools, TaB_2, Mo_3B_4 or WB_2 in powder form may be mixed with 3% to 15% of iron, cobalt or nickel and sintered into durable form.

Chromium borides may be used in a similar manner, or employed directly as abrasives. Some borides have such high melting points and such resistance to oxidation as to make them interesting for use in high-temperature equipment.

Borides of Be, Mg, Al, Ce, Mn, Fe and Ni have been reported to react with aqueous acids, forming boron hydrides (*q.v.*) in small yields. Magnesium boride reacts vigorously with water, yielding hydrogen and solutions of strong reducing agents (M. W. Travers, 1913). By treatment of such solutions with potassium hydroxide, R. C. Ray was able to isolate the dry salts $K_2B_4O_6$, $K_2H_4B_2O_2$ (two isomers), $K_4H_2B_2O_2$ and $K_2H_2B_2O_2$, in all of which it would appear that B-B bonded units must occur.

(A. B. Bg.)

BORING (MINING): *see* Drilling Machinery.

BORIS: *see* Godunov, Boris Fedorovich.

BORIS I (d. 903), Bulgarian tsar, succeeded his father, Pressian (or Presiam), in 852. Some territorial gains that he made in Macedonia were of far less importance in Bulgaria's history than his adoption of Christianity as the state religion and of Slavonic as the official language. While his own conversion to Christianity sprang from a genuine leaning toward a pious and austere life, he also found in the Christian faith a potent means of unifying the Bulgars and the Slavs, over whom he ruled, as well as an effective device for curbing the arrogance of the boyars. Moreover, during the long struggle between the papacy and the Byzantines for spiritual ascendancy over the Balkans, Boris tried to secure every possible advantage by negotiating with both contenders in turn. His final choice of the Orthodox Church drew Bulgaria spiritually and politically away from central Europe for centuries.

Abandoning his alliance with Louis the German, Boris made a treaty with the Byzantine emperor Michael III and was baptized in 865, compelling his people to follow suit, in spite of fierce opposition from the boyars. Constantinople, however, did not grant Boris his wish for a truly independent national church, and in 866 he turned to Rome and obtained Pope Nicolas I's promise to appoint a patriarch to the Bulgarian Church. As the appointment was delayed, Boris changed his mind again and, at the Council of Constantinople, in 870, finally chose the Orthodox Church. Having achieved his ambitions, he abdicated in favour of his eldest son, Vladimir, in 889 and retired to spend the rest of his life in a monastery. Vladimir, however, proved a bad ruler, and Boris returned to active life to depose him, to have him blinded and to put his youngest son, Simeon, on the throne instead (893). He then went back to his monastery, where he died in odour of sanctity in 903. He was canonized a saint in the Orthodox Church and his feast is celebrated on May 15 (new style; May 2 old style).

(N. I. M.)

BORIS III (1894–1943), king of Bulgaria, born at Sofia on Jan. 30, 1894, the eldest son of Ferdinand I of Bulgaria and Maria Luisa of Bourbon-Parma, received at birth the title of prince of Trnovo. In 1896 his religion was changed, for political reasons, from Roman Catholic to Orthodox. He was educated at the military academy of Sofia and served in the two Balkan wars and in World War I. When Ferdinand abdicated Boris succeeded him on Oct. 4, 1918.

At the beginning of the reign, political power was in the hands of Aleksandr Stamboliski and the Agrarian party, which was greatly strengthened by its consistent opposition to the war. With tact and patience Boris won the peasants' confidence, but they resented his passive acceptance of Aleksandr Tsankov's regime after the overthrow of Stamboliski; the left wing of the Agrarian party joined hands with the Communists in the bloody risings of Sept. 1923 and in the attempts on Boris' life in 1925.

Boris eventually got rid of Tsankov and restored constitutional government; but this came to an abrupt end through the Military league's coup d'état on May 19, 1934. The leaders of the conspiracy were republicans, and though Boris accepted the change without resistance, his position became critical. A warning by Great Britain, conveyed verbally to the cabinet, saved the monarchy. In blunting the edge of the officers' rule Boris played his hand less inconspicuously than he had in the removal of Tsankov. His part in the conduct of affairs, particularly foreign affairs, became henceforth more strongly felt.

Up to the outbreak of World War II, Boris used all his pliancy to avoid committing himself either to the Axis or to the Allies. In March 1941, however, he sent his prime minister to sign the Axis pact; German troops were given free hand in Bulgaria. In Dec. 1941 Boris authorized his government to declare war on Great Britain and its allies—in his own admission his worst mistake. He did, however, consistently refuse to take up arms against the U.S.S.R., mistakenly hoping that Bulgaria might earn some remission on this account when the reckoning came.

Boris died on Aug. 28, 1943, shortly after a stormy interview with Hitler. Whether his death was caused by a heart attack or by assassination was uncertain. He was succeeded by the six-year-old Simeon II, son of his marriage (1930) with Giovanna, daughter of Victor Emmanuel III of Italy. (N. I. M.)

BORISOV, a town of Minsk *oblast* of the Belorussian Soviet Socialist Republic, U.S.S.R., stands on the Berezina at its confluence with the Skha. Pop. (1959) 59,280. Founded in the 12th century, Borisov has always been an important centre of routes and trade. There the Moscow-Warsaw railway and highway cross the navigable Berezina. Borisov was occupied by the Germans in World War II. It is a major timber-working centre, producing saw-timber, matches, paper, furniture, veneer, parquet, wood chemicals and pianos. Glass-, enamel- and zincware and cranes are also manufactured. "New" Borisov on the right bank, where most industries are located, has far outstripped in size the old town across the river. (R. A. F.)

BORKU (Borgu), a region of the Republic of Chad (*q.v.*), Africa, lies between latitude 17° and 19° N., and longitude 18° and 21° E. The northern valleys are inhabited by a settled population of Tibbu stock, the Daza, who merge to the south with Negroid peoples. The nomadic and seminomadic population consists of Tedas, Nakazzas, Arabs and Berbers from the north, particularly the Ouled Slimans.

Borku (also called Borgu but not to be confused with Borgu region in Nigeria) was important because of the lucrative trade, particularly in slaves, carried on through Borku between Cyrenaica and central Africa. Formerly a vassal state of Wadai (*q.v.*), an Anglo-French agreement (1899) gave Borku to France, but Senusi control over the region (Fr. Borkou) was not broken until 1913–14.

(J. G. W.; J. D. F.)

BORN, IGNAZ, Edler von (1742–1791), Austrian mineralogist and metallurgist, was born of a noble family at Karlsburg (Alba Iulia), in Transylvania, on Dec. 26, 1742, and died at Vienna, July 24, 1791. In 1776 he was appointed by Maria Theresa to arrange the imperial museum at Vienna, where he was nominated to the council of mines and the mint, and continued to reside there until his death. He introduced a method of extracting metals by amalgamation (*Uber das Anquicken der Erze*, 1786) and other improvements in mining and technical processes. His publications also include *Lithophylacium Bornianum* (1772–75) and *Bergbaukunde* (1789).

BORN, MAX (1882–), German physicist, was awarded, with Walther Bothe (*q.v.*), the 1954 Nobel prize for physics for his statistical studies on wave functions. He was born in Breslau on Dec. 11, 1882. He was educated in the universities of Breslau, Heidelberg, Zürich and Göttingen, from the last of which he received his doctorate of philosophy in 1907. After teaching and research at Göttingen, Berlin and Frankfurt am Main, he was elected professor of theoretical physics at Göttingen in 1921. In 1933 he took refuge in Great Britain, and taught in Cambridge. He was elected to the Tait chair of natural philosophy in the University of Edinburgh in 1936 and retired in 1953. He became a British subject in 1939. His work on wave functions led to the replacement of the original quantum theory, in which electrons were regarded as particles, by an essentially mathematical description rep-

resenting more accurately the observed behaviour of the electrons. Born also applied the perturbation theory to problems of scattering; he shared in the formulation of the Born-Oppenheimer theory of molecules; and he contributed to the study of crystallography and to the kinetic theory of fluids. He was elected a fellow of the Royal society in 1939. (D. McK.)

BÖRNE, LUDWIG (1786–1837), German political journalist and satirist of radical views, was born Juda Löw Baruch on May 6 or 24, 1786, at Frankfurt am Main. After studying first medicine and later public administration at the universities of Halle, Heidelberg and Giessen, he became police actuary at Frankfurt in 1811 under the new freedom accorded to Jews; but when the earlier restrictions were restored in 1815 he was dismissed. In 1818 he changed his name to Börne and became a Lutheran, partly to avoid prejudicing his journalistic ventures. Of these the periodical *Die Waage* (1818–21) was notable for its disguised radicalism and for the social awareness of Börne's dramatic criticism, but trouble with the authorities, coupled with ill-health, led to his partial withdrawal from journalism between 1822 and 1830. A supporter of the July Revolution, he settled in Paris in 1830 and, though soon disillusioned, mediated French liberal ideas through his *Briefe aus Paris* (1830–34). He died there on Feb. 12, 1837. Börne gave journalism in Germany a new subjectivity and intensity; his style, witty, epigrammatic and at times savage, is at its most typical in *Menzel, der Franzosenfresser* (1837). He and Heinrich Heine are often regarded as the forerunners of the Young German movement (*see* GERMAN LITERATURE), though they were personally at odds.

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BORNEO, one of the great islands of the world, lies southeast of the Malay peninsula between 7° N. and 4° 20′ S., 108° 53′ W. and 119° 22′ E. Roughly kidney-shaped, very mountainous, largely covered in dense rain forest and sparsely populated (by Asian standards), it is 830 mi. long from northeast to southwest, with a maximum breadth of 600 mi. Its area is 288,150 sq.mi.—about five times as large as England and Wales.

Politically Borneo is divided in two. By far the larger part is Indonesian (until 1949 Dutch), known as Kalimantan. Along the west coast and northern tip are three territories within the Commonwealth of Nations: Sabah (North Borneo) and Sarawak, which in 1963 joined the Malaysia (*q.v.*) federation, and between these the British-protected sultanate of Brunei. (*See* SABAH; BRUNEI; SARAWAK; INDONESIA, REPUBLIC OF.) There are many variations in social and political structure, racial and religious grouping, within these four countries; and in the early 1960s reliable information was not available for Kalimantan, where no accurate census had been taken since before World War II (see *Population* below).

This article is divided into the following sections:

I. Physical Geography
1. Geology
2. Relief and Drainage
3. Climate
4. Vegetation
5. Animal Life
II. Natural Resources
1. Water Resources
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3. Mineral Resources
4. Land Use
III. The People
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IV. Archaeology
V. History
1. Early History
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3. British Influence
4. Mid-20th Century
VI. Population

I. PHYSICAL GEOGRAPHY

1. Geology.—The geology of Borneo is still imperfectly known. Extensive advances were being made, however, in the 1960s through the technical explorations of the Shell Petroleum company and its subsidiaries and the British Borneo Geological survey in Sabah, Brunei and Sarawak. These researches were of necessity largely directed toward immediate practical problems. Much of the research has taken place on the coastal plain (which carries the major population and production potential), where it was discovered that there was an absence of really hard rock in reasonably accessible places. It was only after the Japanese occupation of World War II that good supplies of quarrying stone, road-surfacing material and fill were discovered—including a previously unrecognized stratum of granite at Sebuyau in southwest Sarawak and a very hard limestone at Batu Gading on the Baram river.

Until recently, the general conception of Borneo's geology has been largely one of a great island of sandstone with some other deposits and a few igneous areas, mostly in the extreme south-southwest. It was not until the 1950s that extensive new outcrops of igneous rock were first encountered in the far interior: the Usun Apau plateau, in the far headwaters of the Rajang river of Sarawak, and the 6,600-ft. Hose mountains, the very existence of which had previously been in doubt. The most striking topographical feature in the island, Mt. Kinabalu, rises to more than 13,000 ft. in a great tangle of jagged peaks of bare, black granite (see *Relief and Drainage* below).

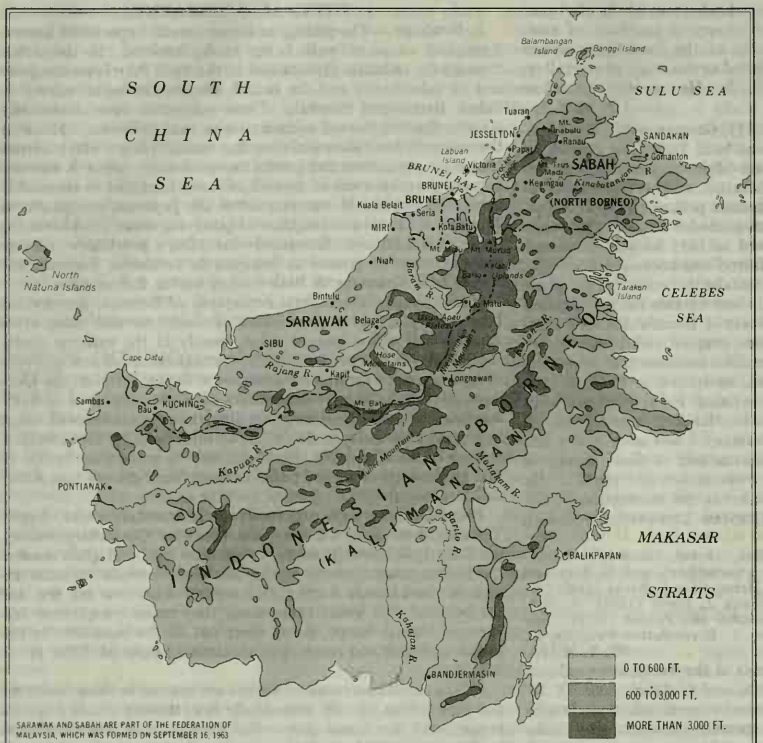
Borneo is composed principally of sedimentary rocks, largely Tertiary; but along the coast are extensive Quaternary sectors, particularly in the delta country, and dead level and often deadening swamp, characteristic of the whole of Borneo's coastline except in the extreme north. Outcrops of limestone are few and far between, but where these occur they make conspicuous features of the landscape, rising sheer out of the sandstone in impressive shapes and reaching a maximum height of 7,798 ft. on Mt. Mulu.

All the significant caves of Borneo are centred in these limestone outcrops, which, though numerically few, thereby attain a special importance; for these caves—the most famous are Gomanton in Sabah and Niah in Sarawak—are the homes of millions of swiftlets, which provide the edible bird's-nests of commerce (see *Animal Life* below), and bats, which provide guano extracted as fertilizer. In the great cave at Niah (26 ac.) extensive excavations by the Sarawak museum revealed a succession of prehistoric occupation down to the Middle Paleolithic (see *Archaeology* below).

The great spinal range, which corresponds roughly with the political boundary between Indonesian territory and the rest of Borneo in the interior, consists chiefly of crystalline schists together with slates, sandstones and other rock, all much disturbed and folded. From this spinal range, lateral and parallel ranges strike out in all directions, characterized by large-scale disturbance. The low-lying country between the mountain ranges is frequently covered with Tertiary and sometimes with Cretaceous deposits. There are igneous bands on the eastern side, in Indonesian Borneo, mostly south of Longnawan.

2. Relief and Drainage.—The general character of the island is mountainous. The highest peak is Mt. Kinabalu, 13,455 ft., a great jagged outcrop of granite emerging out of a sandstone formation almost from sea level to form the highest mountain in southeast Asia and one of the splendid mountains of the world.

Seen from the summit of Kinabalu or any other of the high mountains, Borneo appears as a confused, irregular tangle of ranges, hillocks and great winding valleys with none of the symmetry characteristic of Burma or Java, Sumatra or Malaya. Thus it is one of the hardest countries in the world to move around in on foot. To follow a compass bearing is an unbearable experience; it will inevitably involve crossing and recrossing stream after stream and climbing hillsides, gullies and landslides in wearisome succession. The stranger to Borneo who is fortunate enough to get off the beaten track is usually irritated by the tortuous trails which the native peoples use to travel vast areas of jungle. But, from centuries of experience and an unsurpassed feeling



TOPOGRAPHICAL MAP OF BORNEO

for jungle life, these people—once head-hunters, now peaceable—have usually worked out the best routes, however indirect these may appear.

Fortunately, a very large part of the island, including the whole southern half, is intimately drained by navigable rivers. Farther north, as the island narrows and the mountainous centre becomes relatively more formidable, few rivers are navigable for more than 100 mi., often much less; after that, men must walk, wade and climb. This is largely why the northern interior of Borneo has until recently remained one of the least-known parts of the world. Throughout the south, but to a less extent elsewhere, the great waterways are the principal and often the only life lines of human trade and commerce.

The Kapuas river is the waterway of the southwest, rising near the centre of the island and reaching the sea in a great delta south of Pontianak, the chief town in this part of Indonesian Borneo. Small steamers can travel as much as 400 mi. when tide and rainfall are suitable. The Barito is the great river of the south coast, rising in Kuti Lama lake and entering the Java sea at 114° 13′ E. Like most of Borneo's rivers, the upper reaches are rocky, with gorges, rapids and waterfalls. The lower Barito forms another great delta with very extensive areas of nipa palm, sago, mangrove and other swamp, mainly inhabited and exploited by Muslim Malays. The Barito alone drains 38,000 sq.mi. Farther east, the Mahakam (or Kutai) is the major river; at a great distance from its mouth it still has a depth of three fathoms.

North of the Mahakam, flowing into the sea opposite the oil field on Tarakan Island, is the Kajan (Batang Kayan) river which traverses northeastward from the very centre of Borneo. As the name implies, the river is the headquarters of the Kayan (and Kenyah) peoples, riverine folk of the southern interior who live by shifting cultivation of rice and have developed the highest level of arts in Borneo—wood carving, ironwork, music and dancing. From the headwaters of the Kajan these people have spread north and west to populate a large inland area of Sarawak. They are the great boatmen of Borneo, and on the Kajan, above all, they need to be, for this is the fiercest of rivers and would barely be regarded as navigable at all by most standards. The worst rapids on the river are the Brembrem, which are indeed impassable. While the Dutch still occupied this part of Borneo they built a graded road for 20 mi. around this tremendous gorge, with boat depots at either end to facilitate traffic. They also built the only far-inland government post in the island, with hospital, troops, etc., stationed at Longnawan near the head of the Kajan.

To the west, the Rajang is the greatest river, rising from Mt. Batu Tiban, the Nieuwenhuis mountains and the Usun Apau plateau in many sources which merge above Kapit and flow through Sibu, a commercial centre and second most important town in Sarawak, to the South China sea, 30 mi. farther down. The upper reaches of the Rajang are inhabited by Kayan, Kenyah and related peoples; the middle reaches are densely populated by the Iban (Sea Dayaks) who, over the past several centuries, have been pushing up the west centre of the island from the headwaters of the Kapuas. The Rajang is navigable for about 160 mi. by large launches, but above Kapit it is broken by formidable rapids, notably the Pelagus.

Farther to the northwest the Baram is also a mighty river, but difficult for navigation after the first 100 miles. However, by the 1960s light outboard motors attached to native canoes had begun to revolutionize the speed and load of small-scale transport in these more difficult rivers.

North of the Baram on the west coast and the Kajan on the east, the belt of coastal delta and subcoastal plain country narrows, and in the extreme northwest amounts to only a few miles between the sea and the beginning of the 500-ft. foothills which rise behind Papar, Jesselton and Tuaran almost directly into the tormented mountain massif of Mt. Kinabalu and the Crocker range. Whereas much the larger part of the other Borneo territories is lowland country below 500 ft. (and much of this at sea level), the greater part of Sabah is 700 ft. and over. This highland has a rainfall of over 200 in. a year, which drains with great energy outward to form rivers beyond the capacity of any boatman. Therefore much of Sabah is only approachable on foot. Moreover, the Kinabalu-Crocker massif continues southwestward, roughly along the boundary between Sabah and Sarawak to Mt. Murud (7,950 ft.), where the borders of both these territories and Indonesian Borneo meet. Southwest of Murud the spinal range continues at over 3,000 ft. to Batu Tiban (5,590 ft.), then turns west with irregular, broken extensions running south into the Müller mountains, which seldom rise beyond 5,000 ft.

Within this really rather complicated pattern of central mountains lies an irregular series of upland plateaus or plains, isolated from the lowlands by impassable rivers and until the mid-20th century isolated culturally and economically as well. The highest

of these upland plains is at Bario, south of Mt. Murud, and it is probably the highest permanently inhabited point in the island (3,500 ft.). Wide valleys, impressively set among mountains and cultivated by wet rice, they are in striking contrast to anything on the outer side of the central massif. In the north, around Ranau, these plains are inhabited by the Dusun peoples; farther south, from Keningau, by the Murut; and south of the Murut, by the Kelabit. The Kelabit country became thoroughly known during World War II when Allied parachute forces were dropped into these rich and well-populated places to organize—with considerable success—guerrilla operations against the Japanese occupying the coastal areas and at first quite unaware of any such threat in their rear.

South of the Kelabit uplands, between the headwaters of the Baram and Rajang rivers, another system of tablelands on the west side of the border was first suspected and then explored by a Sarawak museum expedition in 1951, then further by geologists and fully by an Oxford university expedition in 1956. This inaccessible region is now only inhabited by a few wild bands of the nomadic Punan. But evidences of large populations, including ancient long houses (a dwelling housing many families), burial grounds and widespread sago cultivation discovered in 1951, were confirmed by excavation in 1956. This strikingly supports the myths and sagas among the lowland people on both sides of the border, who often refer nostalgically to previous centres of population in cooler and more fertile highlands called Usun Apau ("mountain garden").

Native legends suggest that in very ancient times much of the interior was covered with lakes. Very few lakes now exist in Borneo, the only important ones lying in the headwaters of the Kapuas and possessing a highly specialized aquatic bird not found elsewhere. Over many centuries there was a migration trend from the south and east across the spinal range to the north and west, in recent centuries accelerated by powerful pressure from the aggressive and rapidly increasing Iban. Under European influence this process has ceased and a converse sequence commenced. With peace, security and trade in the lowlands, more and more Borneo people have moved out of the interior toward the coast, and at the same time immigrant peoples, notably the Chinese since about 1870, have come in from the sea and met with the indigenous people on the coastal plain.

Thus, in the middle of the 20th century, vast tracts of the interior south of the Kelabit uplands were inhabited sparsely or not at all, while most of the good land on the tidal reaches of the rivers and down to the coast was occupied (and sometimes overpopulated). It may well be that with improved communications, a movement back toward the uplands will seem desirable to people who have traditional roots there and who, in the middle reaches of the rivers, are being pressed. Communications have rapidly improved in Sabah and Sarawak, and by the mid-20th century air strips with feeder services were operating far inland at Ranau and Keningau in Sabah and Bario and Belaga in Sarawak.

The coastal plain, although the least attractive, is the most productive portion of Borneo. If a figure of 500 ft. is accepted as a general limit inland, well over half of Borneo falls into this category. The coastline itself generally consists of long, white coral sand beaches, interspersed with great river deltas and occasionally (mostly in the north) minor cliff formations. Largely because of the violence of monsoon storms, as well as the historical factors already mentioned, it is possible to travel for many miles along the coast without finding any human habitation. The villages are usually tucked away out of sight in the estuaries or behind the headlands. With a few insignificant exceptions the coastal and subcoastal people are Muslims and live in separate houses grouped into villages of from 20 to 200 homes; the long house, characteristic unit of the interior, is not to be found there. (See *The People* below.) A large part of this population gains its livelihood by fishing the wide and shallow offshore waters, or working the produce of the great expanse of delta swamps, which are at their most extensive in southwest Sarawak and the Bandjermasin division of southern Indonesian Borneo. Many of the river mouths are blocked by difficult sand bars and narrow, shifting channels, with a complicated network of tides (twice a day along much of the coast). Thus while the rivers provide very efficient lines of inland communication, the problems of communication for larger vessels may be acute. In about 2,500 mi. of coastline there are only 15 ports in any way worthy of the name, of which Victoria on Labuan Island in the mouth of Brunei bay in the northwest is probably the best all-weather sea anchorage.

Islands are not numerous off the coast. The main ones are the Natuna group on the west, the Tawi-Tawi group to the east, Banggi and Balambangan between the northern extremity of North Borneo and the Sulu archipelago, Labuan (*q.v.*), oil-bearing Tarakan to the east, Laut to the southeast and the Karimata group to the southwest. The population of these islands is predominantly Malay stock with a strong seafaring tradition which has served to link coastal Borneo with other land masses for many centuries.

Tiny in size and human population, but commercially valuable and scientifically fascinating, are the "turtle islands." The most interesting and significant of these are three which lie just east of Cape Datu and where on a total beach surface of less than five acres 2,000,000 eggs a year may be laid by edible turtles (see *Animal Life* below).

3. Climate.—The climate is characteristically equatorial—hot and damp. Humidity is normally very high. In the flat, windless deltas and swamps of the coastal plain, in the sweltering sun, a man may feel as uncomfortable as anywhere in the world. By contrast, in the Kelabit uplands the temperature is generally cool and at night cold inside the long house at Bario. Ice—but not snow—has been recorded in February from the top of Mt. Kinabalu (Low's peak, 13,455 ft.). In the Usun Apau uplands, now uninhabited, the daily maximum range is not above 29° C. (85° F.) at about 2,000 ft., and the minimum is 2° C. (35° F.). In the lowlands over the island generally, the thermometer rarely falls below 21° C. (70° F.). On very hot days it mounts to as high as 37° C. (98° F.) in the shade (recorded at Kuching in August).

There is a fairly distinct division into two seasons: the monsoon (*landas*) between October and March, and a relatively drier, calmer period of summer (*tedoh*) for the rest of the year. But this is much complicated by latitude, longitude and the local climates built up around the big mountain ranges. There is no distinct, extensively dry season, though the least amount of rain tends to fall in July, August and September. Nine-tenths of native agriculture is based on the hope that during these months it will be dry enough for the felled jungle to be burned off, so that rice seed may be planted in the cleared areas. Such is the Borneo climate that at least once in every five or six years this goes wrong; in some years, on the other hand, excessive rains at the end of the monsoon ruin the ripening grain before harvesting.

The average rainfall for most localities is about 150 in. a year, most of which falls between late afternoon and early morning.

4. Vegetation.—The flora is very rich, the far greater portion of the surface of the island being clothed in thick evergreen forests. Above about 3,000 ft. dwarf trees covered in mosses and lichens replace the rain forest. The king of the forest is *Koompassia excelsa*, which rises to a great height without fork or branch to a splendid dome of foliage, beneath which may often be seen 50 to 70 nests of wild bees on the larger branches. The official seats of some of the native chiefs are constructed from the wood of this tree. Ironwood, remarkable for its durability, is abundant; it is used by the natives for the pillars of their homes, and forms an article of export, chiefly to Hong Kong. In all, about 60 kinds of timber of marketable quality are furnished, but the difficulty of extraction, even in the regions near the large waterways, renders it improbable that the timber trade of Borneo will attain very great dimensions until other easier sources of supply have become exhausted. Palm trees are abundant in great variety, including the atap (the leaves of which are used for roofing); others are the cabbage, fan, sugar, coconut and sago palms. The last two furnish large supplies of food to the natives.

Most of the tropical fruits flourish, including the evil-smelling durian, a large fruit with an exceedingly strong outer covering of stout pyramid spikes, like a huge horse chestnut.

There are nearly 300 genera of flowering plants found in Borneo but not found east of the Makasar straits, and 59 endemic genera are known. Ten Asiatic genera and several Australian plants, *e.g., Styphelia suaveolens* and *Trochocarpa learmonthiana,* are not found elsewhere in Malaysia. *Philbornea* has only been reported from Borneo and the Philippines. *Pandanus,* also found in the Malay peninsula and in Sumatra but not in Java, obstructs many of the rivers. Among the more beautiful of the flowering plants are rhododendrons (of which there are 32 known species), orchids and pitcher plants, the last reaching extraordinary development, especially in the northern mountains Kinabalu, Trus Madi and Mulu. Epiphytous plants are common, many that are usually independent assuming in Borneo a parasitic character; the orchid *Arachnanthe lowii,* for example, grows on the lower branches of trees, and its strange pendant flower stalks often hang down almost to the ground. *Rafflesia,* the largest flower in the world, named after Sir Thomas Stamford Raffles who discovered it, grows in the south. Ferns and allied plants are abundant everywhere, particularly on the limestone mountains.

5. Animal Life.—The fauna of Borneo comprises a great variety of species. Among the large mammals the most remarkable is the orangutan (Malay *órang útan,* "jungle man"), the huge ape (*Pongo pygmaeus*) called *maias* by most natives. The *maias,* now restricted to a few lowland areas of Borneo and Sumatra, is protected by law, being in danger of extinction because of its popularity in zoos and circuses. Borneo has another of the four living apes which is much commoner: the gibbon (native, *wawa*), graceful and easily tamed. The island is also the only home of the astonishing proboscis monkey (*Nasalis*), which inhabits the delta swamps of Sarawak, where they have increased and become tame since they have been protected. There are numerous other primates. The large-eyed *Tarsius spectrum* and the loris, *Nycticebus coucang,* also deserve mention.

The bigger beasts of prey are not found in Borneo, and there is little check on the plant eaters. The clouded leopard (*Neofelis nebulosa*) is the largest feline on the island. The honey bear is common and is the only mammal in Borneo of which the people are afraid. The largest mammals are the Asiatic two-horned rhinoceros and the elephant. The rhinoceros, a purely jungle beast, was once common, but the introduction of shotguns to the inland people in the 20th century has led to its near extermination. The horn, hoofs and hide are greatly esteemed by the Chinese for medicinal purposes. Since 1947 full measures of protection have been enforced in time to save a few remaining survivors in the interior. Elephants are possibly not endemic but a considerable herd of feral Indian elephants roam the Kinabatangan area of the northeast. The third large mammal is the wild ox (*Bos sondaicus*), a finely built brown animal with white markings like socks. It has not suffered like the rhinoceros, since it can move faster and is of no value economically. Wild pigs abound, moving in scattered hordes following supplies of fallen fruit in the jungle, often in turn followed by the nomadic Punan who hunt them with blowpipe and poisoned dart.

Four species of deer are common, including the mouse deer or plandok, of remarkable grace and beauty, about the size of a hare but considerably less heavy. There are also civet cats, bear cats, flying foxes, otters, porcupines, squirrels, flying squirrels, tree shrews (*Tupaia*), rats, bats and the curious little badger *Mydaus.* Crocodiles are found in all the rivers, but the gavial occurs less frequently. Lizards are in great variety, some of the genus *Draco* being able to fly; snakes of various kinds, from the python downward, are abundant, including the most deadly of snakes, the king cobra or hamadryad—one of the few which will sometimes aggressively attack and even pursue man. The remarkable "flying snake" is a true serpent which can extend its ribs to make a flattened plane on which it can glide from a tree or bush to earth. Frogs are abundant, especially in the lowlands; some of the giant toads are larger than a Pekinese dog.

There are more than 500 kinds of birds recorded in Borneo. Several are confined to the islands, including the handsome blue-wattled Bulwer's pheasant (*Lobiophasis bulweri*) and a brilliant scarlet and black partridge (*Haematortyx sanguiniceps*) found only in jungle above the 3,000-ft. contour line.

There is a distinct montane fauna with many species both of vertebrates and invertebrates not found in the lowlands. Only Mt. Kinabalu runs above 10,000 ft. and at this height there is a limited and peculiar fauna, including a primitive shrew, two tree shrews (although there are no trees) and a little brown bird (*Androphilus accentor*), found nowhere else in the world. Two birds are of economic significance. Small finchlike manakins (*Munias*) descend in droves upon the ripening rice and do serious damage in some years. In limestone caves swiftlets (*Collocalia*) make edible bird's-nests—one of the most expensive foods in the east.

Some travelers say that Borneo is spoiled by its biting bugs. Jungle tracks are infested with leeches, river banks with sand flies, and mosquitoes are everywhere. There are also two kinds of fire ants whose sting is particularly painful. Hornets, bees and wasps of many varieties abound. Butterflies, moths and beetles are remarkable for their number, size, variety and beauty. *Ornithoptera brookeana,* or Raja Brooke's bird wing, one of the many swallowtails found in Borneo, is widely regarded by entomologists as the most beautiful of butterflies.

Fish are periodically caught in great quantity by poisoning several miles of water with the pulped tuba vine, this event being an occasion for excitement, carnivals and feasting over a whole district. Fish plays a major part in the diet of the coastal Malays and Chinese, but is not so plentiful as in some seas. There appears to be a shortage of plankton and other microscopic food to attract them in large numbers. Nevertheless there are many fine sea fish, and the coastal peoples have met their difficulties by using a wide variety of techniques with net, hook, stake, trap, light and spear. In the straits between Banggi Island and North Borneo, a successful tunny fishery run by the Japanese before 1941 was recommenced in 1957. Shark fishing is undertaken particularly for the fins, a Chinese soup delicacy. Turtles, sea cucumbers and pearl shell are also of some commercial importance. The eggs of the edible turtle (*Chelonia mydas*) are marketed to Chinese and Malays, who regard them as great delicacies. Marking experiments prove that one turtle may lay five times in a few days, and more than 100 eggs at a time.

The dog, cat, goat, pig and fowl are domesticated. The buffalo, a smaller breed than that found in the Malayan peninsula, and in some districts bullocks of the Brahmin breed, zebu and small horses and goats are the principal domestic animals. The buffaloes are used not only as draft animals in agriculture but also as beasts of burden. Horses, introduced by Europeans and owned only by the wealthier classes, are raced regularly in Kuching and Jesselton. The use of native pack ponies has been encouraged by the government of North Borneo for many years. As a result, quite a good system of bridle paths (also used by zebu carrying trade goods) has been developed as far inland as from Mt. Kinabalu into the rich uplands farther south.

II. NATURAL RESOURCES

1. Water Resources.—Borneo is essentially a land of rivers. In all but the northern extremity of the island and the small but rapidly developing state of Brunei to the northwest, normal communications are by river. Between the interior and the coast, traffic, both passenger and commercial, is by the numerous, often mighty and frequently dangerously rapid rivers (see *Relief and Drainage* above). From one river system to another there is often no normal overland communication, nearly all contact and trade being made out of one river mouth by sea and into another. As rainfall is high and Borneo seas are tempestuous and wild during part of the year (see *Climate* above), this has been a considerable factor in slowing up the development of natural resources.

In such a setting, water resources tend to be too plentiful. But along parts of the coastal plain the Malay fishing communities may be short of nonsaline water, which is limited in time of drought (mainly August through September). Piped water is still almost unknown outside the towns.

2. Soils.—Generally speaking, Borneo soils are poor, largely leached out from sandstone and in the coastal area even from deposited (coralline) sands. Some of the swamp soils and those of the far uplands are good, however. But little is known about this scientifically, and serious soil research only began in the late 1950s (Sarawak and Sabah). Outstanding volcanic soils occur in the now uninhabited Usun Apau (see *Geology* above) and in the northeastern corner of Sabah, where valuable crops of tobacco and sisal are grown on a large scale.

3. Mineral Resources.—Borneo as a whole is poor in mineral resources which are sufficiently accessible and concentrated to be exploited commercially. Thus gold, diamonds, antimony, mercury, gypsum and iron have all at some time since the beginning of the 19th century been exploited in inland deposits by predominantly native methods and mainly on an individual-producer basis. The story of gold extraction in southwest Sarawak goes back to the T'ang dynasty, when the Chinese bartered ceramics and cloth for gold from the headwaters of the Sarawak river over 1,000 years ago. Early in the 19th century antimony, which also occurs extensively at Bau, was highly valued, and it was this which largely influenced Sir James Brooke to settle in the area in 1841, to become the first white raja of Sarawak; mercury was important in the 1870s, and then coal (which occurs at several points behind the west coast) became important.

From about 1900 to 1910 gold was the significant export product of the Borneo territories; from 1910 onward major oil strikes were made along the coastal plain—at Balikpapan in the southeast, Tarakan Island in the northeast, Miri in the northwest and Seria in the state of Brunei 70 mi. north of Miri. The earlier fields have all faded; Miri dwindled to about 66,000 long tons, while the two easterly fields suffered from the disturbed political conditions in Indonesian territory. The Brunei field, on the other hand, has prospered exceedingly and is one of the greatest in the world, providing more than 90% of that tiny state's revenue. In the 1960s Brunei was one of the richest countries, per capita, in the far east.

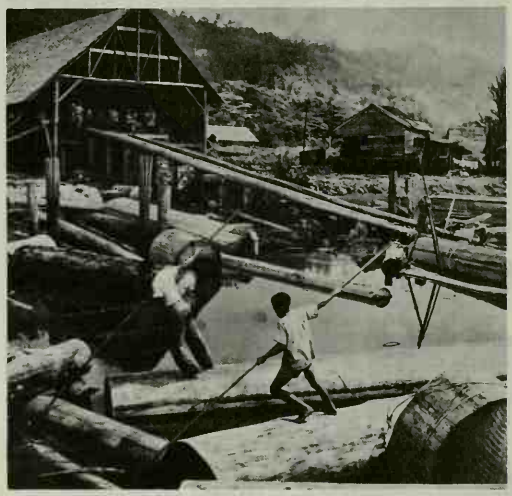
Gold is still mined in the south, even from Bau. Limestone for cement, granite for road and house building and cave guano for pepper fertilizer are all absorbed locally. But an important new resource, bauxite, first studied by the Japanese during World War II, has been developed near Cape Datu at the southwestern tip of the island. Effective extraction by a joint Swiss-Japanese-Canadian concern began in 1958.

4. Land Use.—About 75% of Borneo is covered in virgin jungle, high primary rain forest, or only secondarily man-influenced coastal swamp. The coastal plain reaches its greatest extent in the southeast, where waters may be tidal for up to 200 mi., and vast deltas carry only nipa palm and mangrove swamp. Minor industries, mainly in Malayan hands, centre in these swamps.

The rain forest, clothing hill and mountain areas inhabited only by nomadic Punan groups, supplies a mean source of cash economy for most of the native peoples: gutta percha; dammar gum (a dye base); camphor; rattan; timber, floated down to coastal sawmills (and exported to Australia, Hong Kong and Europe); and the more esoteric but valuable items peculiar to Chinese pharmacy, notably—now that the rhinoceros is almost extinct—the intestinal bezoar stones of certain monkeys and other forest animals.

But the jungle, which until the introduction of rice in protohistorical times must have dominated everywhere, is slowly receding before the encroachments of the rapidly increasing population. Rice is the staple food, but not enough is produced on the island to meet the demand. Cultivation over much of the island is done by felling jungle on a cyclic basis, planting rice, supplemented by maize, cassava (manioc), cucumber and pumpkin, in a new clearing each year. Where the cycle is long enough, normally over ten years, this is an effective if laborious way of farming hill country. But it is evident that the system requires extensive available land. Borneans are conservative about splitting up communities or moving far from the crowd. In some areas, too, where the population is increasing rapidly, the felling cycle tends to grow shorter because of soil impoverishment. Fortunately new methods are being learned. Many are turning to their inland neighbours to learn by example. The outstanding native agriculturists are those inhabiting the upland plains—the Dusun in Sabah, the Kelabit in northeastern Sarawak and the Murut in the northwestern corner of Indonesian Borneo—who have independently devised advanced methods of irrigation.

Tobacco is grown in the uplands and traded to the lowland natives. Experimental plantings of coffee, cocoa and hemp have also suggested possibilities for the future. Throughout Borneo the problem of cash crops to supply needs in addition to family diet is difficult.



EBRI FROM THREE LIONS

LUMBER MILL IN THE INTERIOR OF BORNEO. TIMBER IS FLOATED DOWN THE RIVERS TO COASTAL SAWMILLS AND THEN EXPORTED

The introduction of *Hevea* rubber did much to meet the expanding demand for imported consumer goods in the first half of the 20th century. Most of this rubber is grown on small native plantations run at very low cost and is of inferior quality. After 1946 pepper was grown increasingly by the indigenous people, but on a large scale only by the Chinese. Newer markets are for vegetables taken from the seeds of the *Shorea* palm, and for chicle, a wild rubber used as the foundation of chewing gum and processed in a U.S.-owned factory at Bintulu (Sarawak). Coastal area exports are sago, copra from coconuts, cutch from mangrove bark and, of course, marine products. (T. Hn.)

III. THE PEOPLE

The ethnic composition of Borneo peoples, while less complex than much of the Malay archipelago, presents some puzzling situations. On the island of Palawan, just north of Borneo, and in other parts of the Philippines as well as in the Malay peninsula are bands of nomadic pygmies, the Negritos. It is assumed that they once occupied most of the islands of the Malay archipelago, where they now appear as remnant groups. But no Negritos have been found in Borneo, although it would seem to be in the direct line of movement between present-day groups, and presents ideal conditions for their way of life. Traces of Negroid ancestry may appear in the modern population, but there is no evidence that the intermixture took place on Borneo.

Another problem is presented by a people known as Punan. Early explorers in Sarawak and other portions of Sabah reported the existence there of nomadic peoples who built only flimsy shelters and lived on jungle produce or by hunting and fishing. They were described as of medium height and slender build, with round heads, noses medium but sometimes narrow, lips inter-

mediate. Their skin colour ranged from light reddish-brown to yellowish tones. A. C. Haddon, who measured and photographed a considerable number of these people, considered them related to the dominant Malayan population, but still pronounced them a "puzzle." In central Borneo the term Punan is known but is there applied to all persons making temporary excursions into the jungle in search of rattan and other products. There is evidence of a unique, nomadic, Punan people in Sarawak and the north, with possible extensions to the south.

1. The Dayak Peoples.—The term Dayak or Dyak (Dajak), which has been generally applied to the non-Muslim groups of Borneo, should not be understood to refer to a uniform physical or cultural type. It has about the same significance as the term Indian has for the American aborigines. In general it can be said that the interior Dayak seem to represent a population intermediate between the proto-Malayan and Malayan. (*See* MALAY ARCHIPELAGO.) Head form tends to be round. Stature is about 5 ft. 3 in., noses are broad, lips full, hair dark brown usually straight but sometimes with a slight wave, eyes are dark and skin colour varies from light to dark brown. But such a general description does not take account of the considerable amount of variation that occurs within each group, perhaps due to intermixture prior to the population's reaching the island.

While there is no strong tribal grouping among the Dayak peoples it is customary to class together those having considerable in common, either in the dialects spoken, in cultural status or in social and religious organization.

The time of arrival in Borneo, the routes traversed and the earlier homelands are matters of speculation, but it is assumed that the earliest of the Dayak settlers are represented by a number of hunting-agricultural peoples in the interior, often classed together as Klemantan. Following them were the Kenyah and Kayan (sometimes called Bahau), groups of higher culture that exerted considerable influence on the earlier peoples. The Kenyah and Kayan occupy the upland regions of the Kajan and Rajang river systems as well as the Baram basin. Still later came such peoples as the Ngadju of the upper Barito and Kahajan systems; the Land Dayak of Sarawak and Sadong drainage; and the Iban or Sea Dayak, of the upper Rajang and Kapuas. The latter were ardent head-hunters, and because of their forays to the coast were called Sea Dayak by the Europeans. They are, however, a riverine people. Other aboriginal groups to be noted are the Murut and a subdivision known as the Dusun of North Borneo. They are wet-rice cultivators. On the plains near the coast in Sarawak is a group called the Melanau, which has maintained its identity despite its location and the fact that it has accepted Islam. Within these broad categories are many subdivisions presenting minor variations.

The Dayak Village.—The general form of Dayak residence is the long house. A single dwelling may take care of all the people in a village, or a settlement may have two or more such structures. Kenyah and Kayan and Land Dayak houses sheltering as many as 50 families have been reported. While there is considerable variation in size, construction and interior arrangement, the long house can be described as a ridge-roofed building raised high above the ground on hardwood piles. It is divided lengthwise into an outer hall or corridor and inner family compartments. Entrance is by means of a notched log or bamboo ladder. The undivided hall serves as a general gathering place; there are also stored paddles, fish traps, pots and various other articles of daily use. The heads of enemies secured in battle were hung near the entrance. In such a village the family is the basic unit and children remain with their parents until married. A boy usually seeks his bride outside his own village and goes to live in her community. There is no tribal or other organization above the village, but there is a feeling of unity between those closely related in language, custom and marriage. Among the Iban and Land Dayak class distinction is absent, but three strata of society are recognized by the Kayan and Kenyah. The upper class consists of the family and near relatives of the village chiefs, while the lowest is made up of captives of war and other persons looked down upon for various reasons. W. R. Geddes characterized the religious practices of all the Dayak as concerned with promotion of the general well-being of the people, the growth of crops and with curative practices. Malevolent forces must be appeased, while friendly ones should be rewarded by gifts and ceremonies. Wishes of superior beings may be made known by omens, such as the flight of birds, the appearance of the liver of a sacrificial animal, or by dream experiences. Favourable beings comprise, for the Iban, a pantheon of more than 300 individuals, each with special interests or powers. Certain persons communicate with the spirit world during ceremonies. Invocations which are chanted may describe a journey to the skies and the eventual visit of the superior beings to the long house. Belief in multiple souls, some of which may wander, leads to soul-catching by the mediums.

An intimate picture of a people who spend most of their lives wresting a living from the jungle was given by J. Provinse for the Siang Dayak of central Borneo. The Siang are found in about 50 small villages situated on the Barito river or streams tributary to it. Each settlement has a headman and an informal council chosen by adult men. An unorganized group, usually men known as *blians,* conduct ceremonies. Head-hunting, carried on for prestige, revenge or to gain favour with the spirit world, was formerly prevalent there as in most of Borneo, but under Dutch rule was nearly stamped out.

In connection with the ceremonies, war celebrations and the like, dances are held in the corridor of the long house. Men clad in breech clouts and rattan caps adorned with argus pheasant feathers enter the open space armed with spears, shields and long knives. Then to the music of copper gongs beaten by women, they go through all the movements of combat. At such times much rice wine is consumed and there is considerable promiscuity.

Agriculture.—The major activities of the people are connected with the cultivation of dry-land rice. A gently sloping hillside is chosen and the underbrush is cut. Starting at the bottom of the plot the larger trees are deeply notched on the up- and downhill sides. One or two key trees near the top of the hill are felled in such a manner that they carry the trees below them to the foot of the hill. Large branches are cut off and the felled trees and brush are allowed to dry until ready for burning. A second burning may be necessary to get rid of larger branches not fully consumed. Such a cutting and burning takes much time, but it furnishes a field free from grass and fertilized by the ash. Planting consists of punching holes in the ground with sharpened sticks and dropping in three or four kernels of rice. There is little need of weeding, but the growing crop must be guarded against monkeys, deer, rats and birds. Small houses are constructed in the fields and from these women and children watch and drive off intruders. In five or six months the grain is ripe and is cut, spear by spear, with small crescent-shaped blades. Finally the grain is threshed and is stored in large baskets. There is no private ownership of land beyond the period of use. To clear a chosen plot requires co-operation, and at least two or three families will exchange labour. In some cases 10 or 20 persons may work together, spending a day in succession at each plot. At this time the occupant furnishes food for the day. A field may be used for two or three seasons, but eventually it becomes less productive and is invaded by a rank grass. It is then abandoned and the entire process is repeated on another site.

Some of the men's time is spent in hunting, in which they use the spear and a blowgun fitted with poison darts. They fish and gather jungle fruits and other produce—such as gutta-percha and rattan. Women and children also fish, gather shellfish and roots. Travel for any distance is by means of a dugout canoe, for movement through the dense forest is difficult and formerly was hazardous for all but war parties.

2. Malays.—Along the coasts, and in some areas penetrating the lower river courses, are the Islamic peoples generally classed together as Malays. This population doubtless comprises early comers to the island as well as later immigrants from various parts of the Malay archipelago—Java, Sumatra, Celebes and the Malay peninsula. Prior to the 15th century the influence of the

Sumatran and Hindu-Javanese empires to the south had led to the development of petty states along the coasts with resulting cultural changes, particularly in the ruling class. Later these courts, and ultimately most of the coast peoples, were converted to Islam. Trade centres of considerable influence and wealth had developed prior to the arrival of the Europeans. Of particular importance was Brunei in northwest Borneo, described by early Spanish explorers as a place of wealth and splendour, partially built out over the water.

The culture of the Borneo Malays follows the general Malay pattern but represents various stages. There are simple interior settlements dependent on dry-land agriculture and raft villages of Malays who travel far up the southern rivers to trade with Dayak peoples. On the coast are fishing villages which stand in sharp contrast to the rather elaborate courts of the sultans. The bilateral family is the typical unit, but since Islam permits polygyny and easy divorce, marriage unions are rather brittle. Wealth and political position lead to class distinctions, particularly in the larger settlements.

3. Chinese.—Chinese contacts go back more than 1,000 years but were not important in modern times until the 19th century. Chinese traders, artisans and labourers are found in most of the Malay areas, especially in Sarawak and North Borneo. They dominate small business concerns and are important in commerce. They are also engaged in the production of rubber, rice, coconuts and vegetables, usually in small holdings.

Europeans, while exercising great influence in recent centuries, are few in number, consisting mostly of government officials, traders, planters or miners.

See also DAYAKS; IBAN; KENYAH; MALAY; MALAY ARCHIPELAGO; MALAYO-POLYNESIAN LANGUAGES; MURUTS; PUNAN.

(F.-C. CE.)

IV. ARCHAEOLOGY

Little was known of the great island's rich prehistory until 1947, and nothing had then been excavated. Since 1947, energetic excavational and related fieldwork has been carried out by the Sarawak museum throughout Sarawak, the adjacent state of Brunei and, on a small scale, in North Borneo. Existing information for a great area of Indonesian Borneo is almost negligible, apart from the well-established finds of certain Buddhistic and Hindu-related figures in southern Borneo years ago.

For the western half of Borneo—Sarawak, Brunei and Sabah—the picture is now considerably clearer. The classic site to date was discovered in 1947 and has since been excavated on a considerable scale. This is the great cave at Niah, 400 mi. N.E. of Kuching, the capital of Sarawak, and 15 mi. inland along a small river behind the South China sea. Among the most significant discoveries at Niah is a radiocarbon (C^{14}) dating of 40,000 years at what is only a medium level in the deposit, much of which remains to be excavated. From 40,000 years ago and more, there is an almost unbroken succession of human frequentations and occupations of the cave continuing after the arrival of a massive Chinese trade starting in the T'ang and Sung dynasties (A.D. 618 to 1279).

No pre-hominid types, such as *Pithecanthropus* of Java, have yet been found in Borneo—though there is fair reason to expect them. Meanwhile, the Niah site provides a unique sequence of the evolution of stone tools from early hand-chopping axes, which are massive pebbles simply struck on one side to a point; through the development of flake tools; then finely edge-ground tools of the Mesolithic; on into the beautiful black polished adzes and axes of the Neolithic or Late Stone Age. A fine set of wall drawings, provisionally attributed to the Early Metal Age, has also been found in one of the caves. These, too, are so far exceptional in southeast Asia. They are associated with decorations showing the journey of the "ship-of-the-dead" to the spirit world. Underneath the drawings, on the floor of the cave, more than 200 ft. above the valley floor, beautifully carved model boats have been used as coffins for the deceased.

The Early Metal Age materials at the Niah caves are closely paralleled by those found in other excavation sites in the Sarawak river delta, at the southwest corner of the island. There about 30 separate places have been mapped as prehistoric monuments, in what must have been an enormous trade between the Asian mainland and western Borneo reaching back for more than 1,000 years. The mainland appears to have brought primarily ceramics, metal and probably clothing. In return they received edible bird's-nests, rhinoceros horn, hornbill ivory (*ho-ting*, one of the most valuable materials for carving in ancient China, and only to be obtained from this area), camphor, spices, woods, bezoar stones, rattans, etc. With whom they actually traded is not yet clear. The nature of an earlier people is overlaid by many generations of interbreeding with existing groups. It is probable, however, that the Kelabit of the far uplands, who still practise an active Megalithic culture with the erection of stone monuments and many other specialized features, may be a survival in comparatively pure form of an earlier stock. The Ngadjus of southeastern Borneo, who still have survivals of the "ship-of-the-dead" cult in their contemporary beliefs and art, are also probably near to Niah man in his later phases.

From the existing information and reasonable amount of speculation, the sequences for western Borneo in particular, which probably apply also to much of the other parts of the island may be tentatively stated thus:

About 300,000–500,000 years ago	Lower Paleolithic; *Pithecanthropine* pre-*Homo* fossils not found in Borneo but certain in Java, which was then connected by land bridge
About 100,000–50,000 years ago	Mid-Paleolithic; *Homo* types, with hand-chopping tools and flakes; in caves
c. 40,000–10,000 B.C.	Upper Paleolithic; developing stone and bone tools; rich at Niah
c. 10,000–5,000 B.C.	Mesolithic; reworked and edge-ground stone tools; Niah and elsewhere
After *c.* 5,000 B.C.	Neolithic; polished stone tools, beginnings of other arts (pottery, careful burials, etc.); widely distributed
A.D. 500	First Iron Age; inhabitants begin trading with China and India; widely distributed on coastal plain
A.D. 1000	Full Iron Age; major mainland commerce, very widely distributed (to west and north); reaching far inland
A.D. 1550 onward	European (Spaniards, Portuguese, etc.)

Borneo is placed at the corner of southeast Asia in such a way that, in relation to monsoon winds, sailing routes and straits, it must long have held a vital position in the prehistoric trade between east and west. This has made the local picture particularly complicated for the later periods.

On the other hand, lying at the extremity of Asia in the continental shelf, Borneo's position is easier to interpret for the stone ages. In some respects, it shows specializations and localizations of Stone Age technique different from those found anywhere else. Others are paralleled as far afield as the Sohan culture in northwest India.

(T. HN.)

V. HISTORY

Borneo was one of the last areas of the Malay archipelago to be explored. Early Arab legends depicted the island as a land of spices, gold and jewels, much exaggerating the limited production of these prized commodities. In general the swampy coastline, the difficulty of access to the interior, the poor weathered soils and the warlike disposition of and constant friction between the various native groups combined to discourage intervention and settlement in Borneo until the more productive areas had been utilized.

Very little is known about the prehistory of Borneo. There have been scattered archaeological excavations in many parts of the island, but investigation on an extensive scale started only after World War II, mostly in Sarawak. (See *Archaeology* above.) So far these excavations indicate that Chinese influence was probably greater than previously supposed; Indian influence less important; and that little as yet can be determined about the early inhabitants of the island. Evidence of the presence of

AVA HAMILTON

FLOATING HOUSES ALONG THE BARITO RIVER IN BANDJERMASIN, SOUTHERN PORT TOWN OF KALIMANTAN

man in Borneo dates from the end of the Ice Age, perhaps about 25,000 to 50,000 years ago. Since that time successive migrations from the Malay archipelago spread over Borneo, each being influenced by, but displacing, the preceding wave. Each migration contributed to the composition of the present population, but the predominate element has remained Indonesian, who started to settle in Borneo about 2,000 years before the Christian era. (See *The People*, above.)

1. Early History.—Perhaps the earliest external influence was Chinese. Many specimens of Han period sepulchral pottery found in east Borneo indicate Chinese trade (and the remote possibility of settlement) in the 1st century B.C. and perhaps as early as 400 B.C. Early Chinese contact with Borneo was primarily for trade in gold, resins and medicinal items such as the prized Borneo camphor (borneol). Such trade was facilitated by the Chinese sea route to southeast Asia, which probably passed along Formosa to the Philippines and thence to Borneo: thus the island was known at an early stage of Chinese exploration in the Malay archipelago. Buddhist pilgrims and travelers from China also visited the area in the 4th century A.D.

While early Chinese contact with Borneo was mainly commercial, the major cultural influence was Indian, coming to Borneo via Sumatra, Java and Malaya. The earliest evidence of Indian or Indian-Javan influence is the Sanskrit religious inscriptions of King Mulavarman in the Mahakam or Kutai area of east Borneo, which date from about A.D. 400. In addition, Gupta-style statues of Buddha, dating from the 5th century, have been found in the Kapuas river area and other areas of western Borneo. It is possible that Borneo is the Yavadvipa, or the land of gold and silver, referred to in the Hindu epic *Ramayana*.

It is probable that the great Sumatran sea state of Sri Vijaya controlled sections of the coast of Borneo during the 12th century. During the late 13th century, southwest Borneo acknowledged the suzerainty of Kertanagara, the great king of the Singasari period in Java. With the rise of Majapahit, Singasari relinquished control and in the mid-14th century much of Borneo became a protectorate of this great Hindu-Javan state. With the decline of Majapahit (early 15th century) and the rise of Islam in the Malay archipelago, the local states in Borneo were converted to the latter religion and consequently assumed greater individual power. Although the Dayaks and other tribal groups of the interior never accepted Islam, the southern coastal areas were rapidly converted by Arab and Javanese traders.

In the north, the state of Brunei was converted to Islam when the ruler married a princess of the royal house of Johore, and relations with the Malay peninsula became closer. When Antonio Pigafetta visited Brunei in 1521 the ruler had been converted to Islam. Brunei threw off the suzerainty of Muslim Malacca in the late 15th century.

After the rise of Portuguese power and the capture of Malacca by the Portuguese, many Muslim merchants moved to Brunei, which became an important centre of Islam in the Malay archipelago. A considerable sea power, Brunei extended control over all Borneo, the Sulu archipelago, even capturing Manila in the Philippines. It was one of the great sea states of the Malay archipelago, and early European travelers gave its name to all of Borneo.

The name Borneo, which appeared first on 16th-century European charts, is a variant of Brunei, and was probably used because Brunei was the most powerful state on the island at the time of the first European contact with the area. The native or Indonesian name for the island has long been Pulau Kalimantan (Klemantan).

European knowledge of Borneo dates from travelers who passed through southeast Asia in the 14th century, although it is first mentioned in western literature in Ptolemy's *Guide to Geography* of *c.* A.D. 150 where "Iabadiou" ("Island of Barley") probably refers to Borneo. Marco Polo reported considerable junk traffic between Brunei and China, but probably never visited Borneo. The first European visitor was the Franciscan friar Odoric of Pordenone, returning to Europe from China in 1330, to visit Talamasim in Borneo. (*See* ODORIC.) Other travelers include Borneo in their reports, but the first accurate descriptions came from the Portuguese in the 16th century who sailed via the coast of Borneo on the way to the Moluccas, or Spice Islands, and called at some of the ports along the way.

After the capture of Malacca, on the west coast of the Malay peninsula, by Portugal in 1511, Affonso de Albuquerque dispatched Antonio d'Abreu with three ships on a voyage of discovery to the Moluccas. D'Abreu, sailing in a southeasterly direction from the Strait of Malacca, skirted the southern coast of Borneo and laid up his ships at Amboina. He returned to Malacca in 1514, leaving one of his captains, Francisco Serrão, a kinsman of Ferdinand Magellan, at Ternate, where the latter's followers found him still living in 1521. After Magellan's death, his comrades, sailing south-south-by-west, entered the Brunei river and landed at Brunei town. Pigafetta, the historian with Magellan's expedition, described the city of Brunei as having more than 25,000 families, and described too the splendour of the court of the sultan. In 1526 Jorge de Menezes visited northern Borneo; in 1530 Gonsalvo Pereira described the area; and a map of the Indies by Mercator, published about 1595, shows many place names of Borneo. During the remainder of the 16th century Borneo was frequently visited by the Portuguese, who established a

trade with Brunei. Of this the Spaniards tried unsuccessfully to win a share, which they attained in 1580, through supporting a claimant to the throne of Brunei who had appealed to them for aid. Thereafter the commercial intercourse between Brunei and the Spaniards was intermittent and hostilities frequent.

At the beginning of the 17th century the Portuguese and Spanish monopoly of trade with and around Borneo was broken by the Dutch and British, who were attracted by diamonds, gold and the pepper trade. However, most of these contacts were short-lived and attempts to control the trade of the island were periodic and unsuccessful. Javanese had settled along the south and east coasts, and Malays and Bugi were scattered along the other coasts. Borneo at this time was composed of a series of small sultanates or states, often mutually antagonistic, and each jealous of its own rights and prerogatives.

One of the main reasons for British and Dutch intervention in Borneo was the prevalence of piracy in the area. Many of the people along the Borneo coasts and adjacent areas had a long tradition of seafaring, and during the pre-European period were the middlemen in trade throughout Malaysia. With the arrival of Europeans and the establishment of trade monopolies, native commerce was curtailed, and many of the sea people turned to piracy—long a highly respected and profitable occupation in the Malay world. European vessels were usually too well armed to attack, so the pirates chiefly attacked other native traders, wiping them out of business and in turn creating more pirates. As their fleets grew larger their zone of activity expanded, and pirate empires were created, such as those of Brunei and the Sulu archipelago. Pirates dominated the coasts of Borneo, raided in the Strait of Malacca and even into the Indian ocean. Most notable were Balanini of the Sulu archipelago, the Lununs of southern Mindanao, the Bruneis and Iban of the North Borneo coast, the Malays of the Malacca strait, at one time the Bugi of the Makasar area and later the Chinese. European powers gradually eliminated them from the waters around the Malay peninsula, but found it more difficult in the Borneo area where they did not control the land. It was the aim of controlling piracy that led to Dutch and, particularly, British intervention in Borneo.

2. Dutch Influence.—In 1600 a Dutch expedition under Olivier van Noort called at Brunei. In 1606 the Dutch East India company (*q.v.*) entered into trade relations with the sultan of Sambas. In 1609 they built a factory in the Sambas district of the west coast, and appointed a factor at Landak and Sukadana. In 1606 the Dutch opened trade relations with Bandjermasin, and in 1635 trade with Kutai on the east coast commenced. Most of these early contacts were short-lived, and the changing fortunes of local dynastic disputes, trade rivalries and wars between different sultanates resulted in the expulsion of the Dutch and the closing of their factories. In 1623 the factory at Sambas was abandoned, and in 1669 the Dutch relinquished their interests in the Bandjermasin area.

Bandjermasin attained importance as a smuggling centre, which prompted renewed Dutch attention to retain control of commerce in the East Indies. In 1711 the Dutch opened trade relations with Bandjermasin, and built a factory there and another on Tatas Island in 1747. Somewhat later, a fort was erected at Tabanio to protect the factories. In 1787 the sultan was induced to cede his whole state to the Dutch East India company, but trade with the area was not rich in comparison with other areas of the Indies, and in 1809 the factories were abandoned as unprofitable. The Dutch had also established relations with the state of Pontianak, west Borneo, in 1771, and factories were built in Pontianak and Mampawah; these, however, were abandoned in 1791.

When the British occupied Dutch holdings in the Malay archipelago during the Napoleonic Wars, Sir Stamford Raffles, then the British governor-general of Java, answered a request for aid from the sultan of Bandjermasin by sending Alexander Hare to act as agent. The British worked to establish themselves in Borneo during this period, but in 1816 the peace treaty restored Dutch interests in the island and the British withdrew. Dutch influence gradually reasserted itself in the south, and in 1826 a treaty was signed with the sultan of Bandjermasin, who ceded to the Dutch areas on the east coast of Borneo, gave them the right to appoint a successor to the throne and to administer the state. War in Java turned Dutch attention and resources away from Borneo, and resentment at their interference with the succession eventually resulted in revolt. After a prolonged period of friction, the Dutch abolished the sultanate and declared Bandjermasin and its dependent areas to be Dutch territory. Opposition and revolt continued for many years and was not finally settled until 1886.

The state of Kutai, in east Borneo, had no official connection with the Dutch, but George Müller, while exploring in this area, obtained an acknowledgement of Dutch authority, and in 1844 a treaty was signed. A resident was appointed in 1846 and by 1908 a large measure of Dutch control was established in eastern Borneo. Tarakan Island, in the north, had come under Dutch control in 1850. The interior of Borneo, inland from Bandjermasin and Kutai, was explored in the late 19th and early 20th century and came under effective Dutch control in 1911. A. W. Nieuwenhuis, in the years 1893–98, explored much of the interior, but by the latter half of the 20th century the area was still not completely known.

The various states on the west coast had been constantly harassed by piracy and local quarrels, and the rulers and Chinese merchants gladly accepted Dutch overlordship to rid themselves of this menace. The Dutch were re-established by 1824, but were constantly embroiled in local wars. In the middle of the 18th century, attracted by diamonds and gold, there was a large migration of Hakka or Kheh Chinese from south China to the Sambas and Landak areas of west Borneo. About 1760, Chinese gold miners employed by the sultan of Sambas rebelled (with ample provocation) and took over the gold mines and considerable territory. This led to clashes with the Dayak population and coastal Malays, and added to the chaotic situation in this part of Borneo. The Chinese pushed inland and cut timber, planted pepper and engaged in extensive trade. Jungle produce, *bêche-de-mer*, rattan, shark fins, tortoise shell, bird's-nests, as well as pepper and Borneo camphor, were important items of commerce, and trade with China boomed.

As the number of Chinese increased in west Borneo they formed themselves into so-called "Kongsis," or small self-governing communities which paid small attention to the local sultans or the Dutch government. When the Dutch resumed control of their Borneo territories they were determined to establish control over western Borneo. They were attracted to the rich Chinese-controlled mines, and their subsequent actions were facilitated by an appeal from the sultan of Sambas for aid against the Kongsis. The sultan gave the Dutch the authority to purchase the mines, and starting in 1818 they sent military expeditions into the Chinese areas. A long period of warfare commenced. Eventually, because they controlled the sea, the Dutch won, and the Kongsis were defeated by 1854. The Chinese revolted in 1884 because they felt the Dutch were violating the terms under which Kongsi power had been abdicated. The Dutch victory over the Kongsis was an empty one, for during the long period of war the Chinese in the interior had been cut off from trade and had learned to live without it. Moreover, all immigration from China had ceased. The main ports, such as Singkawang and Pontianak, once prosperous trading centres for Chinese junks, did not recover their former importance. Mines had been abandoned, and some observers considered that in the 1960s western Borneo had still not recovered from this painful period.

3. British Influence.—The British had reached Borneo in 1609, but proceeded slowly in establishing trade relations. There was intermittent trade with the Bandjermasin area as early as 1614, but the British East India company was not able to establish a factory there until 1701. A good trade in pepper developed, and in 1706 the British solidified their hold by the construction of a fort, but were expelled the following year, with the assistance of the Chinese, because they had been interfering with native shipping. The pepper trade with southern Borneo was resumed in 1737, and continued until 1756 when the Dutch obtained from the sultan of Bantam a trading monopoly in his Bornean territory. In 1612 the British had established a factory at Sukadana, southwestern Borneo. Dutch competition stifled the British attempt,

and when the factory was destroyed by a Javanese force in 1622 the British company withdrew.

By the middle of the 18th century the British had failed in attempts to establish trade with south Borneo, but in 1762 a British expedition sent to capture Manila was ceded the island of Balambangan and the Sabah peninsula at the northernmost tip of Borneo, by the sultan of Sulu in gratitude for his release from Spanish captivity. The British also briefly occupied the island of Labuan (*q.v.*) at this time. A fort was built on Balambangan Island in 1771, but four years later was attacked and destroyed by the local chiefs who resented the cession of their territory. This action also negated a treaty of trade which had been signed with Brunei in 1774, and ended, for the time being, British influence in Borneo, partly because British interests had turned to the Malay peninsula as a control point on the sea route to China.

Chaotic conditions in Sarawak, the southern province of the sultanate of Brunei, provided the opportunity for the re-establishment of British influence in northern Borneo. In 1839, the Dayak and Malays in Sarawak rebelled against the oppressive rule of the sultan's governor. At this time James Brooke, a former officer with the East India company, arrived in Sarawak, and in return for his services in putting down the rebellion he was promised the title of raja and control of a large area of Sarawak. After some difficulty in getting the sultan to honour this agreement, Brooke was installed as raja of Sarawak in 1841. The next few years were spent in the suppression of piracy and head-hunting, often with the aid of British naval forces.

During the wars between the Dutch and the Kongsis in the 1850s, there was considerable migration of Chinese from the Sambas district into Brooke's domain. The Chinese, aroused by the second Anglo-Chinese war then in progress, formed a secret society intent on taking control from Raja Brooke and establishing an independent state. In 1857 the Chinese seized the capital, Kuching, and forced Brooke to flee, but the Malays and Dayak of Sarawak put down the revolt and restored order. The Chinese remained in Sarawak, and aided by migrants they formed one of the important elements in the country. Chinese also continued to migrate to Brunei and their migration to North Borneo was encouraged in the 19th century by the British Chartered company in order to obtain a supply of labour for the exploitation of the country. In the late 19th century large-scale Chinese immigration saturated the labour market; since that time sounder immigration policies have been established.

Under the provocation of the pirates who kept moving their bases of operation eastward, Brooke extended his control over all of Sarawak west of the Rajang river by 1861. By stages, the Brooke family extended control over more Brunei territory, under the rationale that the sultan's control was either ineffective or oppressive. By 1890 the sultan of Brunei controlled only a small portion of his original domain. In 1850 the United States recognized Sarawak as an independent domain, and recognition was given by Britain in 1864. In 1888 an agreement with the British government placed Sarawak under British protection, but the Brooke family maintained control over all domestic affairs. (*See* BROOKE, SIR JAMES; SARAWAK.) At this time there was great need for a coaling station to serve the rapidly growing steamship traffic to China, and Brooke had observed seams of coal in Brunei and on the offshore island of Labuan. In 1846 the British government accepted an offer from the sultan of Brunei to cede Labuan, and appointed Brooke governor of the new colony. The Dutch, also anxious to obtain coaling stations, protested the cession as a violation of a treaty signed in 1824 by which the British renounced activities in the Indies. Their protests were unsuccessful, but the activities of Britain in the north tended to stimulate Dutch interests in the consolidation of southern Borneo, and they developed coal supplies in Kutai on Laut Island off the southeastern coast of Borneo. Labuan became a British naval base, important in the suppression of piracy in Borneo waters.

Toward the end of the 16th century the power of Brunei started to decline, chiefly because of the loss of trade to the European powers. Anarchy and piracy prevailed, and under a variety of circumstances the sultans of Brunei were forced to give up the territories comprising Sarawak, North Borneo and the island of Labuan, so that within a period of 100 years Brunei was reduced in area from the northern third of Borneo to a small territorial enclave surrounded by its own lost territory. In 1847 the sultan had entered into a treaty with Britain to expand commercial relations and aid in the suppression of piracy. In 1888 a new treaty made Brunei a British protectorate, and in 1906 Brunei agreed to accept a British resident. Conditions gradually improved during the period before World War II, and a productive oil field near Seria was developed which made the small sultanate very prosperous. (*See* BRUNEI.)

North Borneo came under British control at the end of the 19th century. In 1872 the sultan of Sulu gave William Cowie, a gunrunner, permission to establish a base on Sandakan bay. Cowie was also given other trading privileges in North Borneo, but he ran into opposition from an American, Joseph William Torrey, who claimed trading privileges for the area under an older grant from the sultan of Brunei. Torrey joined with Baron Gustavus de Overbeck who represented a private syndicate headed by two English brothers, Alfred and Edward Dent, and although the sultan of Brunei had no right to cede the territory and despite the protests of the Spanish and Dutch governments who had claims in the area, the Dents became the possessors of a large part of North Borneo for which they paid an annual rent to the sultan of Brunei. They then formed a limited provisional association, which became the British North Borneo company in 1882, incorporated by royal charter. In 1888 the state was made a British protectorate, and for the next 20 years territorial consolidation took place, the final boundaries being defined in 1905. (*See* SABAH.)

4. Mid-20th Century.—During World War II, the Japanese invasions of Borneo in 1941–42 quickly eliminated the token British and Dutch forces on the island, and all of Borneo passed under Japanese control. The three and one-half years of occupation was marked by oppressive measures, particularly directed toward the captive Europeans and the Chinese community. Borneo was one of the first areas in the Indies to feel the force of Allied action. From 1944 on the Allied air forces raided all over Borneo, concentrating on the oil fields and port installations. The island of Labuan was reoccupied by Australian forces in June 1945, and Tarakan Island shortly thereafter. British military government was established in the northern areas of Borneo, and reconstruction began.

The raja of Sarawak ceded the protectorate to Great Britain, and on July 1, 1946, it became a crown colony. The reconstruction and development of Borneo was beyond the resources of the chartered company, and North Borneo, including Labuan, became a crown colony on July 15, 1946.

In Dutch Borneo a strong nationalist movement developed, and led to fighting between Indonesians and the Dutch forces. British troops were landed to restore order, but the independence movement flourished. Transfer of sovereignty by the Netherlands to the Indonesians took place on Dec. 27, 1949. (*See* INDONESIA, REPUBLIC OF.) In Aug. 1950 a new constitution was proclaimed and Dutch Borneo became part of the Republic of Indonesia.

The British government relinquished its sovereignty over North Borneo and Sarawak in Sept. 1963 when these territories joined the Malaysia federation. Indonesian hostility to the new federation expressed itself in the form of raids across the borders of Sarawak and Sabah (North Borneo) by guerrillas operating from Indonesian Borneo. The Malaysian government took defensive measures. (L. A. P. G.)

VI. POPULATION

The population of Borneo is extremely varied, with two-thirds of it in Indonesian territory (Kalimantan), for which no reliable statistics have been available since before Japanese occupation in World War II (1941).

The population in general is rapidly increasing, especially among the Iban and Chinese. But the island as a whole, including huge tracts of the interior, is sparsely inhabited by Asian standards. The total is probably still less than 6,000,000, of whom 750,000 were estimated for Sarawak (end of 1962), rather less in North

Area and Population of the Parts of Borneo

Political Unit*	Area sq.mi.	Population 1960 Census	Density per sq.mi.
Brunei	2,226†	83,877	37.7
Belait	1,059	31,708	29.9
Brunei	204	37,511	183.9
Temburong	505	3,948	7.8
Tutong	457	10,710	23.4
Malaysian states			
Sabah (North Borneo)	29,388	454,421	15.5
Interior	7,648	102,309	13.4
Sandakan	10,330	73,943	7.2
Tawau	6,189	71,719	11.6
West Coast	5,221	206,450	39.5
Sarawak	48,250‡	744,529	15.4
First	3,464	247,954	71.6
Second	4,129	109,422	26.5
Third	22,465	261,487	11.6
Fourth	15,094	96,666	6.4
Fifth	3,190	29,000	9.1
Indonesian Borneo (Kalimantan)	208,286	4,101,475§	19.7
West Indonesian Borneo (Kalimantan-Barat)	56,664	1,581,034§	27.9
Central Indonesian Borneo (Kalimantan-Tengah)	58,919	496,522§	8.4
South Indonesian Borneo (Kalimantan-Selatan)	14,541	1,473,155§	101.3
East Indonesian Borneo (Kalimantan-Timur)	78,162	550,764§	7.0
Total	288,150	5,384,302	18.7

*Sub-divisions of Brunei are administrative districts; of Sabah, residencies; of Sarawak, divisions; and of Indonesian Borneo, provinces.
†Sub-division areas do not add to total because of rounding.
‡The officially accepted total area; does not equal the sum of the divisions.
§1961 census.

Borneo, 85,000 in the state of Brunei and the balance in Indonesia.

This population may be divided into four main elements: the native Dayak and other inland inhabitants, about 3,500,000; Chinese, about 1,500,000; Malays and other coastal Muslims, about 950,000; others (Europeans, Indian, Javanese, etc.), about 25,000.

The Dayak peoples are Borneo's farmers and primary suppliers of jungle produce. Trade is largely in the hands of Chinese middlemen. Although there is indisputable evidence of the presence of Chinese traders for the past 1,000 years (see *Archaeology* above), there was a break in occupation during the Ming dynasty, and the present Chinese population—of many subraces—is relatively recent. The Malays play a major part in the administration of all the territories, having a tradition of public service. The others live in the larger towns and are concentrated about the administrative centres of Sambas, Jesselton, Sandakan, Brunei town, Sibu, Kuching, and in the oil fields of Seria, Kuala Belait, Miri, Tarakan, Balikpapan and Bandjermasin (see *The People*, above). *See* also references under "Borneo" in the Index.

(T. Hn.)

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BORNEOL (also known as Borneo camphor): *see* Camphor.

BORNHOLM, a Danish island and *amt* (county) of 588 sq.km. (227 sq.mi.) in the southwestern approaches of the Baltic sea, lies 169 km. (105 mi.) S.E. of Copenhagen and 36 km. (22 mi.) S.E. of Skaane, Swed. Rhomboid in shape, from northwest to southeast its length is 35 km. (22 mi.) and its average width 21 km. (13 mi.). Pop. (1960) 48,373. The northern two-thirds of the island consists of a block of Pre-Cambrian granite, giving a rocky cliff coast and a hilly interior reaching 162 m. (531 ft.) in Rytterknaegten. Deep fissure valleys, such as Dyndal and Ekkodal, lie within the glaciated granite upland. The southern, more populous, part of Bornholm forms an undulating lowland of sandstones, limestones and shales of Cambrian to Silurian age with Triassic, Jurassic and Cretaceous rocks in the southwest. On the boulder-clay covered surface barley, oats and wheat are grown; the raising of dairy cattle and pigs is extensive. Granite, sandstone and limestone are exported, while porcelain, pottery, tiles, drain pipes and refractory bricks are made from local kaolin and clays around Rönne. Fishing for salmon and cod is carried on from Rönne, Hasle, Allinge, Gudhjem, Tejn, Listed, Svaneke and Neksö, the smoking of herring being important in summer. The island's sole railway links Rönne (pop. [1960] 13,195), the capital and chief port, with Neksö (3,220). Many tourists visit the ruined 13th-century castle of Hammershus and the fortified churches which testify to Bornholm's eventful history. Controlled by Sweden, the Hanseatic league, Denmark, and then by the city of Lübeck, it finally passed to Denmark in 1660. (Ha. T.)

BORNIER, HENRI, Vicomte de (1825–1901), French poet and dramatist, was born in Lunel (Hérault) on Dec. 25, 1825, and died in Paris on Jan. 28, 1901. He served for half a century in the Arsenal Library, when he rose to be director in 1889. In 1893 he was elected to the Académie Française. His first volume of lyrics, *Premières Feuilles*, appeared in 1845, and his *Poésies Complètes* appeared in 1894. His best known work, however, was done for the theatre, in historical verse dramas. The most famous were *Le Mariage de Luther* (1845), *La Fille de Roland* (1875), *Les Noces d'Attila* (1880), and *Mahomet* (1888). In *La Fille de Roland*, his major work, he went back to the national legend of Charlemagne for his subject, and his grandiose treatment of the conflict between love and honour inevitably provoked comparison with Corneille.

BORNITE, a copper-iron sulfide, is an important ore of copper. It usually occurs as a vein mineral in massive aggregates intergrown with chalcocite and chalcopyrite (*qq.v.*) and also important ores of copper. The colour of a freshly fractured surface of bornite is coppery, but in moist air this rapidly tarnishes with iridescent blue and red colours; hence the names peacock ore, purple copper ore, variegated copper ore (Ger. *Buntkupfererz*), horseflesh ore and erubescite (from the Latin *erubescere*, "to grow red"). The lustre is metallic, and the streak grayish-black; hardness is 3; specific gravity is 5. Occurrences of bornite are common and widespread being nearly always of plutonic origin. It occurs in dikes (Gilpin county, Colo.); in basic intrusive formations (Namaqualand, S.W.Af.); and in contact metamorphic deposits (Marble Bay, B.C.). It is also mined at Butte, Mont.; Bisbee, Globe and Ajo, Ariz.; Braden, Chile; and Redruth, Cornwall.

Crystals of bornite are rare and have been found only in druses, or crystal-coated surfaces, in veins, as at Bristol, Conn. Above 220° C. bornite crystallizes in the cubic system, inverting upon cooling to a pseudocubic crystal of lower symmetry but maintaining the cubic morphology. The formula of bornite is Cu_5FeS_4.

(A. J. F.)

BORNU, a region of the central Sudan southwest of Lake Chad, now a province (area 45,733 sq.mi.) of Northern Nigeria, was formerly the centre of one of the longest-lived and most notable of Sudanic empires, that of Kanem-Bornu. The greater part of the province lies in the Sudan savanna belt and comprises a flat sandy plain, with a little laterite in the west.

History.—In about the 8th century A.D., Kanem, north of Lake Chad, then, like Bornu, inhabited by groups of Negro agriculturists collectively known as Sao, was invaded by the Sefawa, non-Negro horsemen, who gradually established their hegemony over the country. The Sefawa claimed descent from Sayf ibn Dhu Yazan, the 6th-century Himyarite hero who called in the Sassanids to rid

the Yemen from Axumite rule. Sayf himself is not supposed to have gone to Kanem, the effective founder of the dynasty and first *mai* ("king" or "chief") of Kanem being Dugu, traditionally thought to be Sayf's grandson. If Dugu is a historical personage, he may be dated *c.* 800. The trend of modern opinion follows accounts of the central Sudan by Arab writers from Ya'qubi (*c.* 891) onward, that the invaders were members of the Zaghawa, the great confederation of Libyan nomads then dominating the eastern Sahara; any Yemeni or Nubian influence in early Kanem would thus be at best indirect.

Initially the Sefawa kept themselves distinct from the Negroes they dominated, avoiding settlement in any one place and eschewing intermarriage. But through their contacts with the desert nomads, trade developed between Kanem and north Africa via the Fezzan, and Njimi emerged first as the commercial centre of the country and then as its political capital. With trade, Islam came to Kanem; Umme (1085–97) was the first Muslim *mai*. The process of converting the irregular nomad hegemony into a formal Muslim state seems to have begun with Umme's son Dunuma (1097–1150). Through trade and the hadj ("pilgrimage"), regular relations were established with Tunis and Egypt, and Muslim concepts of law, administration and taxation, as well as such material innovations as building in burned brick, were introduced and blended with the conciliar and feudal notions of nomadic times. A regular army was raised from vassal nomad horsemen and levies of Negro bowmen and spearmen, and an empire was built up which reached north to the Fezzan and embarked on the colonization of Bornu. After political stabilization, the Sefawa began to merge with the conquered Negroes (the sobriquet Silim, "the Black," applied to *mai* Abd al-Jalil [*c.* 1193–1220] is significant) and in this way the distinctive Kanuri people and language began to develop.

By about 1300, Kanem was a Sudanic centre of Islamic civilization comparable to Mali in the west, but then dynastic jealousies and the rise of a rival group of nomad invaders, the Bulala, led to the disruption and downfall of the empire. But by the time of Ali Dunamani (*c.* 1475–1505), the Sefawa had re-established themselves in the erstwhile province of Bornu, and N'gazargamu was becoming a new imperial capital. During the 16th century the power of the revived monarchy steadily increased. The eastern Hausa states were made tributary and Kanem was reconquered, though its administration was left to Bulala vassals. Aïr was brought within Bornu's influence, and relations with Tunis were re-established. The new empire reached its peak under Idris Alooma (*c.* 1575–1610). Going early on the hadj, Idris introduced firearms and Turkish military instructors to Bornu, building up a formidable power which enabled him not only to dominate neighbouring states but also to make the authority of his rule and of Muslim law unquestioned among unruly vassals within his own domains.

Idris Alooma's achievement was maintained by his sons for about 50 years, but then the *mais* began to concern themselves too much with the etiquette and pleasures of court life, the administration deteriorated and the empire declined under pressures from the Tuareg nomads of the Sahara and the Kwararafa in the south. Hausa cities like Kano and Katsina replaced Bornu as the major entrepôts for the central Sudan's trade with north Africa.

Early in the 19th century a new political power appeared on the scene when the Fulani jihad (religious war) against the Hausa kings resulted in the establishment of the empire of Sokoto under Usuman (Othman) dan Fodio and his son Mohammed Bello. Bornu, into which Fulani had been infiltrating since the 13th century, was attacked in 1808. The *mai* was driven from N'gazargamu, but his appeal for aid was answered by a remarkable fakir from Kanem, the *shehu* (sheikh) Mohammed al-Amin al-Kanemi (Laminu), who was convinced that, whatever may have been the case with the Hausa states, Bornu and its people were as rightfully Muslim as Bello and his Fulani. Laminu led a national revival which expelled the Fulani and made him the real, if not the titular, master of Bornu, Kukawa becoming the new capital. When he died in 1835 the remaining Sefawa sought to expel his son 'Umar, but they were defeated and killed, 'Umar assuming the titular kingship with the title of *shehu*.

In 1893 Bornu was conquered by Rabah Zubayr (*q.v.*), but it was now rapidly coming within the European sphere of influence. Dixon Denham, Hugh Clapperton and Walter Oudney had been the first European visitors in 1823; they were followed by Heinrich Barth, who got to know the country well during 1851–55, and by Gerhard Rohlfs (1866) and Gustav Nachtigal (1870). Rabah was eventually defeated and killed by the French in 1900, but in 1902 Bornu was occupied by Frederick Lugard's British forces who reinstated the heir of the *shehu* killed by Rabah, and made Bornu a province of the British protectorate of Northern Nigeria. From then on, its history was associated with that of Northern Nigeria (*see* NIGERIA). (J. D. F.)

The People.—Bornu province in Nigeria, though but the central fragment of the old Bornu state and empire, is populated by many tribes, their ethnic, linguistic and cultural variety reflecting the history of that empire. The Kanuri (*q.v.*) are the dominant people. They occupy the plain of the eastern Chad basin, now Bornu division, the largest of the five divisions of the province and the realm of the *shehu* of Bornu. In 1960 they numbered, together with some Kanembu clans, about one-half of the total population of 1,833,209 in the province. A very dark-skinned people of Negro appearance, their ancestry may nevertheless include a Berber strain. Their language, resembling neither the Berber spoken by the Tuareg north of Chad nor any of the Nigerian languages, is cognate with Teda (Tubu) in the Tibesti area of the southeastern Sahara. In the International African institute's classification of African languages Kanuri is classed as a member of the Eastern Saharan group whereas J. H. Greenberg puts it in the Central Saharan family. The Bornu state has long administered Koranic law, and Muslim rules of marriage prevail among the Kanuri, though not among many of the tribes in the former empire. Like all the people of Bornu province, the Kanuri are patrilineal. Like all except the Fulani, they bear distinctive patterns of tribal markings cut into the face; an element of these patterns characteristic of the Kanuri (though shared by the Bade and Tera) is a single vertical line down the forehead.

A ring of tribes descended from an earlier population encircles the Kanuri: on the islands of Lake Chad, the Buduma and Kuri; in the high, broken massif to the south, the Gamergu, Bura, Margi, Tera and others; westward in the open country with its scattered hills that was once the marchland with Kano and Zazzau, the Ngamo (Gamawa), Karekare and Ngizim; and in the Sahel savanna from the middle Yobe north toward the Sahara, the Bade (Bedde). The Bade, who have drifted southward pressed by the Tuareg, are becoming Muslims and their culture has borrowed much from the Kanuri; they have a *mai* who is now the head of Bedde division. The petty states to its southwest, Auyo, Techena and Shira, are probably of Bade origin. The rest of these tribes, less influenced by the Kanuri, have many cultural features in common: religions characterized by sky and earth deities and ancestor worship, and a stateless social organization in which jural authority is confined within the local group or exogamous patrilineage. Between the Bade and Lake Chad are the Manga, a Kanuri-speaking people perhaps descended from the So, reputedly a race of giants driven from the eastern shores of the lake by the Kanuri when they left Kanem. The Bolewa of Fika, speaking a Chad language, are ruled by a king (*moi*), who formerly exacted annual tribute from the Ngamo, Ngizim and Karekare. They claim to have arrived with the Kanuri, as do the Pabir of Biu to whose chiefs the Bura bring cases for settlement. Members of all these tribes except the Kanuri number about 575,000 in Bornu.

The two exclusively pastoral peoples in Bornu, the Shuwa Arabs (98,909) and the Fulani (*q.v.*) (168,944), arrived later; a 16th-century *mai* of Bornu is recorded as the first to have allotted grazing rights to the Fulani. The numbers of both greatly increased in the 19th century, when the Fulani carved the emirates of Hadeijia (Kano province) and Katagum (Bauchi province) out of the Bornu empire, and al-Kanemi invited in more Shuwa to subdue those in central Bornu. (P. M.-W.)

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BORODIN, ALEKSANDR PORFIREVICH (1833–1887), Russian composer of symphonies and opera in an epic-heroic style, and also a scientist notable for research on aldehydes and amarine, was born in St. Petersburg, Nov. 12 (new style; Oct. 31, old style), 1833. He was the illegitimate son of an Imeretian prince by the wife of an army doctor.

He early showed marked gifts for languages and music, learned to play the piano, flute and cello, and composed even as a schoolboy. From 1850 to 1856 he studied at the Medico-Surgical academy, where he specialized in chemistry; in 1858 he was granted a doctorate for his thesis on the analogy of arsenic acid with phosphoric acid. From 1859 to 1862 he studied in western Europe, mostly at Heidelberg and in Italy, and made the acquaintance of a young Russian pianist, whom he married on his return to Russia.

He was at once made "adjunct-professor" of chemistry at the Medico-Surgical academy and became full professor in 1864, yet from the same period dates his first important composition, a symphony in E flat written between 1862 and 1867 as a result of his acquaintance with Balakirev and his circle. The success of this symphony when performed in 1869 led to the composition of a second, in B minor. From the same year until the end of his life Borodin was engaged desultorily on an opera, *Prince Igor;* he also found time to write two string quartets and a dozen remarkable songs. But Borodin's musical work was never more than a relaxation from his professional work: research, teaching and administration. He was active not only in the academy but in the medical courses for women which he helped to found in 1872, and during the 1880s pressure of work and ill-health left little leisure for composition. He died suddenly at a ball in St. Petersburg, Feb. 27 (N.S., 15, O.S.), 1887.

Few though they are, Borodin's compositions are outstanding. His two completed symphonies, with the torso of a third (in A minor), and his quartets place him in the front rank of Russian instrumental composers; *Prince Igor,* completed by Rimski-Korsakov, is a classic of Russian opera. Borodin had a strong lyrical vein but was also outstanding in both the epic-heroic and the epigrammatic manner.

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BORODIN, MIKHAIL MARKOVICH (1884–1953?), known also by his original surname, Grusenberg, was a Russian diplomat and political adviser. Born July 9, 1884, in Yanovichi, Vitebsk province, Russia, Borodin as a young man joined various anti-tsarist movements and in 1906 attended the Stockholm conference of the Russian Social Democratic Labor party. In that same year he was arrested and exiled. After emigrating to the United States, he attended Valparaiso university, Valparaiso, Ind., and then founded a school for *émigrés* in Chicago. After the Bolshevik revolution of 1917 he returned to his native country and was dispatched as a Communist agent to Spain, Mexico, Scotland, the United States and elsewhere. He reached the peak of his career between 1923 and 1927 when he served as chief Comintern agent in China and as adviser to the Kuomintang government. When the Kuomintang broke with the Communists in 1927 he returned to Moscow and became editor of the *Moscow Daily News,* published in English. During the 1930s he disappeared from public life and is believed to have died in a Siberian prison camp some time before Sept. 3, 1953, when his death was announced. (R. C. N.)

BORODINO, BATTLE OF, the battle fought on Sept. 7, 1812, between Napoleon's French and allied forces and M. I. Kutuzov's Russian troops. After Napoleon's invasion of Russia with greatly superior forces late in June 1812 the Russians had been withdrawing before him, fighting rear guard actions but avoiding a major battle. When Kutuzov halted his retreat at Borodino, 70 mi. W.S.W. of Moscow, Napoleon's *masse de manoeuvre* had been reduced to 130,000 men. The Russians, 127,000 strong, adopted a strong defensive position, constructing redoubts along the heights east of Borodino, their left flank protected by woods, their right wing by the tributary to the Moskva river, which covered their right flank and rear. Ignoring Davout's advice against an almost exclusively frontal assault, Napoleon massed his main forces, 90,000 men, on a front of only two miles, retaining behind his centre a reserve (27,000) of two divisions and the guard. On the far French right J. A. Poniatowski was to lead 10,000 men, too few to exert a decisive effect on the battle, against the extreme Russian left wing. After a day of preparations, the battle began before 6 A.M. on Sept. 7. On the French left Eugène de Beauharnais captured the advanced posts in Borodino but was halted before the central redoubt. On the right Ney and Davout, supported by Murat, at length established themselves in the emplacements near the village of Semenovskoye. Russian counter-attacks could not oust the French, supported by massed artillery, from the ground won, or prevent the eventual loss of the central redoubt. Napoleon refused to commit the guard, and it is doubtful whether the use of his remaining reserve could have transformed an inconclusive advantage into an undeniable victory. After more than 12 hours fighting the Russians had been forced back 2,000 yd. Retiring in reasonable order, they then withdrew to the south of Moscow to observe the French, who entered the city on Sept. 14. The Russians had lost about 45,000 killed and wounded, the French 30,000. (J. H. N.)

BOROEVIĆ VON BOJNA, SVETOZAR (1856–1920), Austro-Hungarian field marshal, was born at Umetic in Croatia. He served through the campaign for the occupation of Bosnia in 1878, and afterward on the general staff until he reached the rank of general. In World War I he first led the VI Corps in the victorious battle of Komarow, and as commander of the 3rd Army beat off the Russian attacks in the Carpathians until May 1915. He then took over the command on the Isonzo River. His name is associated with 11 victorious battles fought in the defense against Italian armies twice as numerous as the Austrians and considerably better equipped. After the collapse of the monarchy the Yugoslav government refused him permission to return to his province. He died on May 23, 1920, at Klagenfurt, Aust.

BOROLANITE, in petrology, a plutonic alkali igneous rock occurring near Loch Borolan, Assynt (northwest Scotland). The typical rock, forming part of the Borolan igneous complex of Lower Paleozoic age, is a remarkable variety of melanite-nephelite-syenite exhibiting large rounded or polygonal white spots from $\frac{1}{4}$ to $\frac{3}{4}$ in. across, set in a dark base of orthoclase, melanite garnet, and biotite. The white spots consist largely of orthoclase partly intergrown with a mineral derived from nephelite, identified in various examples as sodalite, natrolite, sericite, or sulfatic cancrinite. These spots have been interpreted as pseudoleucite intergrowths derived during crystallization of the magma from originally precipitated leucite, an origin to which bulk analysis of the spots gives some support. Borolanite in its type outcrop has been partly crushed and sheared with the spots pressed out to white streaks during the Caledonian thrust movement which affected the region. (C. E. T.)

BORON, a semimetallic element, occurs in nature as boric acid (boracic acid, sassolite), as borax (tincal) and in numerous other widely distributed borate minerals (*see* BORAX and BORIC ACID), which may represent as much as .001% of the earth's crust. As borax it was known to ancient peoples (Arabic, *buraq;* Persian, *burah*) but was often confused by medieval writers. The name boron, analogous to carbon, was coined by Sir Humphry Davy. In the

form of boric acid or borates, this element is necessary for the growth of plants, and thus is essential to the continuation of animal life as well.

Small quantities of boron (from .0005% to .005%) are used for the manufacture of steel of special hardness. Boron is used also in the manufacture of glass, and, in conjunction with aluminum, for the manufacture of highly conductive electrical wire. The boron hydrides (boranes) range from compounds so reactive as to be employed as rocket fuels, to materials so inert as to be promising in the field of heat-resistant plastics. Quite different from either is the boric acid derivative used in gasoline to minimize preignition.

Properties.—Boron is the lightest member of the third group of the periodic system. Symbol B, atomic number 5, electronic structure $1s^2 2s^2 2p^1$, ionization potential for first electron 8.257 v., atomic weight 10.82, stable isotopes 10 and 11, radioactive isotopes 8, 9 and 12 (half lives <1 sec.).

The free element was first recognized with certainty in 1808, by J. L. Gay-Lussac and L. J. Thénard, who made it in the form of a black powder by heating boron oxide (B_2O_3) with metallic potassium. Magnesium is more convenient than potassium for this reduction, but any oxide method allows impurities which are very difficult to eliminate. E. Weintraub (1909) passed a mixture of hydrogen and boron chloride across an electric arc, forming rods of pure boron on the water-cooled copper electrodes. A. W. Laubengayer and associates (1943) deposited pure crystalline boron upon a tantalum filament heated to 800°–1300° C. in an atmosphere of hydrogen and boron bromide; this method has been extended to make pure boron rods more than two inches in diameter. Large batches of boron can be made by passage of direct electric current through a melt containing boron oxide, magnesium oxide and magnesium fluoride at a temperature of 1,100° C. (J. L. Andrieux, 1927).

Pure boron in fine-powder form is jet-black, but the massive form has a dull metallic lustre. Its density is 2.31; the covalent single-bond radius has been variously estimated from 0.80Å to 0.88Å (10^{-8} cm. units), and may actually lack definition. Boron is hard enough (9.3 Mohs) to scratch carborundum, but it is too brittle for use in tools; the fracture is conchoidal. Its slight electrical conductance increases not more than one hundredfold on heating from 20° to 600° C. and its specific heat rises from 0.3 to 0.6 cal. per gram degree. It melts and boils above 2,200° C.

Boron is chemically almost inert at ordinary temperatures, although the fine powder is ignited by elementary fluorine or slowly converted to boric acid by the action of hot nitric acid. At elevated temperatures it acts like carbon: heavy metal oxides are reduced to metals, often with formation of borides (*q.v.*). At 600° C. or higher, water vapour converts the powder to boric acid, or molten alkali hydroxides oxidize it to borate, with liberation of hydrogen; also, boron chloride, bromide, sulfide, selenide, oxide, nitride or carbide can be formed from the elements. Of these compounds, the first four are most easily hydrolyzed to boric acid and volatile hydrogen compounds, or similarly attacked by alcohols, ammonia or amines.

In accord with its place in the periodic system, boron can be assigned a valence of three in many of its compounds, but the valence concept becomes somewhat indefinite because the boron atom has a strong tendency to complete an electron octet—either by electrons which form extra bonds from adjacent atoms (halogen, oxygen, nitrogen or others) in planar BX_3 atomic arrangements, or by single bonding to four atoms at once, as occurs in many compounds of elements in Group IV.

Boron Halides.—The ability of boron to form a fourth bond is especially evident in the chemistry of the boron halides (formula type BX_3), which form innumerable compounds with ethers, amines and other substances able to offer electron pairs for bonding, or undergo reactions of hydrolysis type through the intermediate formation of such molecular addition compounds. Boron fluoride (boiling point −100° C.) has important catalytic effects which are ascribed to its electron-acceptor bonding power; it may be even more versatile than aluminum chloride for promoting condensations, rearrangements, isomerizations and substitution reactions of carbon compounds. Four-co-ordinate boron appears also in the BF_4^- ion (fluoborate), salts of which can be made by direct addition of boron fluoride to a metal fluoride or by the action of hydrofluoric acid upon a metal borate, in aqueous solutions.

Boron fluoride can be generated in the laboratory by heating boric acid with calcium fluoride and sulfuric acid, but a more pure product is obtained from a fluoborate salt with boron oxide and sulfuric acid or by heating benzene-diazonium fluoborate.

Boron chloride (BCl_3; b.p. 12.5° C.) and boron bromide (BBr_3; b.p. 91° C.) may be prepared by the action of the halogens on boron or calcium boride (500°–800° C.) or by halide exchanges between boron fluoride and the aluminum halides at 200°–300° C. Boron iodide (BI_3; m.p. 50°, b.p. 210° C.) can be made by the action of hydrogen iodide upon the chloride or bromide, or by the action of iodine on an alkali metal borohydride. It is unstable relative to the elements and polymeric subiodides.

The subhalides B_2Cl_4 and B_2I_4 are formed from boron chloride or iodide by removal of halogen in an electric discharge at 1 mm. pressure. Their room temperature decomposition forms lower halides such as B_4Cl_4. Hydrogen is avidly absorbed by B_2Cl_4, which also adds as BCl_2 units to the C=C double bond.

The hydrolysis of boron fluoride is incomplete, whereas the other boron halides rapidly form hydrogen halides and boron oxyacids. The similar ammonolysis produces indefinite polymers such as $(HNBNH_2)_x$ and finally boron nitride at high temperatures.

Boron Nitrides, $(BN)_x$.—Ordinary boron nitride can be made from the elements or from many compounds containing them. Its refractory and electrically resistant soft, white crystals have a layered-plane structure like that of graphite except that all B and N atoms are on BNBN . . . lines perpendicular to the planes. Under a pressure of 70,000 atmospheres at 1,600° C., it converts to a form called borazon (Wentorf, 1957). This has the structure and hardness of diamond; moreover, it resists action by the open air at 1,900° C., whereas diamond burns below 900° C. It may become a uniquely valuable component in tools meant for high-temperature machining of hard refractories and, if made available in larger quantities, would serve as an important refractory in its own right.

Organo-Boron Compounds.—Compounds with boron attached to carbon can be made most easily by the action of a Grignard reagent, RMgX, upon a boron halide or a boric acid ester. Dialkyl-zinc compounds were used for the same purpose by E. Frankland (1862). The trialkylborines, R_3B, usually inflame in air but hydrolyze or ammonolyze only at elevated temperatures. They form a weak fourth bond to ammonia or amines, but bond strongly to an alkide ion, as in the fairly stable $LiB(CH_3)_4$ and $LiB(CH_3)_3C_2H_5$. The triarylborines, such as $(C_6H_5)_3B$, are less active toward air, but form far more stable complexes with ammonia. They react with sodium to form coloured free-radical ions analogous to triphenylmethyl (E. Krause, 1924):

$$2Na + 2R_3B \rightarrow (Na_2B_2R_6) \rightleftarrows 2Na^+ + 2BR_3^-$$

With some aryl groups, salts of the type Na_2BR_3 are formed; probably analogous is $Na_2HB(CH_3)_2$, a very strong base.

Compounds of the type R_2BX are formed by carefully controlled oxidation or halogenation of R_3B compounds. Hydrolysis of R_2BX compounds yields R_2BOH, which may be dehydrated easily to form R_2BOBR_2. Many compounds of type RBX_2 are known, and lead to alkyl and aryl boric acids by hydrolysis (*see* Boric Acid), or to $(RNBR)_3$ compounds by aminolysis.

THE HYDRIDES OF BORON

The boron hydrides (boranes) offer an unusual variety of structural principles and chemical behaviour. They had been known only as the unstable and self-inflaming gaseous reaction product of magnesium boride in aqueous acids, and were misconceived until A. Stock (1912) developed high-vacuum methods and apparatus whereby the individual compounds were shown to be as follows: an unstable tetraborane (B_4H_{10}; m.p. −120°, b.p. 18° C.), a stable pentaborane (B_5H_9; m.p. −47°, b.p. 48° C.), very little of a somewhat unstable hexaborane (B_6H_{10}; b.p. about 100° C.) and traces of a well-crystallized and very stable decaborane ($B_{10}H_{14}$;

m.p. 100°, b.p. 213° C.). On standing tetraborane yielded diborane (B_2H_6; m.p. −165°, b.p. −93° C.; too easily hydrolyzed to have escaped from the HCl solution), a further yield of decaborane, a very unstable pentaborane (B_5H_{11}; m.p. −123°, b.p. 63° C.) and indefinite solid products. The yields of volatile hydrides from the aqueous acid system were low, and the whole process was tedious and expensive.

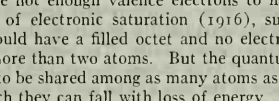
More efficient was the method of H. I. Schlesinger and A. B. Burg (1931): hydrogenation of boron trichloride in a silent electrical discharge (possibly through formation of B_2Cl_4, which absorbs hydrogen rapidly), and disproportionation of the resulting chlorodiboranes; thus

$$6B_2H_5Cl \rightleftarrows 2BCl_3 + 5B_2H_6$$

This elaborate process was superseded through the discovery (Schlesinger and associates, 1947 *et ante*) of convenient methods based upon alkali metal hydrides. Thus sodium hydride reacts with an alkyl borate to form $NaHB(OR)_3$, from which diborane can be generated by treatment with the ether complex of boron fluoride; or lithium hydride under ether will convert a boron halide to diborane, best through intermediate formation of borohydride (BH_4^-); or lithium aluminum hydride (*see* HYDRIDES) can be used with a boron halide to produce diborane.

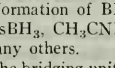
Diborane, tetraborane, the unstable pentaborane and hydrogen form a system of easily reversible reactions (greatly favouring diborane), from which the stable pentaborane, decaborane and indefinite nonvolatile solids are formed irreversibly at elevated temperatures. Hence any of the higher boranes can be made by heating diborane under conditions favourable to the desired product; however, hexaborane is difficult to obtain in this way.

The formulas of the boranes were considered anomalous even as they were being discovered; for any arrangement of the atoms in space, there are not enough valence electrons to meet the G. N. Lewis concept of electronic saturation (1916), such that every boron atom would have a filled octet and no electron pair would be shared by more than two atoms. But the quantum theory permits electrons to be shared among as many atoms as can offer open space into which they can fall with loss of energy. In the case of diborane the evidences of spectroscopy, heat capacity and electron diffraction all favour the model



in which two electron pairs occupy energy states (orbitals) established by the two B–H–B groupings of atoms. Diborane thus is far more stable than separate BH_3 groups, for it represents a step toward electronic saturation; however, the bridge system is easily broken by any substance offering electrons for a more normal completion of the electron octet of boron. Hence most reactions of diborane occur through formation of BH_3 complexes: H_3NBH_3, R_3NBH_3, R_3PBH_3, R_3AsBH_3, CH_3CNBH_3, R_2OBH_3, R_2SBH_3, BH_3CO, BH_3PF_3 and many others.

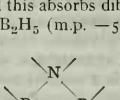
In the higher boranes, the bridging unit may be



or something more complicated; however, a tertiary amine breaks such bridges also, forming R_3NBH_3 and inert aminated $(BH)_n$ polymers. In B_5H_9, X-ray and electron diffraction results show a tetragonal-pyramidal arrangement of boron atoms, with four B–H–B linkages holding the square base together; and $B_{10}H_{14}$ is like a regular icosahedron with a pair of boron atoms removed. Both B_5H_9 and $B_{10}H_{14}$ have been mentioned as sources of high-energy fuels, the use of which would add substantially to the distance traveled by a rocket or guided missile which carries its own fuel for long-range propulsion. Such materials are less dangerous to handle than certain more energetic highly volatile borohydrides.

Protolytic Reactions.—Diborane reacts with hydrogen chloride slowly, liberating hydrogen and forming B–Cl bonds; the similar reactions of BH_3 complexes are much faster, suggesting that activation for a hydride-type reaction is easier. The rapid reaction of diborane with water yields only boric acid and hydrogen, but may well go through stages such as $H_2O.BH_3$, $HOBH_2$, $HOBH_2.H_2O$, etc. With methanol $(CH_3O)_2BH$ (m.p. −130°, b.p. 26° C.) is obtained; similar compounds form quickly at −78° C. from aldehydes or ketones—again through formation of BH_3 complexes which cannot be isolated.

With ammonia or amines, borine complexes and definite steps in their protolyses are easily recognized. By absorbing diborane into dimethylamine (1:2 mole ratio) and heating, dimethylaminoborine, $(CH_3)_2NBH_2$ (m.p. 74° C.; forms an N-bridged dimer), may be formed easily, and this absorbs diborane to form dimethylaminodiborane, $(CH_3)_2NB_2H_5$ (m.p. −54°, b.p. 50° C.), a stable liquid having the



unit in its molecular structure. The corresponding ammonia product, $H_2NB_2H_5$ (m.p. −66°, b.p. 76° C.), easily loses a BH_3 group as diborane, leaving a white polymeric solid $(H_2NBH_2)_n$. A far more stable XBH_2 polymer is $[(CH_3)_2PBH_2]_3$ (m.p. 85°, b.p. 312° C.), which is made from $(CH_3)_2PH.BH_3$ by heating above 150° C. (Burg and Wagner, 1953). It is chemically almost inert, requiring temperatures above 300° C. for hydrolysis. The tetrameric form is only slightly less stable. However, $[(CH_3)_2AsBH_2]_3$ is less stable and more reactive, and $(CH_3)_2SbBH_2$ is a reactive monomer.

Another stage of protolysis is represented by borazine ($B_3N_3H_6$; m.p. −58°, b.p. 53° C.), a liquid analogous to benzene but capable of forming addition compounds by bonding electron donors to B or electron acceptors to N; thus it is capable of self-condensation to form high polymers. Many substitution derivatives of borazine can be made by the action of ammonia or primary amines on derivatives of diborane.

Radical-Transfer Reactions.—Boron trihalides (except BF_3) react with diborane easily at room temperature, exchanging halide for hydrogen and forming chiefly compounds of the type B_2H_5X, all unstable in the sense of the reverse reaction. With similar ease, diborane exchanges hydrogen for alkyl groups in trialkylborons (BR_3), forming compounds of types B_2H_5R, BH_3BHR_2, RBH_2BHR_2 and $(HBR_2)_2$, all chemically like diborane and each unstable in the sense of the reverse exchanges. Trialkylborates, $(RO)_3B$, with diborane easily form $(RO)_2BH$ compounds, also unstable in the sense of the reverse reaction. Even the relatively stable $(CH_3)_2NBH_2$ undergoes some disproportionation at 100° C.:

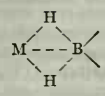
$$3R_2NBH_2 \rightleftarrows R_2NB_2H_5 + (R_2N)_2BH$$

and the resulting bis-amino-borine reacts with diborane even well below room temperature to form $(CH_3)_2NBH_2$ again. Exchange reactions such as these have been important in the elaboration of the chemistry of substituted boron hydrides.

Borohydrides.—The hydride ion H^-, having great bonding power because of its unshared electrons, easily receives BH_3 groups to form the stable borohydride ion BH_4^-. Lithium borohydride is formed in solution in ether by leading diborane into lithium hydride suspended in ether; and sodium borohydride can be made from $NaHB(OR)_3$ by heating to cause disproportionation, or more simply by using diborane to displace the alkyl borate $B(OR)_3$. The product of addition of diborane to sodium amalgam, once thought to be the salt $Na_2B_2H_6$, has been shown to be a mixture of $NaBH_4$ and the ether-soluble NaB_3H_8. The alkali borohydrides, water-soluble, though destroyed by acids or heavy-metal ions, act as powerful reducing agents in water or other solvents.

If a positive ion is difficult to reduce, it usually can form a borohydride, and if the ratio of ionic charge to radius is large, the compound may well be volatile. Thus, $Be(BH_4)_2$, $Al(BH_4)_3$ (b.p. 45° C.), $Ti(BH_4)_3$, $Zr(BH_4)_4$, $Hf(BH_4)_4$, $Th(BH_4)_4$ and $U(BH_4)_3(CH_3BH_3)$ are all the most volatile compounds of the

respective metal ions. In each of these, the BH_4 group is attached to the metal ion through the



type of bonding, like that in diborane but less symmetrical. They are violently reactive compounds, undergoing explosive reactions with air or water, reacting with hydrogen chloride at low temperatures to form the metal chloride, diborane and hydrogen (an evidence of strong hydridic character) and bonding strongly to amines or ammonia or even ethers—sometimes with a removal of BH_3 groups. The general method of making the volatile borohydrides is by the action of the appropriate metal halides on an alkali metal borohydride. Or, from a volatile borohydride, a saltlike borohydride may be obtained by treating it with the appropriate metal alkyl compound, usually in a suitable solvent.

See also references under "Boron" in the Index volume.

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BORORO, a tribe of South American Indians occupying a large area near the headwaters of the Paraguay river in southern Mato Grosso, Brazil. Their language is thought to be related to the Ge languages spoken by many of their neighbours. They are a settled people who cultivate a variety of crops, although hunting and fishing provide a substantial part of their subsistence. Clothing is minimal, but decorating the body is common, and the most spectacular ornament is a large headdress of red macaw feathers which is worn by the men on ceremonial occasions.

Villages are built in the form of a circle, with a ring of thatched dwellings surrounding a men's clubhouse. A moiety organization divides the village into two halves; each moiety is composed of several clans. Membership in both moiety and clan is traced matrilineally, and residence after marriage is matrilocal. In keeping with matrilineal descent, the chief of the village usually passes on his somewhat nominal authority to his nephew.

Most of the major ceremonies are connected with funerals, which last for several weeks. Elaborate dances are held, during which costumed performers act out incidents from mythology, and at one point the souls of all the recent dead are invited to share a communal meal. This phase of the ceremony is directed by a religious leader who is believed to be able to contact and control the spirits of the dead, and who on other occasions uses his supernatural power in the treatment of disease. The funeral ceremonies also serve as initiation rites for adolescent boys, who at this time are accepted as members of the men's house and are allowed to witness ritual forbidden to women and uninitiated children.

For the Bororoan family of languages, *see* the table in the article INDIAN, LATIN-AMERICAN.

See Robert H. Lowie, "The Bororo," in *Handbook of South American Indians*, ed. by Julian H. Steward, Bureau of American Ethnology Bulletin 143, 1:419–434 (1946); Julian H. Steward and L. C. Faron, *Native Peoples of South America* (1959). (SE. L.)

BOROUGH, in Britain, an incorporated town with special privileges, or a district entitled to return a member of parliament. The medieval English borough was an urban centre identified by the grant by charter of privileges, autonomy and, later, incorporation. From Tudor times onward, the importance of boroughs as units of local government declined, but they gained a new importance as parliamentary constituencies. The reform of municipal corporations in 1835 gave English boroughs a uniform constitution and transformed them into modern units of local government. In some parts of the United States the term denotes a town, village or other municipal unit.

Origins.—There is no evidence of continuity between the Romano-British municipality and the Saxon borough. F. W. Maitland showed that the oldest boroughs had their origins in agricultural communities. The term "burgh" implies a fortified place of defense, but the Saxon boroughs were also commercial centres with trading privileges. In the reconquered Danelaw they were administrative centres around which the shires were organized. Judicially, from the 10th century the borough already showed its distinctive character as an area excepted from the general hierarchy of shire and hundred, and there were borough courts in which the borough's own legal customs could be enforced.

Medieval English Boroughs.—The Norman Conquest brought increased economic activity to the English boroughs; they were influenced by the continental developments in municipal autonomy, though they never succeeded in freeing themselves of royal control to the same degree as the continental communes. Many new boroughs were founded both by the king and by baronial lords on their lands and were known as mesne or seignorial boroughs.

The character of the borough was marked by varying degrees of freedom from the manorial system and the royal administration. A serf became free after a year and a day in a borough; land holding was by burgage tenure, under which land was held by payment of money rent, instead of manorial obligations, with freedom to sell or devise. The economic privileges granted by charter were also often exemptions, such as the freedom from tolls, as well as the right to hold markets and fairs, to levy tolls on nonburgesses, and to regulate trade. Administratively, the first step was usually for the burgesses to obtain from the crown the right to collect the customary royal dues (the "farm" of the borough) and account for them at the exchequer. This enabled the burgesses to exclude the sheriff from collection of the revenue from the borough. Though the practice of selling the right to farm the borough began in the 12th century, the grant by charter of privileges greatly increased under Richard I and John because of the crown's chronic need for money.

In the 13th century more charters were granted and the reeves or bailiffs began to obtain the title of mayor; the borough officials were now regularly chosen locally. The borough bailiffs obtained the right of return of writs, though they still had to report on the execution of them to the sheriff, who could execute them himself if the bailiffs failed. The sheriff was completely excluded only from the few boroughs which had obtained the right to appoint their own sheriffs and had become in fact counties corporate. Incorporation was also granted to boroughs by charter; in the mid-14th century the five rights recognized as denoting the incorporation of a borough were perpetual succession, power to sue and be sued in the name of the corporation, power to hold land in mortmain, a common seal and power to make bylaws.

Attempts of the poorer townsmen to obtain a share in control in the 13th and again in the 15th century proved vain. Oligarchic constitutions were embodied in charters of incorporation and, from Tudor times, it became royal policy to strengthen the tendency to close corporations, both to enforce central control and because the borough corporations returned members to the house of commons.

Parliamentary Boroughs.—Sheriffs summoned representatives of boroughs to parliament from Henry III's time (*see* PARLIAMENT: *The Parliament of England*). Representation was at first unpopular because of the expense, and the smaller towns dropped out. By the mid-15th century, however, representation became attractive, and later Edward VI began the practice of creating new boroughs, especially where the crown could hope to influence the choice of members (*e.g.*, the small boroughs of Cornwall) and so control parliament. By the end of the 17th century 200 English boroughs were returning about four-fifths of the lower house. The franchise was in most cases limited to a self-renewing corporation or a limited number of freemen. The close corporations were normally dominated by one political party and were socially and religiously exclusive. A borough controlled by one person or one family was often referred to as a pocket borough, for it was said that a single man carried control of such a borough in his pocket. As time passed, some boroughs such as "Old Sarum" (Salisbury), declined in population and lost their earlier importance; their proprietors, nevertheless, continued to name representatives in parliament. Reformers of the early 19th century

denounced this practice and referred to these communities as rotten boroughs. (*See* REFORM MOVEMENT [BRITISH]).

The boroughs were little concerned with the provision of local government services. When, in the 18th and early 19th centuries, new functions, such as the paving, lighting and watching of the streets, were required, they were entrusted to commissioners appointed for the purpose under local acts. The main local importance of boroughs between the 16th and the 19th centuries was that leading members of the corporation acted as justices of the peace. The appointment of at least one member of the corporation as a justice of the peace was regarded by Sidney and Beatrice Webb as the criterion of borough status in this period. The possession of a court of petty sessions by virtually all boroughs, and of quarter sessions by a considerable number, gave them a degree of exemption from the contemporary county system of control comparable with that enjoyed by boroughs in the middle ages.

The Reformed Corporations.—The age of reform dealt with the boroughs in two measures. The first, in 1832, disfranchised 56 boroughs with less than 2,000 population and took seats from others; the redistribution of seats was accompanied by the introduction of a uniform franchise. Second, the boroughs in their municipal aspect were investigated by a royal commission. The 1835 Municipal Corporations act that followed the report dealt with 178 corporations (the most notable exception being the City of London which remained "unreformed"). The act provided for a uniform municipal franchise (adult householders who had been ratepayers for 3 years) and a uniform constitution for all boroughs: a council elected by the ratepaying householders, a third of the council retiring and being replaced by election every year. The council elected a mayor and aldermen (a number one-third that of the councilors), who did not need to be, but usually were, members of the council. Aldermen differed from councilors only in dignity and in having a six-year instead of a three-year term of office. The constitutional pattern of the 1835 act was re-enacted in the consolidating Municipal Corporations act of 1882, and again in the Local Government act of 1933, which dealt also with other types of local authority.

Boroughs in Modern English Local Government.—The 1835 act gave the reformed boroughs few specific powers to provide local government services. The development of these services in the 19th century was either by parliamentary acts dealing with specific subjects (*e.g.*, the Public Health act, 1848) or by local legislation. The number of boroughs increased from the 178 dealt with by the act of 1835 to 402 in 1958; new charters were granted to urban districts and, in a few cases, to previously unreformed boroughs not affected by the act of 1835. Borough status was greatly appreciated by growing unincorporated urban districts, not so much because of the relatively minor difference in powers, but because of its dignity. Some boroughs, usually the seat of a cathedral and bishop, received the title of city and a few the right to style their mayor as lord mayor; these differences did not affect powers.

There was, however, a difference in powers between county boroughs and other boroughs. The Local Government act of 1888, which established county councils, also provided that certain boroughs should be county boroughs, exercising the same functions as county councils in addition to those of ordinary municipal or noncounty boroughs. They exercised the powers of both city and county governments. The act provided for 61 county boroughs with populations generally over 50,000. The number of county boroughs in England and Wales had increased to 83 by 1926; one new one (Luton) was formed in 1964. Three ceased to exist in 1965 under the London Government Act 1963 (*see* LONDON). After 1945 populations of about 100,000 were required.

In the 20th century there has been considerable conflict between county councils and county boroughs seeking extension of their areas at the expense of counties. Friction has also resulted from the efforts of noncounty boroughs to achieve promotion to county borough status. The Local Government act of 1958 entrusted the task of reviewing the main local government structure to a Local Government commission empowered to make proposals for change to the minister of housing and local government, who would submit them in orders for the approval of parliament. The act of 1958 also affected the position of noncounty boroughs in the administrative counties. For example, the county council could propose the absorption of a noncounty borough by a rural district. This would involve, in effect, the loss by the borough of its status as a county district, though it would retain at least the powers of a rural parish.

Local government in London and neighbouring areas was changed by the London Government Act 1963 (effective April 1, 1965): the County of London and its 28 metropolitan boroughs were abolished and the area joined with that of about 60 other authorities, the whole divided into 32 London boroughs which, with the City of London, constitute Greater London. There is a Greater London council and a council in each borough.

Boroughs in Scotland and Ireland.—The medieval and later unreformed Scottish burghs were broadly similar to their English counterparts, though their trade monopolies were generally greater. They were founded either by the Scottish crown or by feudal lords with royal licence. They sent representatives to the Scottish parliament from 1295 and to the British parliament after the Act of Union in 1707. The reform of the Scottish burghs in 1833 preceded that of the English boroughs. In local government the large burghs (generally those with over 20,000 population) correspond to the English county boroughs, though with not quite such wide independence of the county as is enjoyed by the English and Welsh county boroughs, apart from the four Scottish counties of cities. Scottish burghs are also classified according to origin, as royal, parliamentary or police burghs. All Scottish urban local government units are termed burghs, there being no authorities equivalent to the English urban districts.

The Irish boroughs and municipal corporations followed more closely on the English pattern. Charters were granted in the 12th and 13th centuries, followed by others in the 17th century. After the corruption of close corporations in the 18th century, reform both for parliamentary and local government purposes came in the 19th century.

Boroughs in the U.S.—The term borough appeared occasionally in colonial Virginia, where the representative assembly was known as the House of Burgesses. But the term was not widely used in the United States after the Revolution. Village, town and city were the terms most commonly applied to municipal units. The American city corresponded most closely to the English borough as a full-fledged urban unit. In only four states, New Jersey, Pennsylvania, Connecticut and Minnesota, was the term borough officially recognized, and in these areas it indicated an incorporated town or village of lesser status than a city. The New York legislature adopted the term in 1897 when it combined five large municipal areas, known as the boroughs of Manhattan, Brooklyn, Queens, the Bronx and Richmond, to form the city of Greater New York.

See also CITY GOVERNMENT.

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BOROUGH ENGLISH, the English form of ultimogeniture, (*q.v.*) was the rule of inheritance by which real property passed to the youngest son or, failing sons, to the youngest daughter, and was essentially the rule for the unfree peasant. The land of free peasants tended to pass by equal division among sons or daughters. Just as it was to the king's interest to preserve the unity of the feudal inheritance, thus ensuring the proper performance of due military service, so it was the lord's interest to preserve the unity of a peasant's inheritance, whether in the hands of the youngest or the eldest son. The custom of ultimogeniture was an ancient one in England and in other parts of Europe and may well have arisen

because elder sons went out to provide for themselves and the youngest, remaining longer in his father's house, was still there when his father died. Of a family of sons, he was the least well able to find other land than his father's and sometimes he was still a child on his father's death. The name Borough English became the accepted legal name for this custom after a famous case of 1327 drew the attention of lawyers to the fact that in the French borough of Nottingham, which after the Norman conquest grew up beside the English borough, land passed to the eldest son, while in the English borough it passed to the youngest son. Ultimogeniture was very general in English boroughs. At Leicester Earl Simon de Montfort in 1255 changed the rule of inheritance from ultimogeniture to primogeniture (*q.v.*) at the request of the burgesses for the welfare of the town, which "on account of the feebleness and youth of the heirs for a long time past has almost fallen into ruin and decay." The custom continued in many rural manors into the 20th century, particularly in the south and southeast of England, but in a single field in Nottinghamshire in the 19th century it was accepted that some strips should pass by Borough English, some by partible inheritance, and some by common law. The custom was abolished by the Administration of Estates act, 1925, s. 45.

See C. I. Elton, *The Tenures of Kent* (1867); Sir F. Pollock and F. W. Maitland, *History of English Law Before the Time of Edward I*, 2nd ed. (1898). (D. M. S.)

BORROMEAN ISLANDS, four islands on the west of Lago Maggiore (*q.v.*), Italy, off Baveno and Stresa. Isola Bella, named for Isabella, Countess Borromeo, is famous for its château and terraced gardens, built by Count Vitaliano Borromeo (d. 1690); northeast of this is the Isola Madre, the largest of the group, with a palazzo and gardens; north again, off Pallanza, is the little Isola San Giovanni. The westernmost is Isola dei Pescatori, occupied by a fishing village. (G. Kh.)

BORROMEO, SAINT CHARLES (1538–1584), Italian cardinal and archbishop of Milan, was born at Arona, Oct. 2, 1538. His studies at the University of Pavia won him the doctorate in civil and canon law in 1559.

Upon the election of his maternal uncle as Pope Pius IV that same year, he was called to Rome, where he was created cardinal-deacon (1560) and later cardinal-priest (1564). On May 12, 1560, he was named archbishop of Milan, and upon the completion of his 25th year was consecrated a bishop by Cardinal Serbellone on Dec. 7, 1563.

As cardinal-nephew, the young prelate filled many functions at Rome, chief among them that of heading the Consulta, which thus made him secretary of state to Pius IV. The pope leaned upon him heavily in directing the third convocation of the Council of Trent (1562–63). When the council closed, Borromeo sat as a member of the commission to execute its decrees and was largely instrumental in bringing out the Roman catechism in Sept. 1566. Increasingly, the archbishop desired to reside at Milan, a permission at length granted by his uncle in 1565. Recalled to Rome by the illness and death of Pius IV, the archbishop took part in the conclave which elected Pius V on Jan. 7, 1566, and then was allowed to return to his see, where he resided thereafter.

At Milan, serious administrative problems confronted him. He was responsible for more than 1,000 parishes scattered over a territory in part subject to King Philip II of Spain, in part to Venice, Genoa, Novara and the Swiss cantons. In regular fashion, the cardinal visited every section of his archdiocese. Eleven diocesan synods ordered the ecclesiastical life of the see, while six provincial councils extended the reforms of the Council of Trent to the 15 bishoprics suffragan to Milan. Clerical education was fostered by the establishment of a Seminario Maggiore (1565) and of a Collegio Elvetico (1579), both at Milan, and of minor seminaries at Inverigo and Celano. For lay students, the Collegio Brera (1572), entrusted to the Jesuits, and the Collegio dei Nobili (1573) were erected. The archbishop's last undertaking was the public opening of the college at Ascona in 1584. He widely employed the Confraternity of Christian Doctrine for the instruction of about 40,000 children in 740 centres. Though embroiled with the Milanese senate, and in conflict with Gov. Luis de Requeséns, as well as with the rebellious canons of Sta. Maria della Scala and the order of the Humiliati, the archbishop had the support of many religious congregations, including his own Oblates of St. Ambrose. His heroic behaviour during the plague of 1576–78 won him the admiration of his flock.

The archbishop died at Milan on Nov. 3, 1584. He was canonized on Nov. 1, 1610, by Pope Paul V, who set the feast day as Nov. 4.

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BORROMINI, FRANCESCO (1599–1667), Italian architect, who in his very dynamic use of space and lighting was the chief exponent of the baroque style in architecture, was born at Bissone in Lombardy on Sept. 25, 1599. Trained as a stone cutter at Milan for five years from the age of nine, Borromini went to Rome in 1614 to work in that capacity under the architect Carlo Maderno at St. Peter's. From 1629 he was the chief assistant of Giovanni Lorenzo Bernini at the Palazzo Barberini and at St. Peter's, where he was responsible for the execution of Bernini's great altar canopy. Borromini's first independent commission was the small cloister and church of San Carlo alle Quattro Fontane in Rome (1634–44), whose façade he added in 1662–67. The plan of the church was composed of a series of intersecting ovals capped by an oval dome with intricate coffering. The serpentine wall and intersecting spaces created a very dynamic interior and façade. He also designed the church of Sant'Ivo alla Sapienza in Rome (1642–60) on the basis of a six-pointed star-shaped plan covered by a complex dome rising out of the plan. Other principal works by Borromini in Rome are the Oratorio di S. Filippo Neri (1637–42), next to Santa Maria in Vallicella, the interior refurbishing of San Giovanni in Laterano (1646–50), the church of Sant'Agnese in the Piazza Navona (1653–57) and a perspective colonnade (1632–36) added to the Palazzo Spada.

Borromini used the classic architectural vocabulary in a much freer manner than Renaissance architects or his eminent contemporary Bernini, and created a much more personal style which was very effective for expressing the religious emotion of 17th-century Italy. He consistently used an undulating wall surface and made a great effort to unite as possible all the elements of an architectural composition without losing any of the elements in the totality. Borromini died at Rome on Aug. 2, 1667. Engravings of his two most important buildings were published in two posthumous volumes, *Opus architectonicum equitis Francisci Boromini* (1720 and 1725).

See Baroque and Post-Baroque Architecture.

See E. Hempel, *Francesco Borromini* (1924); H. Sedlmayr, *Die Architektur Borrominis* (1930). (D. R. Cn.)

BORROW, GEORGE HENRY (1803–1881), English traveler, linguist and one of the most imaginative minor prose writers of the 19th century, was born at East Dereham, Norfolk, July 5, 1803, the son of a professional soldier who had risen slowly from the ranks, and of the daughter of an East Anglian yeoman. He led a wandering childhood, as his father's regiment was moved around the British Isles; these peregrinations inspired memorable passages in his masterpiece, *Lavengro*. But between 1815 and 1818 he attended the grammar school at Norwich, where Captain Borrow eventually settled, and it was at Norwich that he began to pick up a smattering of many languages, including Latin, Greek, French, German, Hebrew, Armenian and Romany; and, under the influence of a local sage, William Taylor, he imbibed "infidel notions" and tormenting philosophic doubts. An attempt to apprentice him to the law proved unsuccessful, and early in 1824 he decided to try his luck in London. There he remained, he tells us, for about a year, scraping a bare livelihood from various types of hack work. At length his health collapsed and he experienced a severe attack of a nervous affliction that he called "the Fear" or "the Horrors," which drove him off on a long bohemian pilgrimage

through the fields and heaths of rural England. His adventures provided some of the background of *Lavengro* and *The Romany Rye,* which describe how he consorted with gypsies, fought the "Flaming Tinman," encountered the Amazonian virgin Isopel Berners and was "drabbed" by the ferocious Mrs. Hearne.

He strayed back again, however, to Norwich, where he completed *Romantic Ballads,* translated from the Danish (1826). For the next six years, known to his biographers as the "veiled period," the record of his movements is obscure, though he liked to imply that he had traveled as far as the frontiers of China. Having returned to Norwich, he was oppressed by a sense that he had already failed in life; he was "drifting on the sea of the world" without occupation or real purpose, and he did not discover the incentive he needed until in 1833, helped by a Norfolk friend, he became the agent of the British and Foreign Bible society, walking the 112 mi. from Norwich to London for the interview. He went first to St. Petersburg to superintend a Manchu translation of the New Testament, and later to Portugal and Spain to promote the circulation of the Holy Scriptures. In Spain he found his literary homeland, whence he drew the raw materials of *The Zincali: or an Account of the Gypsies in Spain* (1841) and of his brilliantly picturesque, yet highly informative travel book *The Bible in Spain* (publ. Dec. 10, 1842; title page date 1843). Its success was "instantaneous and overwhelming."

Meanwhile, Borrow had married (1840) a motherly widow seven years older than himself, who possessed a cottage at Oulton Broad, Norfolk, and there he rusticated for two decades after his retirement from the service of the Bible society. In 1851 he published *Lavengro*— "a dream, partly of study, partly of adventure"—in which poetic glimpses of his childhood and youth, and of the vanished England through which he had wandered as a boy, are presented and linked with great imaginative freedom. It is neither a novel nor a straightforward autobiography, but has some of the qualities of both.

Yet *Lavengro* was coolly received by the critics; and so was its sequel, *The Romany Rye* (1857), and a new travel book, *Wild Wales* (1862). Borrow gradually grew more and more cantankerous and eccentric. He still traveled widely, both in Great Britain and on the continent, but there was no repetition of his former triumphs; his last book, *Romano Lavo-Lil, Word-Book of the Romany* (1874), proved an inadequate and ill-digested work. His mother, whose influence had always been strong, died in 1858, and in 1860 he moved to London. His wife died in 1869, and in 1874 he returned to Oulton Broad, where he died, alone, on July 26, 1881.

Physically, George Borrow was a splendid figure—muscular, strongly built, "standing six foot two in his stockings"; temperamentally, he was a prey to fits of profound dejection and introspective gloom. No doubt it was the blend of these two contrasted personalities—the man of action and the melancholy introvert—that helped to give his two great books, *The Bible in Spain* and *Lavengro,* their strange and fascinating character.

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BORSIPPA (modern Birs or Birs Nimrud), an ancient city about 15 mi. S.W. of Babylon (*q.v.*) and 10 mi. S.W. of the modern town of Al Hillah in southern Iraq, on the canal connecting the Hindiyah and Euphrates rivers. It was the sister city of Babylon; its patron god was Nebo. Borsippa became an important religious centre after Hammurabi had made Babylon his capital (*c.* 1790 B.C.). Hammurabi built or rebuilt the temple E-Zida at Borsippa, dedicating it to Marduk, subsequent kings recognizing Nebo as the deity of E-Zida and making him the son of Marduk; and his temple was second only to that of Marduk in Babylon. As with Babylon, the time of Nebuchadrezzar (reigned 605–562 B.C.) was the period of Borsippa's greatest prosperity; there is evidence that the temple school of astrology and astronomy, for which Borsippa had for centuries been famous, was still in existence in the late 6th century B.C. A famous archaeological text entitled *Enuma Anu Enlil,* a list of omens and prognostications about the kings of Assyria and Babylon, was edited there.

The site of the ancient city extended over a wide area and was excavated at intervals from the middle of the 19th century onward. The first systematic and productive work was that of R. Koldewey, who was concurrently excavating Babylon in 1902. At that time he undertook the clearance of the incomplete and ruined ziggurat built on the site of a predecessor by Nebuchadrezzar. This now forms a hillock over 100 ft. high and consists of a pointed core of vitrified brick split down the centre, around which lie masses of rubble and some enameled bricks, inscribed with the name of Nebuchadrezzar, twisted and broken, apparently by great heat. This extraordinary phenomenon has been accounted for by spontaneous combustion activated by matting and bitumen in the core of the structure. Not far distant from the ziggurat there was a vast temple erected to Nebo on a typical Babylonian ground plan. These buildings were enclosed by a sacred *temenos* which comprised a series of magazines. Koldewey interpreted these structures as designed to accommodate pilgrims. If this theory is correct there is a close analogy to be drawn with the layout in the neighbouring Muslim city of Kufa. Borsippa was destroyed by Xerxes I of Persia in the early 5th century B.C. and partly restored by the Seleucid king Antiochus I in the 3rd century B.C., but was in ruins long before the middle ages.

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BORSTAL SYSTEM. The Borstal system, as established in England by the Prevention of Crime act, 1908, derived from the concern of the Gladstone committee of 1895 with the penal treatment of offenders between 16 and 21 years of age and their suggestion that they should be removed from the prisons to a "penal reformatory." There they should be given sound education and industrial training, with a staff "qualified to exercise the best and healthiest kind of moral influence" and "special arrangements for receiving and helping them on discharge." Sir Evelyn Ruggles-Brise (1857–1935), then chairman of the prison commission, determined to follow this course. He went first to the United States to study the reformatory at Elmira, N.Y. In Oct. 1902, he took over an old convict prison at Borstal, Kent, "for the special location and treatment on reformatory lines of young prisoners aged 16–21 selected from the ordinary prisons." Rules for giving effect to this system were approved by parliament, but it was not until 1908 that "Borstal detention" was prescribed as a separate sentence which the courts might pass in lieu of imprisonment. These legal provisions were replaced by sec. 20 of the Criminal Justice act, 1948. Borstal detention became "Borstal training" and the eligibility for sentence was based on the need of the offender for such training: to assess this the courts were required to consider a report on the offender made by the prison commissioners. The effect of the sentence is that the offender is under control for four years, of which not less than nine months nor more than three years is spent in an institution, the remainder in controlled freedom under supervision.

The basic principles of Borstal training were laid down by Alexander Paterson, who became a prison commissioner in 1922: individual personal training by a trained and dedicated staff, based on progressive trust and responsibility, in conditions as little like those of a prison as possible. To further this system the institution was divided into houses of, ideally, not more than 50, each leading its separate and corporate life under its own housemaster or housemistress and house staff. The training is nevertheless exacting, based on a full day's hard and interesting work. There are vocational training courses in skilled trades for all who can profit by them, with six hours a week of evening education either in the Borstal or in local technical colleges. Physical education and sport are highly developed and activities outside the institution are

encouraged. Every opening is sought for contacts, whether social or sporting, with young people outside. The period of training, though decided in each case on individual considerations, is related to an over-all average of about 16 months and governed by the progress of the inmate through a grade system. In the latter part of the training five days' home leave is allowed. On release the inmate comes under the care and supervision of the Central After-care association and may be recalled for further training if necessary.

The Borstal system for boys includes centres for those recalled from supervision and transferred for absconding or serious misconduct, and reception centres at which inmates are studied for some weeks, so that they may be sent to the Borstals best suited to their characters and requirements. About half of the Borstals are "open," the others of various degrees of security. The program for girls is less extensive. In one five-year period from 1952 to the end of 1957 about 10,000 boys passed through the Borstal system of whom, by the end of 1959, about 4,700 had not again been convicted. For girls the numbers were 700 and 500.

The Borstal system set a pattern widely followed in the commonwealth and many other parts of the world. A new future was proposed for it in a report of the Advisory Council on the Treatment of Offenders, *The Treatment of Young Offenders* (1959): imprisonment for young offenders for terms of under three years would be abolished; sentences of detention up to six months would be served in detention centres; below three years there would be an indeterminate sentence from six months to two years, on the lines of the existing Borstal sentence, followed by two years' supervision. These proposals were accepted by the government in principle. *See* also PRISON.

See L. W. Fox, *The English Prison and Borstal Systems* (1952).
(L. W. F.)

BORT (BOART) is an inferior kind of diamond, or pure carbon, unfit for cutting but useful as an abrasive agent. The typical bort occurs in small spherical masses, of grayish colour, rough or with a crystal-coated surface, and showing on fracture a radiate crystalline structure. These masses, known in Brazil as *bolas*, are often called "shot bort" or "round bort." Much of the bort consists of irregular aggregates of imperfect crystals. In trade, the term bort is extended to all small and impure diamonds and crystalline fragments of diamonds, useless as gem stones. A large proportion of the output of some of the South African mines consists of such material. This bort is crushed in steel mortars to form the diamond powder used by lapidaries for grinding and polishing gem stones. *See* also ABRASIVE; DIAMOND.

BORUJERD (BURUJIRD), chief town of a district (Shahrestan-e Borujerd) in western Iran, in the *ostan* (province) of Khuzistan and Luristan (Lorestan). Pop. (1956) 49,228, mostly Lurs. It lies 5,500 ft. above sea level at the eastern foot of the high ranges of Luristan, in a wide and fertile valley drained by a tributary of the Sezar which joins the Dez. Borujerd is a flourishing regional centre profiting from its position on the main highway from the Persian gulf and Khuzistan via Khorramabad to Teheran, with good communication to Hamadan and Kermanshah. The Trans-Iranian railway can be reached 30 mi. away at Dow Rud.

Borujerd district (pop. 130,277 including the town) comprises mainly the valley and has many traces of ancient settlement in the form of *tappehs* ("mounds"). (H. Bo.)

BOSANQUET, BERNARD (1848–1923), English philosopher, the last major representative of Neo-Hegelianism in England, was born on June 14, 1848, the son of the Rev. R. W. Bosanquet, of Rock hall, near Alnwick, Northumberland. He was educated at Harrow and at Balliol college, Oxford, where he came under the influence of Benjamin Jowett and of T. H. Green and was a younger contemporary of R. L. Nettleship. Elected a fellow of University college in 1870, he worked as tutor there for ten years. Then, in 1881, he moved to London, where he devoted himself to philosophical writing and to work on behalf of the Charity Organization society and of various associations. In 1895 he married Helen Dendy, with whom he set up house at Oxshott, Surrey, in 1899. In 1903 he was appointed professor of moral philosophy at St. Andrews, a post which he held until 1908. In 1911 and 1912 he delivered his Gifford lectures at the University of Edinburgh on *The Principle of Individuality and Value* and *The Value and Destiny of the Individual*. He died in London on Feb. 8, 1923.

Although Bosanquet, like F. H. Bradley, owed much to Hegel, his first writings, *Knowledge and Reality* (1885) and *Logic* (1888), show the influence of R. H. Lotze (English translations of Lotze's *Logic* and of his *Metaphysics* had appeared under Bosanquet's editorship in 1884). The fundamental principles in these works, which are brought out more clearly in the later and smaller *Essentials of Logic* (1895) and *Implication and Linear Inference* (1920), turn on the dynamism of logical thought and on the notion of system and coherency and are summed up in Bosanquet's remark: "Logic, or *the spirit of totality*, is the clue to reality, value and freedom."

In middle life, Bosanquet turned to aesthetics and ethics. Already in 1886 he had introduced a comparatively new subject into British philosophy by his translation of the Introduction to Hegel's *Philosophy of Fine Art*. His own *History of Aesthetic* (1892) and *Three Lectures on Aesthetic* (1915) show his belief that aesthetics can reconcile, as he himself says, "this world and the other, the *a posteriori* and the *a priori*, the natural and the supernatural." In his ethical and social philosophy, the more practical side of which appears in *Some Suggestions in Ethics* (1918), he shows the same desire to think of reality as a concrete unity wherein "the other world" and "this," pleasure and duty, egoism and altruism are reconciled. This desire, he says, was inspired by Plato's passion for the unity of the universe, a passion which reappeared in Christianity as the doctrine of the divine spirit present in human society. In social life, the most valuable thing, for Bosanquet, is that communal will which grows out of individual co-operation and at the same time supports the individual, making him free and bestowing upon him the fruits of participation in the whole. This doctrine is developed at length in his famous *Philosophical Theory of the State* (1899; 3rd ed., 1920) and in his *Social and International Ideals* (1917).

In later life, Bosanquet became more interested in metaphysics. In the Gifford lectures, he started with Hegel's concept of the dynamic character of human knowledge and experience. Insisting that the content and the object of thought are inseparable and that thought, as he was to express it in *Three Chapters on the Nature of Mind* (published posthumously in 1923), is "the development of connections" and "the sense of the whole," Bosanquet eventually arrived at the conviction of an indispensable reality beyond and behind experience, a reality which determines the true mutual relations of all beings. He observes in his contribution to J. H. Muirhead's *Contemporary British Philosophy* (1924) that experience has value insofar as the fullness of the whole is reflected in it and that knowledge is true in proportion as a system has adequate determination and the minimum of alternative possibilities. It was his overemphasis on the incoherencies and hazards of finite personality which led him to deny to this ultimate reality or Absolute the applicability of the word "personality" and to prefer "individuality"; and just as he believed that it could not be the supreme end of the Absolute to give rise to beings such as he experienced himself to be, so he concluded that the desire for personal immortality is unworthy, since the content of the self and the continuance of that for which we care most is secured in the Absolute.

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(W. H. W.; X.)

BOSCÁN ALMOGÁVER, JUAN (Catalan JOAN BOSCÀ ALMUGÀVER) (*c.* 1490–1542), Catalan poet who wrote exclusively in Castilian and adapted the Italian hendecasyllable to that language, was born in Barcelona between 1487 and 1492. Though a minor poet, Boscán is of major historical importance because of his naturalizing of Italian metres and verse forms, which had

only been sporadically cultivated in Spanish before the Venetian ambassador, Andrea Navagiero, persuaded him in 1526 to attempt them. Modest as the success of this experiment was, it sufficed to induce one of the greatest of all Spanish poets, Boscán's younger friend Garcilaso de la Vega, to follow his example. Their works appeared together posthumously in 1543, and the tide of Petrarchanism flowed over Spanish poetry for the next century and a half.

Boscán had published in 1534 a translation of Castiglione's *Il Cortegiano:* his prose was greatly superior to his verse, and *El Cortesano* is not only one of the influential books of the Spanish Renaissance but a work of art in its own right. He died in Barcelona on Sept. 21, 1542. (F. S. R.)

BOSCASTLE, a small seaport in north Cornwall, Eng., 19 mi. N. of Bodmin by road. Pop. (1951) 684 (civil parish of Forrabury and Minster). The village, with its precipitous street, rises from a small harbour in a very narrow cove into which the Valency flows; vessels have to be warped into the harbour by means of hawsers. One of the two jetties was destroyed in World War II. A mound on a hill above the harbour marks the site of a Norman castle. Minster church is in the woods, but the parish church of St. Symphorian, Forrabury, stands high, overlooking the Atlantic from Willapark point. Its tower (1750) is without bells. The coast scenery near Boscastle is severely beautiful, with abrupt cliffs broken only by inlets such as Crackington and Pentargon coves. Inland are bare moors, diversified by narrow dales, rising to the mountain mass of Brown Willy (1,375 ft.). The National trust owns more than 400 ac. around Boscastle, including the harbour.

BOSCAWEN, EDWARD (1711–1761), British admiral who played a distinguished part in the Seven Years' War, was born on Aug. 19, 1711, the third son of Hugh, 1st Viscount Falmouth. He entered the navy at an early age, serving under Vice-Admiral Francis Hosier in the West Indies in 1726, and under Admiral Vernon at Porto Bello (1739) and at Cartagena (1741). On his return he married Fanny Glanville, a noted "bluestocking," whose conversation, said Dr. Johnson, was the best of any woman he had met. Boscawen became member of parliament for Truro in 1742, but continued to serve at sea, notably at the battle off Cape Finisterre in May 1747 when the French squadron suffered an overwhelming defeat. He was then sent out in command of a fleet to recapture Madras, and when the news of peace arrived in India the place was given up to him. His premature capture of the French ships "Alcide" and "Lys" off Newfoundland in April 1755 precipitated the outbreak of the Seven Years' War. In 1758 he was promoted admiral and in co-operation with Jeffrey Amherst and James Wolfe captured Louisburg, Cape Breton. The next year, when in command of the Mediterranean fleet, he chased a French fleet under M. de la Clue off Lagos, took three ships and burned two, thus defeating the proposed concentration of the French fleet at Brest for an invasion of Great Britain. As a reward, in Dec. 1760 he was given the lucrative post of general of marines, but his death on Jan. 10, 1761, cut short a brilliant career.

See P. K. Kemp (ed.), "Boscawen's Letters to His Wife, 1755–56" in *Naval Miscellany,* Navy Records Society, vol. iv (1952); C. Aspinall-Oglander (ed.), *Admiral's Wife: Life and Letters of the Hon. Mrs. E. Boscawen, 1719–61* (1940). (C. C. L.)

BOSCH, HIERONYMUS (*c.* 1450–*c.* 1516) was the signature used by Hieronymus van Aeken or van Aken, a Dutch painter famous for his fantastic allegorical paintings; it derives from his birthplace, Hertogenbosch in North Brabant. Possibly a grandson of the local artist Jan van Aeken, he is first mentioned in 1480–81 as "Jeroen the painter" in the records of the Confraternity of Our Lady, for which he is known to have worked, and his name recurs there intermittently until, in 1516, he is referred to as being dead.

None of Bosch's works is dated, but the earliest paintings ascribed to him seem to belong to about 1475–80. They are firmly rooted in the conservative north Netherlandish tradition, and include a painted table top of "The Seven Deadly Sins" in the Escorial, near Madrid, "The Stone Operation" in the Prado, Madrid, and an "Ecce Homo" in Frankfurt.

His personal style can be seen emerging from this early blend of archaism and intense originality in such works as "The Wedding Feast at Cana" now in Rotterdam, but it is in the great triptychs of his maturity, "The Hay-Wain" and "The Garden of Lusts" in the Escorial, "The Temptation of St. Anthony" in Lisbon, and "The Epiphany" in the Prado, that his genius is fully revealed. Also among his mature works are smaller paintings such as the "St. John on Patmos" in Berlin, the "St. Jerome in the Desert" in Ghent and the "St. John the Baptist in the Wilderness" in Madrid; the last-named is closely connected with a painting of a similar subject by Geertgen tot Sint Jans, whose art shows many links with that of Bosch. With the late works, such as the two versions of "The Crowning With Thorns" now in the National gallery, London, and in the Prado, Bosch's constant preoccupation with the embodiment of evil takes on a new emphasis that culminates in "The Carrying of the Cross," now in Ghent. There is indeed a pessimistic strain throughout his work, a stress on sin and folly and the forces of evil, upon death and damnation and the horrors of hell, which in part reflects the troubled religious and social currents of the day.

BY COURTESY OF NATIONAL GALLERY, LONDON

"THE CROWNING WITH THORNS" BY HIERONYMUS BOSCH. IN THE NATIONAL GALLERY, LONDON

The actual subject matter of some of Bosch's works is a source of great controversy, not only as regards the grotesque, part human, part animal, or half mechanical, half vegetable forms that populate them, but also as regards the general meaning.

On the one hand, it is argued that he was a member of an extreme, heretical, secret society. On the other, it is increasingly clear that much of what seems strange and esoteric in his art derives directly from local folklore, from popular sayings and traditions, and, more especially, from the local mystery plays and pageants with their elaborate *tableaux vivants,* and would therefore have been wholly familiar and intelligible to Bosch's fellow citizens.

Bosch was a vibrant colorist and his technique was based upon translucent glazes floated over a light ground with such extreme delicacy that the bold under drawing is often clearly visible. The pen work in his few existing drawings has a freedom that was new in Netherlandish art, and the apparent mass of detail in his mature works is characterized, in the areas of heavier pigment, by a brilliant liveliness of brush stroke that distinguishes his own works from innumerable copies and derivative paintings.

As a satirist, as a moralist and observer of the human scene, as a designer of landscape settings, and as a painter in the technical sense, Bosch was a pioneer upon the road that was followed by Pieter Brueghel half a century later.

Constantly imitated and misunderstood by lesser artists, his works were collected by the great, particularly in Spain where many of his paintings bear witness to Philip II's passionate interest in his art.

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BOSCH, KARL (1874–1940), German industrial chemist, received the Nobel prize for chemistry in 1931 jointly with Friedrich Bergius (*q.v.*), for contributions to the invention and development of chemical high pressure methods. Bosch was born at Cologne, Ger., on Aug. 27, 1874, and educated in the University of Leipzig, where he studied under Johannes Wislicenus and obtained his doctorate in philosophy in 1898 for research in organic chemistry. His interests were, however, general and he studied engineering in Charlottenburg in 1894 and obtained workshop experience. Leaving Leipzig, he worked for the Badische Anilin und Sodafabrik, of which (when it became I. G. Farben Industrie) he

was later president; and here he succeeded in transferring from laboratory to industrial scale Fritz Haber's (*q.v.*) process for synthesizing ammonia from its elements, hydrogen and nitrogen, catalytically at high pressures. Researches on this process involved the carrying out of over 20,000 experiments, including an exhaustive search for catalysts among the metals and their compounds.

He invented also the Bosch process for preparing hydrogen on the manufacturing scale by passing a mixture of steam and water gas over a suitable catalyst at high temperature. He died on April 26, 1940, in Heidelberg. (D. McK.)

BOSCH, ROBERT AUGUST (1861–1942), German engineer and industrialist whose firm produced a range of precision machines and electrical equipment in plants throughout the world, was born at Albeck bei Ulm on Sept. 23, 1861. He was trained in the United States, where he worked with Siegmund Bergmann and Thomas A. Edison.

In 1886 he founded the manufacturing company named after him in Stuttgart. In 1902 his co-worker G. Honold invented the Bosch spark plug, which promoted the development of the automobile, and Bosch also developed the Bosch magneto and the Bosch lamp. Bosch had advanced social views. He introduced an eight-hour day in 1906, and he advocated industrial arbitration and free trade. His *The Prevention of Future Crises in the World Economic System* (1934) was translated in 1937. Bosch died in Stuttgart on March 9, 1942.

See Theodor Heuss, *Robert Bosch* (1948). (M. J. Bi.)

BOSCO, SAINT JOHN (Giovanni Melchior Bosco) (1815–1888), a pioneer of education for the poor in Piedmont and the founder of the Salesian order, was born at Becchi, near Chieri, Italy, on Aug. 16, 1815. His early years were passed in extreme poverty. He was ordained priest in 1841 and subsequently, in Turin, came under the influence of Joseph Cafasso, who turned his attention to the moral danger and destitution of many country boys who came to seek employment in the city. John Bosco began his work for them in borrowed premises, providing them with education, religious instruction and recreation; eventually he was at the head of a large establishment containing 700 boys with a grammar and technical school and fine church attached, all built by his persistent begging and hard work. In addition he achieved a certain local reputation as a popular preacher and writer. His genial, affectionate approach to boys accounted for much of his success; he strove to lead rather than to drive them. His sunny disposition, readiness to help all who asked and capacity for hard work ensured him a wide sphere of influence. With those who had come to help him he founded in 1859 the Society of St. Francis of Sales (known as the Salesians; *q.v.*), which before his death had spread to England, France, Spain and a number of South American countries, with several houses in Italy. With Mary Mazzarello he founded a congregation of nuns for similar work among girls. He died at Turin on Jan. 31, 1888. He was canonized in 1934, his feast day being Jan. 31.

See L. C. Sheppard, *Don Bosco* (1957). (L. C. S.)

BOSCOVICH, RUGGIERO GIUSEPPE (1711–1787), Serbo-Croatian astronomer and mathematician, was perhaps the first of the continental virtuosos to adopt Newton's gravitational theory. He was born at Ragusa (Dubrovnik) in Dalmatia on May 18, 1711. Entering the Society of Jesus in 1726, he studied mathematics and physics at the Collegium Romanum where he was appointed professor of mathematics in 1740. His published work, of nearly 70 papers, concerns optics, astronomy, gravitation, meteorology and trigonometry.

A pioneer in geodesy, he measured, together with C. Maire, an English Jesuit, a meridian arc between Rome and Rimini in 1750 for the purpose of testing his theory that the earth is not an ellipsoid of revolution. He accepted the chair of mathematics at the University of Pavia in 1764 and also served as director of the Brera observatory. When the Jesuits were suppressed in Italy in 1773, Boscovich accepted an invitation from the king of France to settle in Paris as director of optics for the marine, a post created especially for him. He returned to Italy in 1783 and died at Milan on Feb. 13, 1787.

See H. V. Gill, *Roger Boscovich S.J.* (1941). (O. J. E.)

BOSE, SIR JAGADIS CHANDRA (1858–1937), Indian plant physiologist and physicist, whose outstanding work in the field of animal and especially plant physiology was so much in advance of his time that the precise evaluation of it was controversial. He was born on Nov. 30, 1858, and educated at St. Xavier's college, Calcutta, and Cambridge university, gaining high honours in 1884 and being awarded the degree of doctor of science in 1896. He was professor of physical sciences at the Presidency college, Calcutta, 1885–1915, and founder and director of Bose Research institute, Calcutta, 1917–37. He died in Giridih, Bengal, on Nov. 23, 1937.

Bose introduced new experimental methods and invented many delicate and sensitive instruments, such as his crescograph for recording plant growth, magnifying a small movement as much as 10,000,000 times. He also devised apparatus for demonstrating the effects of air, food, drugs, etc., on plants and demonstrated a parallelism between the responses of plant and animal tissues. His publications are voluminous; the most important are: *Response in the Living and Non-Living* (1902); *Plant Response* (1906); *The Motor Mechanism of Plants* (1928), etc.

See P. Geddes, *The Life and Work of Sir Jagadis C. Bose* (1920) and *Sir J. C. Bose: His Life and Speeches* (1920); *Chron. Bot.*, vol. iv (1938) and *Nature*, vol. cxl (1937).

BOSELLI, PAOLO (1838–1932), Italian statesman, head of the government which declared war on Germany in World War I, was born at Savona on June 8, 1838. He was the first professor of financial science in the University of Rome. A deputy from 1870 to 1921, when he became a senator, he belonged to the right centre and was a member of the governments of Francesco Crispi, Luigi Pelloux and Sidney Sonnino; in 1899, as minister of the treasury under Pelloux, he reorganized the Bank of Italy. He became president of the Dante Alighieri society in 1907. In favour of Italy's entry into World War I against Austria-Hungary (1915), he made a notable speech in the chamber in defense of the enabling bill giving full powers to the government of Antonio Salandra. On Salandra's fall (June 1916), he formed a coalition government including all parties except the official Socialist party, which still opposed participation in the war. The Italians recovered ground after the Austrian offensive of May–July 1916 and, on Aug. 25, 1916, war was declared on Germany. The defeat at Caporetto, however, made the government's resignation on Oct. 30, 1917, inevitable. In March 1929, Boselli was government spokesman in the senate for the bill to approve the Lateran treaties between Italy and the Vatican. He was president of the Italian Historical institute and founded the museum of the Risorgimento. He died in Rome on March 10, 1932. (N. S. J.)

BOSKOP SKULL. In 1913 a portion of a calvaria (skull dome) was unearthed by labourers on a farm near Boskop, a village in the Potchefstroom district of the Transvaal, South Africa. The specimen consisted of the greater part of the frontal and parietal bones and a small portion of the occipital. The exact spot of the discovery was not determined by investigators who visited the farm shortly after, but it appeared to have been found in the lateritic deposit about four feet below the surface. There was no evidence whether there had been a prepared grave or not. A year later excavations at the site disclosed a nearly complete temporal bone, most of the body of the left side of a poorly preserved mandible (with a second molar) and a number of fragments of limb bones. The site was in a cultivated field about 250 ft. from the bank of the Mooi river and about 12 ft. above the river-bed level. No faunal or cultural remains were found in direct association, except for a single unusual stone artefact which was only described in 1954 (C. van Riet Lowe, "An Artefact Recovered With the Boskop Calvaria," *South African Archaeological Bulletin*, 9:135–137 [1954]). No geological age can be assigned to the skull.

The frontal bone is rounded and narrow (minimum breadth is 102 mm.) with a constriction above the nonprotruding, thin supraorbital ridges. Some degree of parietal bulging ("bossing") is present, and the thickness of the calvaria varies from 6 to 13 mm. The cranial capacity is approximately 1,800 ml. The

distinctive features are the length (205 mm.) and breadth (150 mm.).

The skull has at various times been called Neanderthaloid, Cromagnoid, Negroid, pre-Bush (*i.e.*, Bushman and Hottentot), pre-Negro, etc. Many anthropologists have associated the Boskop skull with a hypothetical Boskop race because of discoveries of apparently similar skulls at other sites in Africa. However, in a detailed review R. Singer ("The Boskop 'Race' Problem," *Man*, p. 232 [1958]) has pointed out that the Boskop skull is of Bushman-Hottentot nature and that its evolutionary significance is minimized in the light of the paucity of scientific data relating to its discovery. It presents no primitive features and there is no justification for utilizing the term Boskop race. (R. Si.)

BOSNIA-HERCEGOVINA (Bosna i Hercegovina), one of the six people's republics of the Federal People's Republic of Yugoslavia. Roughly triangular, it is bounded by Serbia and Montenegro to the east and southeast, and by Croatia to the north and west. The name Bosnia (Serbo-Croatian Bosna) is derived from that of the Bosna river and is probably of Illyrian origin. Hercegovina, the southern part, takes its name from the title *herceg* (Ger. *Herzog*, "duke"), assumed in the 15th century by a local ruler.

With an area of 19,741 sq.mi., Bosnia-Hercegovina is mostly a mountainous country. To the southwest about one-quarter of its area is covered by the so-called *karst* (*krs*), an arid limestone plateau with small depressions fit for cultivation. In the central and eastern parts of Bosnia there are forests of pine, beech and oak. Arable land represents about one-half of the republic's area but the fertile soils are mainly in the north. Hercegovina grows tobacco of high quality.

According to the census of 1961, Bosnia-Hercegovina had a population of 3,274,886. In the 1953 census 44.8% declared themselves as Serbs, 23% as Croats and 31.4% as Yugoslavs (or undetermined). The Serbs are Orthodox, the Croats are Roman Catholic; about one-third of Bosnians are Muslim. The capital of the republic is Sarajevo (*q.v.*), which is also the seat of the head of all Muslims in Yugoslavia (*reis-ul-ulema*) and also of a Serb-Orthodox metropolitan and of a Roman Catholic archbishop. The other main towns are Mostar and Banja Luka, both of which are the seat of a Serb-Orthodox and of a Roman Catholic bishop; Tuzla, the seat of a Serb-Orthodox bishop; and Travnik, the seat of a Roman Catholic bishop.

HISTORY

Traces of Paleolithic life have been found at the mouth of the Usora river. Considerable Neolithic remains have been found at Donja Mahala, Donji Klakar, Kakanj, Novi Seher and, the most important of all, at Butmir. In Hercegovina the main Neolithic location is at Lisicici, near Konjic. Bronze and Iron Ages are also well represented, the most important Iron Age sites being Donja Dolina, Glasinac and Ripac.

Ancient and Medieval Period.—The most ancient inhabitants of Bosnia-Hercegovina were Illyrian tribes (*see* Illyria). After the Roman conquest the country was included in the Roman province of Illyricum, except for the region along the Sava, which belonged to that of Pannonia.

Serbian settlement in Bosnia-Hercegovina began in the 7th century A.D. (*see* Serbia). After the death of Prince Chaslav (960), Bosnia was detached from the rest of Serbia and became a separate political entity. King Bodin (1081–1101) united Bosnia with the other two Serbian principalities—Rashka and Zeta, the prince Stephen ruling in Bosnia on Bodin's behalf. After Bodin's death, however, Bosnia separated again.

Hungarian encroachment on Bosnia began in the middle decades of the 12th century. László, son of Béla II of Hungary, is described as ruling in Bosnia in 1137, and from 1138 the title "king of Rama" was added to the royal style of the kings of Hungary, after their conquest of the small province of Rama. The local representatives of the Hungarian kings had the title of ban (*q.v.*).

The rule of Kulin, "the great ban," began about 1180. He concluded an agreement with Dubrovnik (Ragusa) in 1189 guaranteeing freedom of trade for his country. Then the efforts of the papacy to extend Roman Catholicism in Bosnia, combined with further political pressure by the Hungarians, who wanted Bosnia to be under a Hungarian archbishop instead of the Slavonic archbishopric of Dubrovnik, provoked a strong national resistance in the country, and Kulin embraced the Bogomil (*q.v.*) heresy. Pope Innocent III preached a crusade against him and in 1203 Kulin renounced his heresy in the presence of a papal legate. Nothing is known of Kulin after 1204. A certain Stephen, perhaps Kulin's son, is mentioned as the next ban. Pope Honorius III preached another crusade against the Bosnian heretics. War was avoided but Bosnia came under the jurisdiction of the Hungarian archbishop of Kalocsa.

Matej Ninoslav became ban about 1232. His promise to embrace Roman Catholicism caused a serious disturbance in Bosnia which was considered by the papacy as a country "overgrown with thorns and nettle and a breed of vipers." When Andrew II of Hungary and his successor Béla IV attacked Bosnia, Ninoslav sided with his people, and war went on from 1235 to 1239, the Hungarians making little progress. Ninoslav disappears from history after 1250. In 1252 the seat of the Roman Catholic bishop of Bosnia is recorded as being at Djakovo.

The Kotromanic Dynasty and Hum.—Ban Prijezda, who ruled in Bosnia as a vassal of Hungary from 1254 to 1287, was the founder of the dynasty of Kotromanic. His successor was Stephen Kotroman (1287–1316). Kotroman's son, Stephen Kotromanic (1322–53) extended Bosnia toward the south, conquering the province of Hum or Zahumlye (the future Hercegovina), styling himself count of Hum from 1326.

At the end of the 12th century Hum had been in the possession of the Serbian prince Miroslav, brother of the great *zupan* Stephen Nemanya of Serbia. Miroslav's successor was Petar (probably his son). He was defeated by Nemanya's son Stephen, but retained the part of Hum between the Neretva and Cetina rivers, the rest being divided between Andrija (probably also Miroslav's son) and Stephen's eldest son Radoslav. The Orthodox bishopric of Hum, the seat of which was first at Ston and later at the monastery of Holy Apostles on the Lim, was founded by St. Sava in 1219. Petar's successor in Hum was his nephew Toljen, who perished in battle during the Hungarian invasion of Bosnia (1235–39). Andrija's son Radoslav became a vassal of Hungary, but disappears from history after 1254. Subsequently the situation in Hum underwent a number of changes, but the whole country is known to have been subject to King Milutin of Serbia (d. 1321).

After his conquest of Hum, Stephen Kotromanic was prevented from further conquests by Milutin's grandson Stephen Dushan, but Dushan's struggle with the Byzantine empire prevented him from undertaking a counter offensive against Bosnia until 1350. Then Kotromanic was saved by a Byzantine invasion of Serbia, which forced Dushan to hurry to the south. Kotromanic was the first Bosnian ruler to coin money; his country extended "from the Sava to the sea and from the Cetina to the Drina."

Stephen Kotromanic was succeeded by his brother's son, Tvrtko I (1353–91), who ascended to the throne at the age of 15. Soon afterward Louis I of Hungary occupied part of Hum, claiming it as the dowry of his wife Elizabeth, daughter of Stephen Kotromanic. Relations between Tvrtko and Louis then worsened, leading to open war in 1363. After successfully opposing the Hungarians near Soko on the Pliva river and near Srebrnik on the Usora, Tvrtko was subsequently forced to leave the country by a revolt of the Bosnian nobles, which his brother Vuk supported. Eventually, however, he was restored to power by Louis. In 1377, in the monastery of Milesevo, at the tomb of St. Sava, Tvrtko crowned himself as "king of the Serbs and Bosnia, and the coastlands." In 1382, in order to make his trade independent, he built the town of Novi (the modern Hercegnovi) at the entrance of the Gulf of Kotor. Kotor itself was peacefully ceded to him by Hungary.

In 1386 the Turks invaded Bosnia. Their armies moved as far as the Neretva river but in 1388 were defeated by Tvrtko's commander Vlatko Vukovic at Bileca. Tvrtko also sent his forces under Vukovic's command to help his friend the Serbian prince Lazar, but the Serbs were disastrously beaten at Kosovo (1389).

Turning westward, Tvrtko in 1390 conquered Split, Trogir, Sibenik and the islands of Brac, Hvar and Korcula (Curzola). When he took the title of "king of Rashka, Bosnia, Dalmatia, Croatia and the coastlands," Bosnia was at the zenith of its power.

Tvrtko died in March 1391. His successor was Stephen Dabisa (1391–95), who at Djakovo, in 1393, concluded an agreement with Sigismund, king of Hungary (the future Holy Roman emperor), nominating Sigismund as his successor. After Dabisa's death, however, his widow Jelena assumed power, and Bosnia was not given to Sigismund, though no king was chosen instead. Sigismund's defeat by the Turks at Nikopol (1396), moreover, weakened his influence. In Bosnia two pretenders claimed the throne: Stephen Ostoja (believed to be an illegitimate son of Tvrtko I) and Tvrtko's legitimate son Tvrtko II. At the same time two magnates also rose to power: Sandalj Hranic and Hrvoje Vukcic, who soon were to play important parts in Bosnian history. Dissensions between these four contributed to the slow decline of the country, while the Hungarians and the Turks were still intervening in its affairs. When Ostoja (1398–1404) was dethroned by Hrvoje Vukcic, Tvrtko II became king (1404–09). Though a large number of Bosnian nobles were killed by the Hungarians at Doboj, Sigismund failed to conquer the country; and after Tvrtko II had been dethroned and Ostoja was reinstated (1409–18), the Hungarians were defeated at Doboj in 1415 by Hrvoje, who had received the help of the Turks. Ostoja's son Stephen ruled only two years and Tvrtko II then became king again (1420–43). His policy was now pro-Hungarian, but Sandalj believed that Bosnia must side with the Turks. After Sigismund's death, Turkish influence in Bosnia became greater. Sandalj, moreover, was master in Hum. Tvrtko then asked Venice for asylum and even offered Bosnia to Venice. The Venetians answered that they would receive him with pleasure but expressed their wish that he should retain his position.

Tvrtko II died in 1443 and Tomas, Stephen Ostoja's son, came to the throne (1443–61). He continued the pro-Hungarian policy, but during his reign the Turks defeated János Hunyádi at Kosovo (1448), conquered Constantinople (1453) and occupied Serbia (1459). The pope preached in favour of a war against Turks but there was no unanimity for such an enterprise. Stephen Vukcic, as ruler of Hum (*see* below), told the Venetians through his envoy that he would rather give one of his strongholds to the Turks than have it in the hands of Tomas, who was occupying it.

Tomas' successor Stephen Tomasevic (1461–63) appealed to Pope Pius II for help against the Turks. "If you believe me and help me," he wrote, "I shall be saved; otherwise I shall perish and with me also the others." The pope sent him a crown and, despite the protests of Matthias Corvinus of Hungary, Tomasevic was crowned at Jajce in Nov. 1461. He then refused to pay further tribute to the sultan. On learning that the Turks were making preparations for an invasion of Bosnia, he sent envoys to Hum, to the republic of Dubrovnik and to Venice asking for help. He also sent envoys to the Turks, asking for a 15-year armistice. Four days after the envoys had left Istanbul with the promise of an armistice, the Sultan Mohammed II led his army into Bosnia. Bobovac, the capital, fell, and the king escaped to Kljuc. The Turkish commander, Mahmud Pasha Andjelovic, secured his surrender by promising him his life, but the sultan ordered the king to be beheaded. The execution took place at Jajce in 1463. Bosnia became a Turkish province. Matthias of Hungary in the same year seized northern Bosnia from the Turks and created two banats there: that of Srebrnica and of Jajce. The former was reconquered by the Turks in 1512, the latter in 1528.

Hum, however, resisted longer than Bosnia. After the death of Sandalj Hranic, the country passed to his nephew Stephen Vukcic, "a man of strong will, but of evil nature," who in 1448 proclaimed himself *herceg* of St. Sava. He died in 1466. His three sons were not able to withstand the Turks, who in 1482 conquered Hercegnovi. Hercegovina, too, became a Turkish province.

Bosnia as a Turkish Province.—The seat of the Turkish governor or pasha was at first at Banja Luka, later at Sarajevo. In 1580 the Bosnian pashalik was divided into eight *sanjaks*. The governor interfered little with local affairs so long as the taxes were paid. The real power lay in the hands of 48 hereditary *kapetans*, exercising feudal jurisdiction over their tenants and liable to provide military service for the sultan. The religious discords which had rent the country in medieval times were perpetuated in a new form: the nobility—partly to save their lands and power, partly because as Bogomils they preferred Islam to Roman Catholicism—apostatized as a class. Thus numbers of Bosnian Slavs became Muslim, though they continued to speak Serbian and never adopted polygamy. Few true Turks settled in Bosnia-Hercegovina.

The Turkish era saw an economic decline in Bosnia. The mining industry, which had prospered in the middle ages, decayed and finally disappeared; trade languished. The manufacture of weapons and wrought metals alone survived. Many Bosnians, however, rose to high distinction in the Turkish service—among them such famous grand viziers as Mohammed Sokollu (Sokolovic).

During the 16th and 17th centuries Bosnia was an important Turkish outpost in the constant warfare with the Habsburgs and with Venice. When Hungary was at last reclaimed from the Turks, the Austrians in their turn penetrated into Bosnia and in 1697 Prince Eugene of Savoy captured Sarajevo. By the treaty of Karlowitz (1699) the Sava, forming the northern boundary of Bosnia, became also the northernmost limit of the Turkish empire; and by that of Passarowitz (Pozarevac; 1718) Hercegnovi and part of Bosnia east of the Una river were ceded to Austria. These were restored to Turkey in 1739, and the frontiers remained unchanged until 1878.

In the 19th century the great conservative Bosnian families resented all interference from Istanbul. A revolt broke out in 1821, during the Greek rising, and another during the Russo-Turkish War of 1828, under the leadership of Mustafa Skodra Pasha, a reputed descendant of the Bosnian noble family of the Crnojevic. More formidable was the rising of 1831, when the *kapetan* Husein Gradascevic, known as the Dragon of Bosnia, preached a holy war against the sultan and denounced the reforms of the sultan Mahmud II. He and Mustafa together overran most of Macedonia and northern Albania. After a severe struggle the grand vizier Reshid Pasha quelled the rebellion, helped largely by internal dissensions. Eventually the Dragon was driven across the frontier into Croatia and ended his days in banishment at Trabzon (Trebizond). In 1837 the abolition of the *kapetanates* led to fresh trouble and the reforms with which Abdul Mejid inaugurated his reign were keenly resented. The Hercegovinian chief, Ali Pasha Risvanbegovic, who had sided with the Turkish government during the earlier rising, made himself virtually independent. The sultan's authority was restored in 1850 by Omer Pasha, the renegade Croat. By ruthless measures Omer destroyed the old feudal regime in Bosnia, introduced a new, centralized administration and a system of taxation which opened the door to every kind of licence and exaction. In 1862 the Christians in their turn revolted under Luka Vukalovic. They were eventually reduced, but unrest was chronic and discontent universal; Christians and Muslims, despite acute differences, united in their dislike of Ottoman bureaucracy and corruption. (M. A. P.)

Bosnia Under Austrian Occupation.—In 1875 local troubles in Hercegovina spread rapidly into insurrection throughout the two provinces. In August the Austrian, Russian and German consuls tried to mediate between the Turkish authorities and the insurgents, but without success; and the sultan's decree of Oct. 2, offering reduction of taxes, religious liberty and a provincial assembly, was also rejected. The joint note presented by five European powers on Jan. 31, 1876, proposing a limited autonomy, did not go far enough. The situation was complicated by the Bulgarian rising and massacres and by a revolution in Istanbul itself.

On June 30, 1876, Serbia and Montenegro declared war upon Turkey, while the insurgents proclaimed union with them, and numerous Russian volunteers joined the Serbian army. Turkey's speedy victory upset the calculations on which Francis Joseph and the Russian emperor Alexander II had reached a secret agreement at Reichstadt in July (*see* EASTERN QUESTION). Serbia, defeated again in October, after the expiry of the armistice, lost all hopes of winning Bosnia. By the secret convention of Budapest (Jan.–

March 1877) Russia recognized Austria-Hungary's right to occupy Bosnia-Hercegovina in return for Austro-Hungarian neutrality in the impending war with Turkey. At the congress of Berlin after the Russo-Turkish War of 1877–78, Serbia's aspirations and those of the insurgents were disregarded, and Bosnia-Hercegovina was assigned to Austria-Hungarian occupation, though it was still to be nominally two Turkish provinces. The insurgents attempted armed resistance, and Austria-Hungary had to mobilize an army of 200,000 men. Sarajevo was occupied on Aug. 19, 1878, and with the fall of Bihać a month later the rising was virtually at an end.

The two provinces were at first administered by a special commission inside the foreign office at Vienna, but in 1880 they were placed permanently under the control of the joint Austro-Hungarian ministry of finance, the local administration being concentrated in Sarajevo under a governor.

Benjamin Kállay, who became finance minister in 1882, was for 21 years to direct every department of Bosnian policy. Six years' residence as Austro-Hungarian diplomatic agent in Belgrade had given him a unique knowledge of South Slav problems, but his whole influence was exercised in an anti-Serbian sense. He tried to evolve a "Bosnian" consciousness, to check Serbian national feeling and to create dissensions between Serbs and Croats. Meanwhile he set himself to establish public order and material prosperity and achieved remarkable results; he built a network of roads and railways and many public institutions, founded an incorruptible bureaucracy and a system of law and fostered trade and industry.

On Kállay's death (1903) Bosnian affairs were again entrusted to a Magyar, Baron Stephen Burián. During the next decade there was a rapid growth in national feeling in the provinces. Burián, faced by the clamour of the Bosnian Serbs for self-government, made certain concessions. In 1905 the Orthodox Church received a charter of autonomy and its Serbian nationality was recognized for the first time. In 1907 an assembly of 71 Serbian delegates from every district was allowed to put forward a program of reform, in which figured the demand for an autonomous position "as part of the Turkish empire."

Annexation by Austria-Hungary.—Faced by the growing ferment inside the provinces, Austria-Hungary was already convinced of the need for some change in status when the Turkish revolution of 1908 brought matters to a head. The Young Turks contended that Bosnia-Hercegovina must be represented in the new parliament in Istanbul, and the Bosnian nationalists saw in this demand a convenient legal basis for their agitation. Influenced also by the strategic considerations pressed upon him by the general staff, Aloys, Graf Lexa von Aehrenthal (*q.v.*), the Austro-Hungarian foreign minister, advised Francis Joseph to annex Bosnia-Hercegovina to the dual monarchy and thus solve once and for all their constitutional status. On Sept. 15, 1908, at Buchlau, A. P. Izvolski, the Russian foreign minister, gave Aehrenthal to understand that Russia did not object to such an annexation. Accordingly, by a rescript of Oct. 7, 1908, Bosnia-Hercegovina was annexed to Austria-Hungary.

Vienna was committed to the grant of some measure of representative government to Bosnia-Hercegovina and as neither Austria nor Hungary would consent to its being attached to the one rather than the other, or to its partition between them, a hybrid form of constitution was devised, by which the two provinces received a diet (*sabor*) and special laws of association and assembly, but were not represented in the two central parliaments and delegations and thus had no say in foreign affairs. The new constitution, proclaimed on Feb. 7, 1910, had the capital defect of stereotyping sectarian and social differences by dividing the electorate into three electoral colleges and by assigning in each of these a fixed proportion of seats to the Orthodox, to the Roman Catholics, and to the Muslims. The diet, composed of 72 elected and 20 nominated members, had no control of the executive.

These concessions were badly received. The emperor's visit to Bosnia in the summer of 1910 was intended to symbolize to the outside world the permanence of Austro-Hungarian rule; but the opening of the diet, on June 15, was marred by an attempt on the life of the governor, Gen. Marian Varesanin, by a student, Bogdan Zerajic, who at once committed suicide. Burián now tried to win the Serbian element for co-operation with the government and openly described them as the most progressive element in the country. But the situation in Croatia reacted more and more on Bosnia, rendered Burián's half-measures ineffectual and strengthened the self-confidence of the Serbs. In Feb. 1912 Burián was succeeded by Leon Bilinski (1846–1923), a prominent Polish Conservative who enjoyed the confidence of Francis Joseph; but any hope of clearing up the internal situation was frustrated by Hungary's establishment of a dictatorship in Croatia (April 1912) and by the victories of Serbia in the Balkan War (Oct.–Nov.)—events which excited the whole Yugoslav population of Austria-Hungary.

The "Young Bosnia" (*Mlada Bosna*) group was especially active among the Yugoslav students in Prague, Vienna and Zagreb as well as Sarajevo. The younger generation devoted itself to inculcating revolutionary ideas among the university and secondary school youth in Bosnia with such success that confidential memoranda prepared by high officials in Sarajevo and Vienna on the eve of World War I show them to have been altogether at a loss as to what policy to adopt.

The Bosnian situation was further complicated by the increasing jealousy between the provincial government in Sarajevo and its nominal superior, the finance ministry in Vienna, or, in personal terms, between the military governor, Gen. Oskar Potiorek, representing the views of the general staff, and of the archduke Francis Ferdinand (*q.v.*) and the civilian minister Bilinski as the confidant of the emperor. In May 1913 Potiorek, despite Bilinski's disapproval, had closed the Bosnian diet and dissolved various Serbian societies. He continually urged the adoption of still more stringent measures and tended increasingly to act without consulting Bilinski. The most notorious instance was the decision reached between Potiorek and Francis Ferdinand that the latter should attend the military maneuvers in Bosnia in June 1914. Bilinski was not consulted or even notified, and the entire arrangements remained in military hands. To the circumstance must be ascribed a large share of the blame for the assassination of the archduke Francis Ferdinand and his consort, the duchess of Hohenberg, during their visit to Sarajevo on June 28, 1914, by a Bosnian Serbian student, Gavrilo Princip.

Union With Yugoslavia.—During World War I all political life ceased, but when Austria's Balkan front collapsed in Oct. 1918 a national committee was formed in Sarajevo, which acted in close accord with the Yugoslav National council in Zagreb. After its formal recognition of union with the Kingdom of Serbs, Croats and Slovenes, on Oct. 26, 1918, the fate of Bosnia was bound up with that of the new Yugoslavia (*q.v.*).

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(R. W. S.-W.; M. A. P.)

BOSPORUS (KARADENIZ BOĞAZI OR ISTANBUL BOĞAZI), the strait that unites the Black sea with the Sea of Marmara and forms part of the boundary between Europe and Asia. The channel is 19 mi. long, and has a maximum breadth at the northern entrance of 2¼ mi., a minimum breadth of 787 yd., and a depth varying from 20 to 68 fathoms in midstream. In the centre there is a rapid current from the Black sea to the Sea of Marmara, but in the opposite direction a countercurrent sets in below the surface carrying more saline water from the Sea of Marmara to the Black sea. The scenery on both sides is varied and beautiful. Many villages line each well-wooded shore, while on the European side are numerous fine residences; the city of Istanbul (*q.v.*) is at the southern end of the strait, on the European side. After the treaty of 1841, no ship of war other than Turkish was allowed to pass through the strait (or through the Dardanelles) without the consent of the Turkish authorities. They in turn were under the control of

an International Commission of the Straits after 1918. In 1923, however, under the terms of the treaty of Lausanne, Turkey was given more power in the straits zone and the commission, put under a Turkish chairman, lost much of its independence. In 1936 it was abolished and Turkey was allowed to remilitarize and reoccupy the straits. (*See* also STRAITS QUESTION.)

The Bosporus is the only passage between the Black sea and the Aegean, and is used by migratory fish coming from and going to the Black sea seasonally. It is therefore one of the richest fishing grounds of Turkey and is famous for species such as red mullet.

In antiquity the name Bosporus, signifying strait, was applied both to this strait (Bosporus Thracius) and to the Strait of Kerch (Bosporus Cimmerius). It means literally oxford and is traditionally connected with Io, who crossed the Thracian Bosporus in her wanderings, in the form of a heifer. (N. TU.; S. ER.; E. TU.)

BOSPORUS, KINGDOM OF THE (or CIMMERIAN BOSPORUS), an ancient state on the Straits of Kerch, which connect the Black sea with the Sea of Azov. A number of Greek colonies were established in this region in the 7th and 6th centuries B.C. The most important was the Milesian colony of Panticapaeum (mod. Kerch) on the western side of the straits at the extreme eastern tip of the Crimea. Close to it lay Nymphaeum, 10 mi. S. of Kerch; on the eastern side, Phanagoria (near modern Taman), founded from Teos, Hermonassa, founded from Mytilene, and other small settlements.

The colonies' early history is unknown. Panticapaeum is said to have been founded by permission of the Scythians, who then ruled the area that is now southern Russia except the southern Crimea, and these colonies may have depended on the good will of neighbouring Scythian chieftains, at least in the early stages.

From 480 to 438 B.C. Panticapaeum was ruled by the Archaeanactid dynasty, and from 438 to the end of the 2nd century B.C. by the Spartocid dynasty. Of the former nothing is known. The latter are fairly well known because of their relations with Athens. To judge by the names, the Archaeanactids were probably purely Greek in race, the Spartocids half Thracian. The growth of Athenian imperial power in the second half of the 5th century brought the Bosporan cities within its sphere of influence, and an Athenian cleruchy was settled at Nymphaeum. It is not clear whether the Bosporan cities were tribute-paying members of the Athenian empire or not. Athens, however, acquired a monopoly of local trade. Before then Bosporan exports had gone freely to all parts of the Greek world, a state of affairs resumed after the Athenian defeat in the Peloponnesian War (404). As the largest importer of foodstuffs among the Greek cities, however, Athens remained in the 4th century, as earlier, the principal market and the most reliable customer of the Bosporus. In successive agreements the rulers of Panticapaeum were granted Athenian citizenship and other honours in return for privileges given to Athenian merchants.

The earlier Spartocids governed as archons and the royal title was not used until the Hellenistic age. This was merely a matter of form, however, since there was no free political life at Panticapaeum, the power of the ruling family being absolute. Their position was very similar to that of the tyrants who ruled at different times in various parts of the Greek world. They maintained strong forces of mercenaries and adopted an aggressive policy where it seemed profitable. First Nymphaeum, then Theodosia (Feodosiya in the eastern Crimea), an important harbour for grain exports, were annexed. Later the Sindian kingdom in the Taman peninsula was incorporated and Spartocid power was extended northeastward beyond the mouth of the Tanais (Don) river.

This able dynasty, which, among its other achievements, largely suppressed piracy in the Black sea, reached its greatest strength in the 4th century. Wise management of the trade in grain, fish and slaves had made the state extremely prosperous, as is shown by fine coinage, vases and jewelry. But from about the middle of the 3rd century the power of the dynasty and the kingdom's wealth slowly declined, partly perhaps through internal struggles and partly through external events, in particular the disruption of the Scythian empire by invading Sarmatae and Sacae. After the Spartocid dynasty came to an end about 110 B.C. the kingdom passed under the control of the kings of Pontus. About the beginning of the 1st century A.D. a new dynasty was established that ruled for over three centuries under the protection of the Roman empire. The coinage of its kings ceased in A.D. 342. Thereafter the country was at times in barbarian hands, at other times under the protection of the Byzantine emperors.

The Bosporan state constituted an original civilization of a distinctively Greek type in an environment markedly unlike that of the Aegean world. The prosperity of the Greek cities depended on native serf labour on the adjoining land. In the field of artistic work Iranian influences were strong, but Hellenic culture prevailed in a state that was only partially Greek in population and exposed to many non-Greek influences, an interesting parallel to the Greco-Asiatic states of Hellenistic Asia Minor that it preceded.

See E. H. Minns, *Scythians and Greeks* (1913); M. Rostovtzev, *Iranians and Greeks in South Russia* (1922). (R. H. ST.)

BOSS, LEWIS (1846–1912), U.S. astronomer best known for his compilation of star catalogues, was born in Providence, R.I., Oct. 26, 1846, and was graduated from Dartmouth college, Hanover, N.H., in 1870. He worked for the U.S. government at Washington, and on the northern boundary survey until 1876, when he became director of Dudley observatory at Albany, N.Y. Besides supervising the observatory, Boss led the 1882 expedition to Santiago, Chile, to observe the transit of Venus.

About 1895 Boss began to plan a general catalogue of stars, their positions and motions. The project was supported by the Carnegie Institution of Washington, which in 1906 founded it as the department of meridian astrometry. With an enlarged staff Boss observed the northern stars from Albany and the southern from San Luis, Arg., and older catalogues were corrected and embodied with the new data. He wrote papers on precession and solar motion, and in 1910 published his *Preliminary General Catalogue of 6,188 Stars for the Epoch 1900.*

Boss died in Albany, Oct. 12, 1912, leaving his work unfinished. He was succeeded by his son Benjamin, who completed the task in 1937. The work is in five volumes, entitled *General Catalogue of 33,342 Stars for the Epoch 1950.* (HY. R.)

BOSSUET, JACQUES BÉNIGNE (1627–1704), French bishop, historian and orator, was born in Dijon on Sept. 27, 1627, into a deeply religious middle-class lawyer's family. Educated by the Jesuits of his native town, he went to Paris in 1642 and for ten years studied at the Collège de Navarre under Nicolas Cornet, a master of method, to judge from the terms of Bossuet's funeral oration for him in 1663. By 1652 Bossuet had submitted theses for the licentiate and doctorate in theology, had come under the influence of St. Vincent de Paul and had been ordained priest. Subsequently he spent seven years in Metz, laying the foundations of his skill as preacher and controversialist. His discussions with Paul Ferry, minister of the Reformed Church at Metz, continued over many years and seem to have set a new tone in polemic by the mutual courtesy and respect with which they were conducted. Recalled to Paris in 1659, Bossuet preached several series of Advent and Easter sermons in the Louvre. As a popular preacher he was called upon to pronounce the *Oraisons funèbres* on which his literary reputation perhaps mainly rests. These panegyrics, customary after the death of an important national figure, included those on the queen mother, Anne of Austria (1667; not extant), on Henrietta Maria of England (1669), on her daughter (Madame; 1670), on Queen Marie Thérèse (1683), on the princess palatine (Anne de Gonzague; 1685), on Chancellor Le Tellier (1686) and on Condé (1687). Nominated bishop of Condom in 1669, Bossuet resigned the see in 1671 after his appointment as tutor to the dauphin, which brought with it his election to the Académie Française. Apart from preaching he seems to have devoted his entire time and energy during this period to his pupil, in study and in writing textbooks, the most famous of which, the *Discours sur l'histoire universelle*, appeared in 1681 and the others posthumously: *Traité de la connaissance de Dieu et de soi-même* (1722); *Politique tirée des propres paroles de l'écriture sainte* (1709); *La Logique* (1828).

His tutorial duties completed, Bossuet was made bishop of Meaux

in 1681 and remained so until his death. He was a "residing" bishop and declared that to be pastor of a diocese was the only dignity to which a Christian should aspire. His country house at Germigny was not only a conference centre but also a place of constant hospitality.

No sooner had Bossuet accepted the new see than he became involved in the Gallican controversy, perhaps the most protracted and most serious polemic of his life (*see* GALLICANISM). His famous sermon on the unity of the church, preached by invitation to the assembly of the French clergy, was an irenic attempt to avoid the schism which the conflict between pope and king was rendering imminent. Behind the fair words, however, lay difficult negotiations concerned with the dispute over the royal insistence on its right to revenues of vacant sees, in which Bossuet was concerned to modify the intransigent attitude of Louis XIV without giving in to the Ultramontane position. The result was a declaration in four articles issued and accepted by all parties in 1682.

Concurrently, Bossuet played a leading role in the campaign against the Protestants that culminated in the Revocation of the Edict of Nantes in 1685. Here again he took a middle position, supporting the royal policy but disagreeing with actual persecution. He held that it was for the state to persuade, and to coerce if necessary, but for the church to convince and to make the orthodox position clear to fair-minded inquirers. Hence his writings: *Traité de la communion sous les deux espèces* (1682); *Catéchisme du diocèse de Meaux* (1687); *Histoire des variations des églises protestantes* (1688), *Six avertissements aux protestants* (1689–91) and the *Défense de la tradition et des saints-pères* (1692, published 1753). Much earlier (1671) he had published, on the same subject, *Exposition de la doctrine de l'église catholique sur les matières de controverse,* which attracted the attention of the pope and was immediately translated into English.

The third and most spectacular of Bossuet's major controversies was that against Quietism (*q.v.*), which occupied the last six years of the century. After the failure of an attempted settlement at Issy (1694–95), Bossuet and Fénelon gradually drifted into a duel of pamphlets. When in 1697 Fénelon appealed to Rome, Bossuet represented this as an Ultramontane move and himself as the guardian of Gallican liberties. The Holy See's condemnation of Fénelon in 1699 was no more than a Pyrrhic victory for Bossuet, who no doubt was as aware as his critics of the scandal and damage caused to the church by the long, open and unscrupulous wrangle between two leading prelates.

Bossuet's last years were a hard fight against physical disability and theological dissent. He died in Paris on April 12, 1704.

Bossuet's Reputation.—A controversialist is always sooner or later himself a centre of controversy. Bossuet was not spared, either during his life or since. Much has been made of a story that he was secretly married to a Mlle de Mauléon, whom he is known to have helped financially. It has been said that a "contract" (whether actually of marriage is not stated) was found after his death and that inquiries were silenced by royal command. Modern scholars conclude that an affirmation either way cannot be justified by the evidence available.

On the whole Bossuet emerged from a long career spent in the limelight of public discussion with a reputation for plain speech and fair dealing and for a rugged strength of character. His polemic seems on the whole to have been grounded on extreme industry in determining the facts, on respect for the courtesies of dignified discussion and on an apparently unquenchable faith in the power of argument. Though modern scholarship has been severe on Bossuet's intrigue and diplomacy, and suggests that the traditional picture may be due for revision, most people have been persuaded that Bossuet was honest and Fénelon subtle. This, allied to a pulpit reputation for outspokenness, has had the perhaps more sentimental than logical result that in Sainte-Beuve's words "la gloire de Bossuet est devenue une des religions de la France."

This is the more surprising in that almost all the positions he defended were discredited within a century of his death. The Revocation of the Edict of Nantes, which he thought the miracle of the age, was treated by historians as a serious blunder. Biblical criticism, which he did everything to suppress (his condemnations of the Old Testament critic Richard Simon extend from 1678 to 1702), soon won the field. His notion that Protestants and not Catholics had "varied" in doctrine was put out of date by J. H. Newman. His wholesale condemnation of the theatre was shared only by the most rigorous Puritans. His providential explanation of history hardly survived Voltaire. His notion that heresy and individualism were almost the same thing seemed nonsense to many even before Rousseau.

As a Preacher.—It is remarkable that a man so universally wrong should stand so high, even with those who share none of his credal faith. The main cause of this reputation would seem to be his preaching. Much work has been done on the text of his sermons, and it is doubtful whether what was published was very close to what he said. The manuscripts seem to consist either of his own notes for discourses that in the event were largely extempore, or of hearers' notes of what they heard. But even so, it is impossible to miss the force and range of his rhetoric or to doubt its effect on its audience. The sermons explain why good judges among his own nation rate him as the most magnificent manipulator of the French tongue, unique in his handling of both thought and emotion. Among many widely quoted passages are the soliloquy of the young St. Bernard from the sermon of 1653 ("cette heure fatale viendra, qui tranchera toutes les espérances trompeuses par une irrévocable sentence") and the pen-picture of Cromwell (1670): "un homme s'est rencontré, d'une profondeur d'esprit incroyable." Some of his finest passages occur in pastoral addresses such as the "Discours sur la vie cachée en Dieu" composed as an Easter meditation in 1692. In the formal panegyric Bossuet's success seems to have been due to the effort to make the formal and official simple and homely, to what the abbé Brémond called their "miraculous simplicity." But the simplicity is never flat or trite, as with a small mind it would be; it seems dependent on a deep and indeed acute sense of mortality, of sin, of the temporal seen in the context of the eternal, of the mystery of self-knowledge, all or any of these coming to light in a single phrase.

The secret of Bossuet's appeal thus is largely poetic. His prose is never far from that poetry which accompanies a classical sense of the paradox of human life, so bounded by time and earth that rank and power are an illusion. There is poetry again in his view of history as a procession, impressively contrasted with the brief appearance of any individual life. If we remember that life in the 17th century was drab and cruel and that most of his hearers were taught to regard this world as a vale of tears, then the power of Bossuet's appeal is clearer.

As a Thinker.—But those, like Paul Valéry, who praise the form and disregard the matter of his writing would have seemed blind to Bossuet. The 19th century's image of him as an incomparable writer and insignificant thinker must be discarded or revised in the light of more modern scholarship. Though the causes he championed may have been doomed to defeat, there may well have been in 1680 no other way in which the church could be defended. Even his "providential" view of history is not now as irrelevant as it seemed in an age of progress such as the 19th century. Without Bossuet it is hard to see how Voltaire, Gibbon and Michelet could have achieved what they did. Apart from the assumption (natural to Bossuet and to his age) that only a Christian can understand or explain history, his search, both patient and informed, for a thread of meaning through the upheavals of the ancient world must be counted an important new departure in historical writing. Hardly less original is the method of the *Histoire des variations des églises protestantes,* which establishes the principle that in order to refute an opponent it is necessary to learn what he means. Bossuet was ahead of his time in treating Luther and Calvin seriously. He was unusual in the range of his contacts, being a correspondent of Leibnitz, Mabillon and Arnauld. In his dealings with the Jansenists he preserved both their respect and his own independence.

In a sense our view of Bossuet depends on our view of his king. For those who in Louis XIV see only a tyrant unscrupulously working for national aggrandizement, Bossuet must seem little more than a time-server, working for what Sainte-Beuve called "l'autel adossé au trône." To modern historians who see the French mon-

archy as a delicate balance of forces beyond the power of any individual to bend to his own ends, Bossuet's defense of Gallican orthodoxy seems both rational and dignified. Strangely enough, it is from a historian sympathetic to Fénelon that the most generous summary of Bossuet's career comes: H. Brémond held that his real achievement lay in his lifelong, honest and passionate struggle to bring home to men the things of God.

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BOSTON, JOHN, OF BURY, early 15th-century English bibliographer, was a monk of the Benedictine abbey of Bury St. Edmunds. He compiled an alphabetical catalogue of Latin writers and of their works, with references given in the form of numbers to which there is a key, at the beginning of the catalogue, to English monastic libraries where copies of them were to be found. When he could, Boston entered the opening and closing words of a book. Like most bibliographers, Boston was largely dependent on his predecessors. He drew his list from St. Jerome, *De viris illustribus,* and his continuators, Gennadius and Isidore; from Cassiodorus, *Institutiones;* from Vincent of Beauvais, *Speculum historiale;* from one of the lists of Dominican writers, and from the *Catalogus* (or *Registrum*) *librorum Angliae* compiled by English Franciscans in the second half of the 13th century. Their list provided Boston with most of his references to the monastic libraries throughout England and Wales where copies of a given work could be found. Boston's additions came from the extensive library of his own abbey and from those of a few other houses, chiefly in the neighbourhood.

A manuscript of Boston's catalogue belonged to the London bookseller, Awnsham Churchill, who commissioned an edition from Thomas Tanner in 1694. The edition was never completed but David Wilkins, who edited Tanner's *Bibliotheca Britannico-Hibernica* in 1748, printed the preface, the names of the writers and the lists of works of English writers. The manuscript is lost but Tanner's transcript survives in the Cambridge university library (ms. add. 3470).

It is not known whether Boston had a part in an edition of a work on monastic origins and writers, *Speculum coenobitarum,* originally compiled by a monk of Bury in the first half of the 14th century but attributed to Boston by John Bale (1495–1563).

(RI. W. H.)

BOSTON, a municipal borough and seaport in the Parts of Holland (of which it is the county town), Lincolnshire, Eng., lies on the river Witham, 4 mi. from its mouth in the Wash. Pop. (1961) 24,903. Area 5.1 sq.mi. Once known as Botolph's Town, after St. Botolph who founded a monastery in 654, Boston lies in flat, rich agricultural country, intersected by numerous watercourses or "drains." In the 13th century it was a great Hanseatic port trading in wool and wines and paying more dues than London. Although Henry VIII made Boston a borough by a charter of 1545 (which is still preserved), by then the dissolution of the monasteries and trade guilds and the silting up of the river had caused the town's prosperity to decline. In 1764, however, the river bed was deepened and the Grand Sluice opened. In 1882 a dock, seven acres in extent, was constructed to accommodate vessels of more than 2,000 tons, and a new cut of three miles was made into deep water. A riverside quay 2,640 ft. long was built in 1938 and a large grain silo erected in 1951. The docks, controlled by the corporation as the Port of Boston authority, are now fully equipped to deal with 750,000 tons of cargo a year. The main imports are timber, grain, fruit, vegetables and fertilizers, the chief exports being coal, grain, agricultural machinery, potatoes and cattle.

The church of St. Botolph is a Decorated building; its western lantern tower (1309–1460), known as Boston Stump, is 272½ ft. high and is a landmark for 20 mi. A chapel in the church was restored by citizens of Boston, Mass., in 1857 in memory of a former vicar, the Rev. John Cotton, who followed the Pilgrim fathers to New England in 1633. The church was extensively restored with a further American gift in 1931. On the river bank at Scotia creek, near Boston, stands a granite memorial to those early Pilgrims who in 1607 made their first, but unsuccessful, attempt to escape to religious freedom. The cells in which they were imprisoned may be seen in the guildhall. Several 18th-century explorers of Australia, such as Joseph Banks, George Bass and Matthew Flinders, also originated in Boston and district. In the town are a guildhall (1450), now a museum; Shodfriars' hall, a half-timbered house of the 15th century much restored; the grammar school, founded in 1555; Hussey tower, part of a late 15th-century mansion; remains of the 13th-century Dominican friary; Fydell house (1726); assembly rooms (1822); municipal buildings (1904); and the Maud Foster windmill with five sweeps.

The town's principal industries are fruit and vegetable canning, fish preserving, the making of tags, labels, shoe laces, beds and pillows, and shellfishing. A cattle market is held weekly and a general market twice a week. Each May there is a pleasure fair, which includes livestock fairs. (C. L. H. G.)

BOSTON, the capital city of Massachusetts, U.S., comprises the greater part of Suffolk county. The city is 13th in population in the United States: (1960) 697,197. (For comparative population figures *see* table in MASSACHUSETTS: *Population.*) Its standard metropolitan statistical area is 7th in population: (1960) 2,589,301 (*see* also *Population,* below). Boston is the central city of this standard metropolitan statistical area which also includes all of Suffolk county, 9 cities and 20 towns in Middlesex county, 4 cities and 11 towns in Essex county, 1 city and 18 towns in Norfolk county and 9 towns in Plymouth county.

PHYSICAL GEOGRAPHY

Physical Features.—Boston and its harbour stand at the head of Massachusetts bay, 42° 21′ 27–6″ N., 71° 3′ 30″ W. Boston occupies much of the Boston basin, a territory within a ring of hills. It stands on a surface of granite, conglomerate, slate and lavas between geological "faults" at the Blue hills on the south and Arlington heights on the north. It was, in its colonial days, rocky and irregular, a peninsula lying between the south bay, the Charles river and the Back bay flats. The town was almost an island, being connected with the Massachusetts mainland by the very narrow Roxbury neck.

No U.S. city has undergone greater physical change than Boston after the American Revolution. There remain only a few blocks in two sections on the water front which were on the original boundary. A town of 780 ac. became a city of 28,019 ac. of land area, so increased by annexation of surrounding territory and by 2,944 ac. of made land. The total area including water is 42,176 ac. or 65.9 sq.mi. (land area alone, 47.8). Of the hills which dominated Boston in colonial days, Copp's hill alone stands unaltered. Fort hill, near the water front, has entirely disappeared, while Mt. Vernon, the western peak of the Trimountain—once the most conspicuous feature of Boston—and its eastern peak, Cotton or Pemberton hill, were leveled in building developments between 1799 and 1835. The central peak, Beacon hill, which was shorn of its top 60 ft. between 1811 and 1824, is the only surviving remnant of the Trimountain. The tops of these hills were used to fill the coves as the shore line of Boston was extended and the narrow neck connecting the peninsula was widened. During the 19th century the city became almost surrounded by made land. The greatest project of reclamation was the conversion of the Back bay from mud flats to land, commenced in 1856; this extraordinary enterprise—for which Needham gravel, dug by steam shovel, was transported in special railway trains—produced Commonwealth avenue and other adjacent streets that were for a century the city's most attractive residential section.

The Charles river dam, completed in 1910, removed the flats previously exposed at low water. The dam and machinery of control maintains the water of the basin at an even height. Covered canals on either side of the river take the excess sewage and de-

posit it beyond the dam in the tidewater.

Additions.—East Boston, an island in the harbour settled by Samuel Maverick almost coincidentally with the mainland and having no regular municipal entity, was annexed in 1637. In 1804 South Boston, a peninsula coming close to the city, was annexed. It contains Dorchester heights, the fortification of which by the Continental army made British occupation of the city untenable in 1776.

In 1868 Roxbury, which until the filling in of the Back bay had been the only town through which Boston could be approached by land, was annexed. It was a city at the time and, like Boston and the surrounding colonial towns, has an individual history of its own (*see* ROXBURY). Six years later, in 1874, four communities were added: the city of Charlestown (*q.v.*), and the towns of Dorchester (*q.v.*), Brighton and West Roxbury. No further annexations were made until 1912 when Hyde Park was added from Norfolk county.

Boston Harbour.—The harbour is almost landlocked and is only 6½ mi. from the open sea. The main ship channel is 35 ft. deep at low water. Its wharfage extends along what can roughly be called three sides of an open rectangle, comprising the water front at South Boston, Boston proper and East Boston, with a broad passage northeast of Boston leading to the Charlestown water front along the Charles and Mystic rivers.

HISTORY

Colonial and Provincial Period.—It is possible that the early Norsemen explored Boston harbour. Capt. John Smith made explorations and mapped the locality in 1614. A party from the Plymouth plantations visited it in 1621. It was known to the white man long before a real settlement was made and there were several individual settlers living within the borders of the present city—William Blaxton (Blackstone) on the Trimountain peninsula, Thomas Walford in Charlestown and Samuel Maverick on Noddle's Island. In 1628 the Massachusetts Bay Colony, the first great Puritan settlement, was inaugurated at Salem, under John Endicott as governor. He was joined in a few months by John Winthrop (*q.v.*), who in 1630 with his followers settled temporarily at Charlestown. Finding some difficulty in water supply, he crossed the river at the invitation of Blaxton and made his settlement in Shawmut, or Trimountain, as it was variously called. The accepted day from which the city dates its beginning is Sept. 17, 1630, when it was ordered by the court of assistants that the town should be called Boston after the Boston in Lincolnshire, the leading town of the region from which the principal Puritan leaders had come.

For a short time, Boston, New Towne (Cambridge) and Charlestown flourished in about equal degree but the excellent commercial situation of Boston soon put it to the fore and in 1632 it was made the capital of the colony. During the first ten years 20,000 settlers came to Massachusetts bay, most of whom landed in Boston, a great proportion settling there. Oliver Cromwell and John Hampden were among those who contemplated settling in New England. Then the political tide turned in England and with the rise of the Puritan party, the stream of emigration largely subsided.

The Congregational churches, the first to flourish in the Massachusetts Bay Colony, were the outcome of this Puritan influx. It is to be borne in mind that the Puritans, unlike the pilgrims of Plymouth, were not Separatists. They were originally reformers within the English church. But when they came to the new country they found nothing to reform, either in church or government; thus they were forced to create. This brought into being a church almost the duplicate of that of the Separatists in the adjoining colony, a self-sustaining, self-governing religious unit. The first church of the Boston settlement had been founded before they left Charlestown under a covenant adopted by Winthrop, Thomas Dudley, Isaac Johnson and the pastor John Wilson. It bound the members "to walk in our ways according to the rule of the gospel, and in all sincere conformity to His (Christ's) holy ordinances, and in mutual love and respect to each other, so near as God shall give us grace." Under the intent to reform, qualified by the conditions of pioneering, there was thus brought about, naturally and peaceably, a great religious revolution.

In Boston as well as in all the rest of the Massachusetts Bay Colony the religious test came to be applied to citizenship. In the general court held in Boston, it was ordered "that for time to come no man shall be admitted to the freedom of this body politic but such as are members of some of the churches within the limits of the same." This was at first no very oppressive test, for the early settlers were all of one mind religiously, but it did establish a state church.

The church government was liberal. Within this church there was pure democracy. The ministers had great influence but they were not entrenched as to powers. A sermon regularly preceded an election, but it was not to be one in which the citizens were to be told for whom to vote, and, when in an election sermon Rev. John Cotton preached upon the inadvisability of superseding experienced officials, Governor Winthrop was immediately defeated.

Boston was governed by town meetings: assemblages of citizens were held at least once a year to decide upon municipal improvements, fix taxes, vote appropriations and elect officers. In meetings all citizens had equal rights of voting and speaking.

The early Puritan settlers, though desirous of freedom to worship in their own manner, had been intolerant of dissident groups or individuals, going so far, for example, as to banish Roger Williams (*q.v.*) and Anne Hutchinson (*q.v.*). The narrowness and zeal of its prevailing religious mood perhaps served to make Boston a prey to the superstitions about witchcraft common in both the old and the new worlds. While Salem exhibited the most virulent examples of persecution, several accused witches were also executed in Boston. The notable Boston clergyman Cotton Mather defended his belief in witchcraft in various writings, and even went to an execution in Salem, where, when a speech by the victim had almost aroused the spectators to the point of rescue, he declared the sentence was just.

As the 17th century progressed, the Puritans were joined by other settlers, attracted not so much by the religious climate as by Boston's growing commercial advantages. Certain able and intelligent men came who did not join a Congregational church. Accordingly it became more and more difficult to maintain the theocratic principle in Boston. A party among the Puritans which espoused the traders' cause came to be known as the Moderates, and was strongly opposed by the radical Theocrats. The struggle was finally carried to England, where the influence of the trading class brought about the abrogation of the old colonial charter in 1684. This led to the first defiance of authority in the New England colonies.

The abrogation of the charter was succeeded by a brief interval under the presidency of Joseph Dudley, son of one of the original settlers, Gov. Thomas Dudley. Then the new royal governor arrived in the person of Sir Edmund Andros. He was an honest and well-intentioned man but he governed autocratically. His administration drove the divided Puritans, radical and moderate, together again. The residents of Boston, learning that William of Orange had landed in England, made common cause with that revolution and on April 18, 1689, they rose, seized and deposed Andros, kept him in comparatively easy confinement for nearly a year and sent him back to England.

A new charter was granted by William. It assured the colonists their liberties and freedom of worship, but it protected the English churchmen in their right of worship and extended the franchise so that it no longer rested on church membership. The election of governor was never restored to the people while under English rule. Under the provincial charter, which approximately began the 18th century, Boston and Massachusetts history are closely interwoven (*see* MASSACHUSETTS: *History*). In the middle of the 18th century, the population was about 15,000, the houses were principally of wood, some of brick and stone. The town maintained a town watch and an organization of fire wards but it suffered from destructive fires in 1676, 1690, 1711, 1747 and 1760. The town had 17 churches in 1750, the larger number being Congregational, but there were other denominations represented as well—Episcopal, Anabaptist, French Huguenot and Quaker. Although the religious test had been abolished for suffrage, the

town continued to make money grants to the Congregational churches and foster them officially.

Revolutionary Period.—During the second half of the 18th century the relations of the colonies with England became more and more strained. The Quebec act (1774), recognizing the Roman Catholic Church in that province, gave the Protestant citizens in the colonies some uneasiness. Most of their earlier grievances, however, were financial and political rather than religious. In Boston the first important outward manifestation of discontent occurred when Charles Paxton, the collector of customs, through a deputy at Salem petitioned the court for "writs of assistance," which would enable the customs officers to enter homes and warehouses in the exercise of their duty.

On a hearing of the petition, James Otis made a dramatic plea built largely around the legal axiom that "an Englishman's house is his castle." The writs having been established in legislation by the British parliament, the court sustained the officers of the crown. But Otis had profoundly stirred the people and as John Adams afterward said, "then and there the child independence was born." This was in 1761. The Sugar act of 1764 was followed by the Stamp act of 1765, which was strenuously resisted. On Aug. 26, 1765, the most destructive and disgraceful riot of the period attacked the house of Thomas Hutchinson, then lieutenant governor and chief justice, gutted it and destroyed his magnificent library containing many irreplaceable sources of Massachusetts history.

Other and soberer methods were legitimately and effectively used. Businessmen refused to use the stamps. Trade came to a practical standstill since the tax stamps had to be affixed to invoices and other written evidences of transactions. Even the courts closed for lack of triable causes, for the writs and all other documents had to be stamped. The Stamp act was a failure and nothing remained for parliament to do but to repeal it, which it did in 1766. Of all the American towns Boston was the most enthusiastic in the opposition and at the back of Boston was the Caucus club of active citizens bent on influencing opinion and action. The most influential member of this club was Samuel Adams, whose activities have given him the title of "father of the American Revolution."

With the repeal of the Stamp act came the Declaratory act, in which parliament declared its right to tax the colonies. Under this declaration of policy the Townshend acts were passed, placing duties on lead, glass, papers, paint and tea. This led to a prompt boycott by the Boston merchants. They were not revolutionaries at heart but they made common cause with Samuel Adams and the proletariat for trade purposes. Probably they thought they were making use of Samuel Adams for their own purposes while he was quite as certain that he was using them for his. The time was to come when he would lead them further than they probably intended and they would find themselves in a position from which they could not draw back. The matter was now so acute that it had mounted to chronic defiance and two regiments of regulars were dispatched to the town and camped on the common, being denied housing among the citizens. Friction was inevitable. At last, on March 5, 1770, a group began to harass a sentinel on King (now State) street near the town house. Finally the squad called to his support fired, killing several men. The Boston massacre, as it came to be called, showed that in view of the feeling of the moment, troops could not be quartered in the town without danger both to the citizens and the troops themselves. A committee, with Samuel Adams at its head, demanded the withdrawal of the regiments to the castle. Hutchinson, then acting governor, demurred and sought to compromise on one regiment but to Adams' reply, "both regiments or none," he yielded. It became evident to the British parliament that these acts could not be enforced and they were repealed except for the tax on tea, which was kept for the assertion of the principle involved. Samuel Adams and his associates led the opposition to the principle.

After three vessels laden with tea had arrived in the harbour and been moored at Griffin's wharf, Adams organized meetings and conferences, trying to bring about the return of the tea to England. On Dec. 16, 1773, a town meeting adjourned following Adams' statement, "This meeting can do nothing more to save the country," whereupon a group of responsible citizens, more or less thoroughly disguised as Indians, proceeded to the wharf, boarded the vessels, broke open the chests and threw the tea in the water. So orderly was the crowd, and so conservatively was their performance carried out as to prove the act not a spontaneous but a premeditated one. It became all the more incumbent on the British government, if it wished to maintain more than ostensible sovereignty, to take notice of the occurrence. Accordingly the Boston Port bill, closing the port and ruining its trade, was passed, and more troops, under the mild and well-meaning command of Thomas Gage, were dispatched to the disaffected city. These measures, however, only served to promote open revolt.

The colonists formed a skeleton military organization called minutemen, prepared to muster on the shortest possible notice and gathered ammunition and supplies. Gage promptly sent a detachment to that part of Charlestown now Somerville and destroyed some of these stores. In April 1775 he decided to send a secret expedition to capture or destroy military stores at Concord. His plans were suspected by the insurgents and his movements noted. On the evening of April 18 an expedition was sent out. Before leaving Boston, Paul Revere learned its route and announced it by an agreed set of signals placed in the church tower. From Charlestown, on a borrowed horse, he rode toward Concord to warn the inhabitants. He was joined by William Dawes, who had left Boston by another route; by the time the regulars reached Lexington green, their pathway was obstructed by a small company of minutemen. This was the first armed resistance. After an exchange of volleys, in which eight of the militia were killed, they gave way. The regulars proceeded to Concord but found that the greater part of the stores had been carried to safety. There occurred the fight at the bridge (in which both sides lost men) and the withdrawal of the British. As the minutemen came in from the country they harassed the British column until the withdrawal became a retreat and the retreat a rout.

Thus the American Revolution began with the British troops out of Boston, contesting with militia aroused by Boston men. The war was accepted by the colonies. Siege was immediately laid to the town by a half ring of forts erected on the land side. These New Englanders were reinforced by troops from the other colonies. The continental congress, though it had not yet declared independence, made George Washington commander in chief of the American armies. Before he reached Cambridge, Gen. Artemas Ward, in command, sent a detachment of troops under William Prescott and Israel Putnam to fortify Bunker hill in Charlestown, which commanded the town on the north. The colonials actually occupied nearby Breed's hill. William Howe, in command of the British forces, decided to carry the hill by storm. The colonials were courageous men and excellent marksmen. They repelled the first attack with great slaughter; a second was made, the steady Britishers reforming and mounting the hill again only to meet another sanguinary repulse.

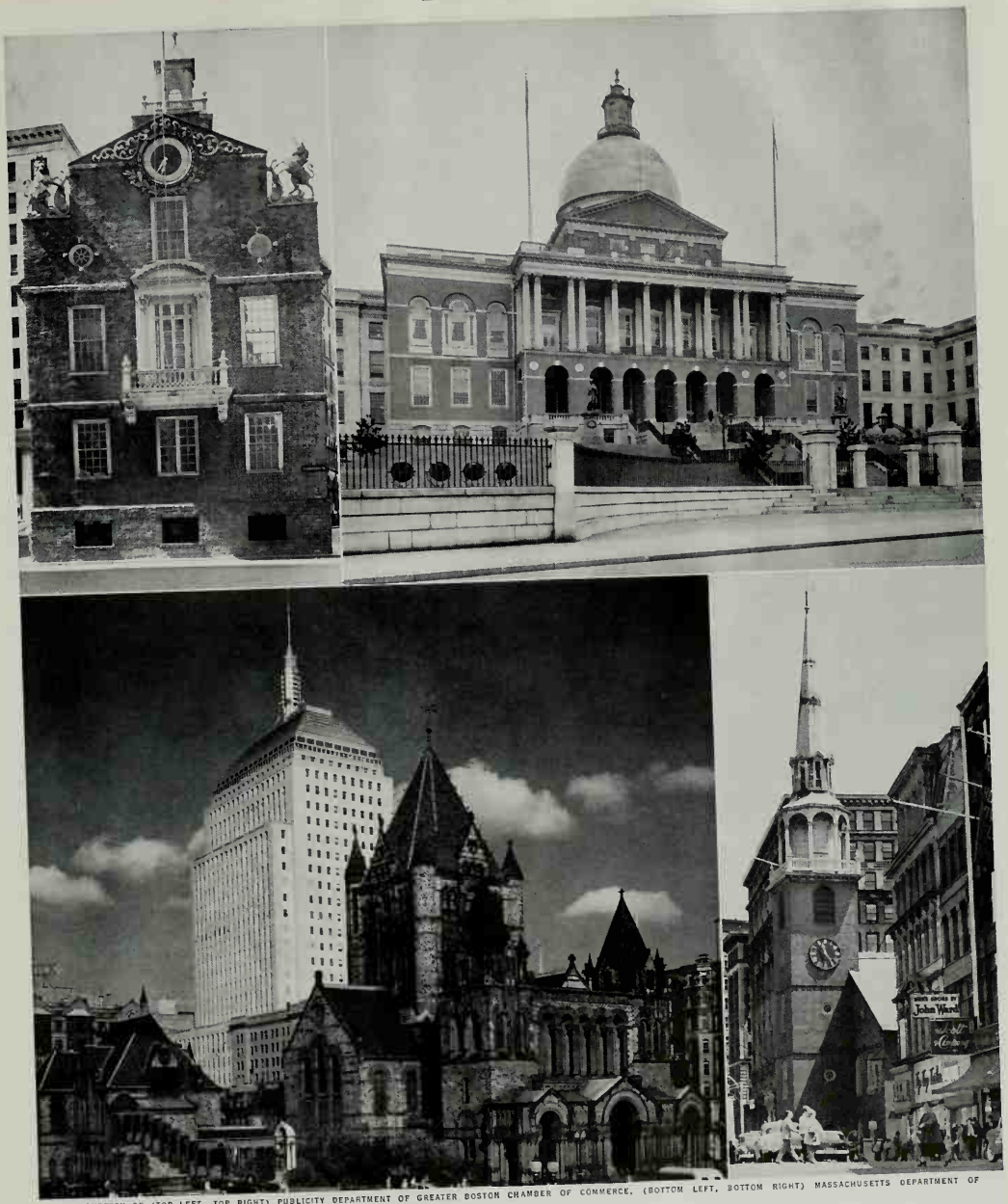
On the third attack the ammunition of the colonials was exhausted and after a bayonet struggle they made an orderly and soldierly retreat. Technically a victory for the British, it was purchased at such a cost that it gave the colonies great encouragement and its anniversary (June 17) is celebrated in Boston to this day. The siege continued unabated until, after the colonials occupied Dorchester heights closely overlooking the town, Howe evacuated the city on March 17, 1776.

Boston was never again in the theatre of the war during the Revolution. Its entire population was not in accord with the revolt. Howe carried with him great numbers of Loyalists to Halifax and others remained to bear reprisals.

Four years before the treaty of peace was signed, a convention was held in Boston and formed a state government for Massachusetts. The town, under the Articles of Confederation and the constitution, maintained the old town meeting system.

Post-Revolutionary Period.—From the ratification of the treaty of peace until 1822 when it became a city, Boston was mingled in the broader history of the state and the nation. During Shays's rebellion (*see* MASSACHUSETTS: *History*) its inhabitants

BOSTON



BY COURTESY OF (TOP LEFT, TOP RIGHT) PUBLICITY DEPARTMENT OF GREATER BOSTON CHAMBER OF COMMERCE, (BOTTOM LEFT, BOTTOM RIGHT) MASSACHUSETTS DEPARTMENT OF COMMERCE. PHOTOGRAPH, (BOTTOM RIGHT) PAUL KRAUSE

SOME HISTORIC BUILDINGS OF BOSTON

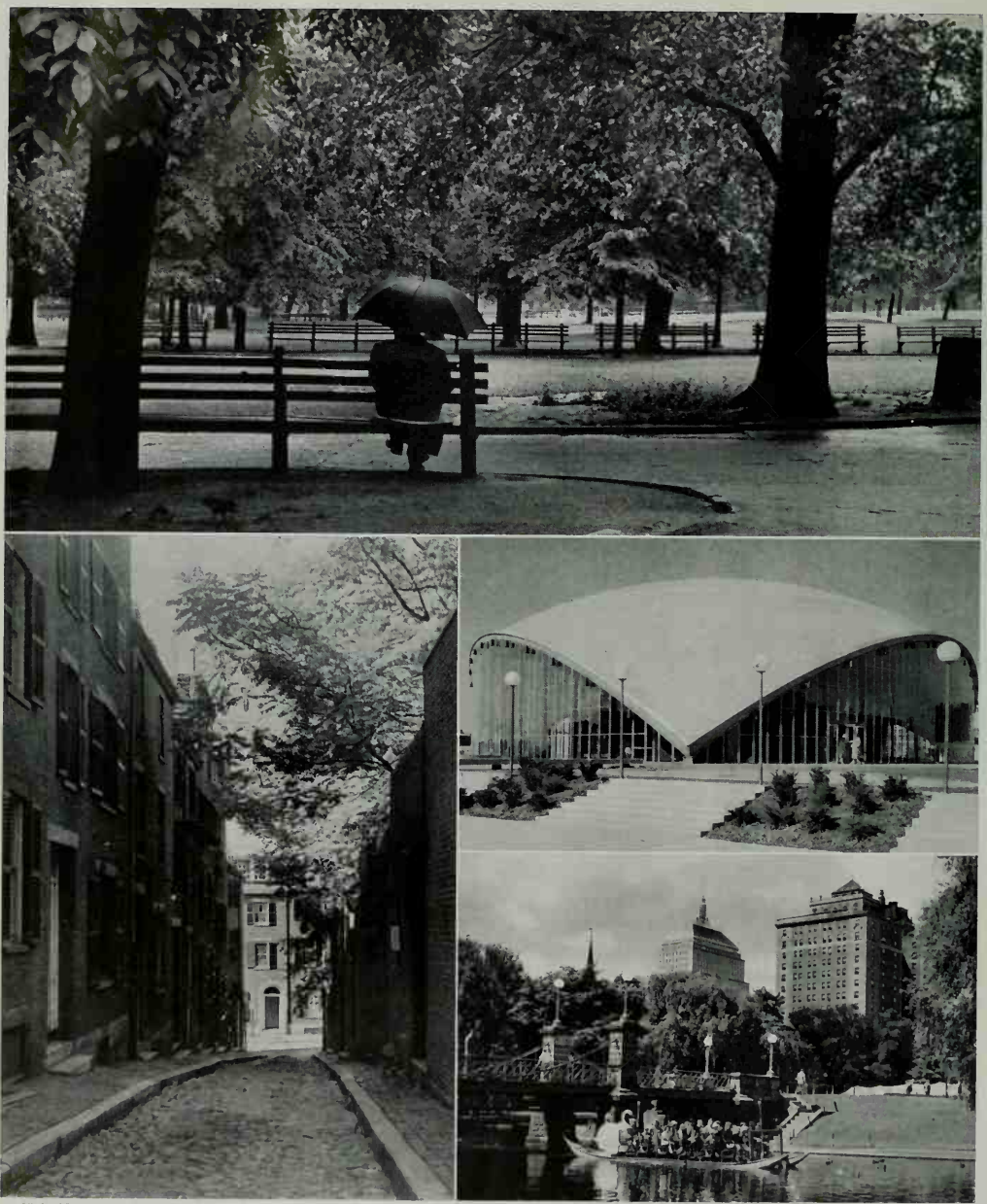
Top left: Old state house (1713, rebuilt in 1748), restored during the 19th century, among the oldest public buildings existing in the United States

Top right: The state house, on Beacon hill, built between 1795 and 1798. The two wings of white marble and additions to the rear were constructed later. The original central structure of red brick was designed by Charles Bulfinch

Bottom left: Trinity church, Copley square. In the background is the John Hancock Mutual Life Insurance Co. building

Bottom right: Old South meetinghouse in downtown Boston

BOSTON



BY COURTESY OF (TOP, BOTTOM LEFT) MASSACHUSETTS DEPARTMENT OF COMMERCE, (CENTRE RIGHT) MASSACHUSETTS INSTITUTE OF TECHNOLOGY, PHOTOGRAPHS, (TOP) EVERETT JACOBY, (BOTTOM RIGHT) ART GRIFFIN FROM F P G.

VIEWS OF BOSTON AND CAMBRIDGE

Top: Boston common during a summer shower
Bottom left: Acorn street on Beacon hill
Centre right: Kresge auditorium of the Massachusetts Institute of Technology, Cambridge
Bottom right: Riding traditional swan boats through Boston's public gardens

strongly supported the firm policy of Gov. James Bowdoin, and later favoured the ratification of the federal constitution. Jefferson's embargo was felt to be nearly as destructive of trade as the Port bill had been a third of a century earlier, arousing such anger as to cause John Quincy Adams to warn the administration that treason and secession were being discussed in Boston. However that might be, Boston supplied the chairman, George Cabot, and sent delegates to the disgruntled Hartford convention. The behaviour of this body set New England and its chief city apart from the rest of the country.

A movement which had a deep effect on the life of Bostonians was the shift of religious belief from the Trinitarian to Unitarian Congregationalism, marking the disintegration in many of the old historic churches of the Puritan theology. Jonathan Mayhew, one of the patriot ministers of the middle of the 18th century, began the movement. It progressed slowly at first but with increasing momentum. By 1780 many pulpits were filled by liberal ministers. The rector of King's chapel, at the time of its separation from the Church of England after the American Revolution, made his own revision of the Prayer Book, leaving out the Trinity. He was refused ordination by two American bishops and in 1782 he was ordained by the congregation. This was the first Unitarian Church organized in America (*see* UNITARIANISM). In 1825 the American Unitarian association was organized and its headquarters has always been maintained in the city.

The City of Boston.—By 1822 Boston had outgrown the town meeting and adopted a city charter, with a mayor, a board of aldermen and a common council. The legislative branch for many years had certain administrative functions through its committees and elected certain officers such as assistant assessors. The first mayor was John Phillips, elected after one trial which had resulted in a stalemate between Josiah Quincy and Harrison Gray Otis. Both were chosen subsequently. Josiah Quincy, the second mayor, ranks as the executive of the greatest activity, broadest municipal outlook and practical sense of any Boston mayor. The original charter has been changed many times by the state legislature. The mayor's term was extended first to two years, then to four. The administrative functions of the committees of the city council were abolished and the police department was put under state control, removing it from local politics. The board of aldermen and the common council were abolished, and a comparatively small single chamber, with greatly curtailed powers, was substituted. A finance commission appointed by the governor was created, with powers of summoning witnesses and administering oaths. Party designations at elections were abolished with the intent of focusing municipal attention on local rather than national issues; party nomination was changed to nomination by petition, thus abolishing party responsibility but leaving nothing in its place.

The Antislavery Movement.—After the organizing of the city under the original charter, the next important event was the Boston antislavery movement. The abolition movement began in 1831, when William Lloyd Garrison, a native of Newburyport, moved to Boston and began the publication of the *Liberator*. A year later the New England Antislavery society was organized. Opinion was so divided in the city as to lead to occasional violence. After a public proslavery meeting, presided over by the mayor, Garrison was mobbed in his office on Oct. 21, 1835. He was, however, soon joined in his activities by Wendell Phillips, son of the first mayor, a young lawyer stung to espouse the cause largely by the defense of the conservatives in the murder of Elijah Lovejoy in Illinois. They attracted others. Even "the best people" found their enthusiastic kinsmen joining the movement. In 1850 the south played into the hands of the abolitionists by the passage of the Fugitive Slave law. Opposition to the act reached its peak following the arrest of Anthony Burns on rendition process on May 24, 1854. The antislavery leaders determined upon mob violence. Clergymen, philanthropists, scholars, felt it their duty to engage in this attempt. But the sortie, which was to follow a protest meeting, failed because the tentative plans leaked out. Burns was carried to the ship by the entire military strength of the county, with loaded muskets and cannon loaded with grape at street corners, between rows of buildings draped in black as though for the death of a national ruler. Abraham Lincoln himself once inferentially stated that Boston more than any other city was responsible for the agitation which led to secession and the American Civil War.

In the Civil War, Boston at Lincoln's first call sent organized troops to the relief of Washington, D.C. It organized the 54th regiment consisting of Negro soldiers, the first Negro gesture of earned freedom. Like all large cities it had its disloyal elements whose disturbances culminated in a riot at the Cooper street armoury at which the commander of the artillery swept the street with grape shot.

Changes After the Civil War.—The greatest physical calamity within the history of the city was the great fire of Nov. 9–10, 1872. It broke out on a Saturday night in the wholesale district and spread rapidly over 67 ac., on which stood 767 buildings filled with merchandise. Property, real and personal, to the estimated amount of more than $75,000,000 was destroyed in less than 24 hours. Beyond the loss of 14 lives, the disaster was almost entirely commercial, since there was little residential property within the burned district. The city made a quick recovery and a new district soon was built of better material, with streets straightened and widened.

Before and after the Civil War Boston was the literary centre of the United States. The chief essayists, historians, poets, philosophers and novelists lived in and around the city. Nearly contemporary with one another were Ralph Waldo Emerson, Nathaniel Hawthorne, George Bancroft, W. H. Prescott, J. L. Motley, Francis Parkman, Henry David Thoreau, John Greenleaf Whittier, Henry Wadsworth Longfellow, Oliver Wendell Holmes, James Russell Lowell and R. H. Dana, Jr.

Until the end of the 18th century Boston remained a pleasant, uncrowded seaport. Its comfortable air came from the circumstance that, while its merchants were making respectable fortunes overseas, the population had increased only slightly during a half century. The 1790 figure of 18,038 was an extremely modest advance over 16,382 inhabitants of 1743, when Boston was the largest town in British North America. In the first half of the 19th century, immigration rapidly swelled the population and changed the character of the city. Many early immigrants who had arrived in Boston moved on to regions of greater opportunity. The later great exodus from Ireland, accentuated by the famine (1846), brought to Boston thousands who, having only the funds for the passage, and no skilled craft or trade to recommend them in the newer parts of the country, remained in Boston to eke out a miserable existence by unskilled labour. Although the Irish were the most numerous, other nationalities, Jewish (largely from Russia), Italian, Canadian, Polish, Scandinavian, Armenian, Lithuanian and Balkan peoples followed in large numbers. By the beginning of the 20th century Boston had become a non-Anglo-Saxon city with strong influential threads of old-time English, Scotsmen and Scotch-Irish running through the fabric, and predominantly Irish in influence.

By the middle of the 20th century Boston had largely lost the heritage of Puritanism, which for generations had given it a distinctive character. Although it has long since lost the leadership in letters, on which it had prided itself in the post-Civil War period, Boston maintained its position as a leading centre of education and learning.

Landmarks.—Landmarks still cherished in Boston include public buildings, residences, old graveyards and the Boston common. The common, purchased by the town from William Blaxton, the first settler, in 1634, was originally set aside for training and common pasturage. Since a burial ground was early set off within it, it has never been encroached upon for any utilitarian purpose except when, in 1895, part of the Boston subway was built under its eastward edge. It contains various monuments, a small artificial pond known as the Frog pond and the "parade ground," often used for military events.

The old Boston cemeteries are the King's Chapel burial ground containing the bodies of John Winthrop and John Cotton; the Old Granary burial ground, in which are interred John Hancock, Sam-

uel Adams, James Otis, the parents of Benjamin Franklin and many other Boston notables; and Copp's hill, wherein lie the Mathers. The burial ground on the south side of the common is not so old as these colonial burial places, having been put to that purpose after the Revolution.

From the tower of Christ church (Episcopal) built in 1723 on Copp's hill, the oldest surviving church in the city, lanterns were hung on orders of Paul Revere to signal the route of the British to the Sons of Liberty in Charlestown. The old South meetinghouse (1729) was used for many of the public meetings that led to the Revolution. The old state house (1713, rebuilt in 1748) was the seat of the provincial government. There Otis delivered his oration against the writs of assistance and the Declaration of Independence was read to the people from the balcony. The Boston massacre occurred almost beneath its windows. Faneuil hall, given to the town as a market house in 1742 by Peter Faneuil, was enlarged to its present form in 1805. The meetings held in the hall above the market have given the building the popular name of the Cradle of Liberty.

The greater market house adjoining it, known as Quincy market, was the first municipal improvement of importance after Boston became a city. King's chapel was the first Episcopal church in Boston (the first edifice erected in 1688 was replaced in 1749–54). It was also the first Boston church to become Unitarian.

The dominating building of Boston since it was built in 1795–98 has been the state capitol of Massachusetts, familiarly known as the state house, occupying the present summit of Beacon hill, the original portion having been designed by Charles Bulfinch. The central or original structure is of red brick, with a pillared portico surmounted by a dome, which has been gilded since 1874. Additions were made in 1831, 1859, 1889 and 1914. It is now flanked by two great wings of white marble standing at right angles to the old edifice and joined to it by buildings of the same material, while a large addition in the rear bridging Mount Vernon street extends for two blocks. It has a total floor area of nearly 500,000 sq.ft. It contains many paintings, tablets and sculptures of a memorial nature and its Memorial hall contains glassed-in niches, in which are the Massachusetts battle flags of the Civil, Spanish-American and World Wars I and II. Opposite it, on the common, at the street boundary, is Saint-Gaudens' bas-relief memorial to the heroism of Robert Gould Shaw and his Negro regiment, the first such unit mustered during the Civil War.

Federal Buildings.—The post office, 22 stories high, houses not only the post office but the subtreasury, the federal courts and other U.S. government activities. It is located on Post Office square, convenient to the office-building centre of Boston. One of the most famous of Boston buildings, the custom house, was built in 1838. To provide additional office space, a tower just under 500 ft. was added in 1915. Long the tallest building in the city, this first Boston skyscraper was overtopped by four feet in 1949 by the John Hancock Mutual Life Insurance Co. building in the Back bay section.

Churches.—There are two cathedrals in Boston—the cathedral of the Holy Cross (Roman Catholic) and St. Paul's cathedral (Episcopal). Neither is among the notable cathedrals of the country although St. Paul's (in the retail district opposite the common) is a fine example of early 19th-century architecture. It was built as a parish church and became a cathedral only in 1912. The most notable church edifice is Trinity church (Episcopal) on Copley square, built in the romanesque style of southern France. It has a number of large memorial windows by John LaFarge, William Morris, Sir Edward Burne-Jones and others. Christ church, in the north end, is a fine example of the colonial meetinghouse, as is the Old South, not used for church purposes. The First church in Roxbury, built in the first decade of the 19th century, is a beautiful example of a 17th-century Puritan meetinghouse, the style of architecture surviving at that time. The largest church building is the extension of the First Church of Christ, Scientist, built adjoining the original Mother Church.

POPULATION

The population of Boston was 18,320 in 1790, the year of the first U.S. census. After 1840 it exceeded 100,000, and exceeded 500,000 after 1900. Growing steadily throughout the 20th century, the population was 801,444 in 1950, and 697,197 in 1960. The citizens of colonial antecedents are only a small minority, the number of foreign born is decreasing.

The trend toward urban decentralization brought about by the automobile and declining immigration was reflected in the declining population of the central city by 13.0% (1950–60) as compared with a growth of 17.6% for the metropolitan area outside the central city in the same period. This area is an economic and social unit with no physical indications of the political boundaries of such large cities and towns as Brookline, Cambridge, Somerville, Newton and Quincy. Thirty-seven of these cities and towns form a metropolitan district, which controls their water supply and park system.

INDUSTRY, COMMERCE AND TRANSPORTATION

The Federal Reserve bank of the New England district is in Boston. Boston is the chief U.S. wool market and, combined with nearby Gloucester, the chief U.S. fishing port. Small factories and a great diversification of industry are characteristic of Boston. The leading industries are woolen textiles, food products, clothing, leather, footwear, meat packing, boot and shoe machinery, printing and publishing, rubber products, confectionery, electrical and other machinery, transportation equipment, iron and steel products, chemicals and beverages.

Local transportation in Boston and the surrounding communities is provided by the Metropolitan Transit authority by surface cars and buses, an elevated system and a municipal system of subways, built by the city and leased to the authority.

The Charles river is spanned by about a dozen bridges between Boston and its northern shore. Among them may be mentioned the Charlestown and Warren bridges, connecting the city with the Charlestown district. The granite Longfellow bridge, which connects the west end of Boston with East Cambridge, is the most striking and ornate large bridge over the river, built from a Russian original with eight large towers. The Viaduct bridge is used at the Charles river dam by the elevated railway. Still farther west, the Harvard bridge connects the upper Back bay at Massachusetts avenue with the most direct road to Harvard square and the college buildings. The Boston university bridge, formerly known as the Cottage Farm bridge, crosses the river directly west of the Boston university campus. The Larz Anderson bridge connects Cambridge and Brighton district and the road between Harvard university and the Soldiers' field. The John W. Weeks Memorial bridge crosses the river opposite the Harvard graduate school of business administration.

Boston is the nearest major Atlantic port to Europe. It is served by more than 100 steamship lines that link it with almost 300 ports of the world. It has freight service on 19 world trade routes classified as major by the Federal Maritime board. Its total port activity (foreign, coastal and intercoastal) amounts to more than 20,000,000 tons annually. The port is served by three class I railroads and by 1,500 motor truck lines. Berths for ocean-going steamships have railside connections; warehouse space is 5,000,000 sq.ft. including cold storage, and grain elevator capacity is 2,000,000 bu.

Boston's Logan International airport was acquired by the state in 1941, and is used by several passenger and cargo air lines.

During World War II extensive additions were made to the facilities of the U.S. navy at the South Boston army base, the air base at Squantum and the navy yard at Charlestown. These, with the Bethlehem Steel company's Fore River shipbuilding plant at Quincy, make Boston one of the most important centres of naval building.

EDUCATION AND CULTURAL ACTIVITIES

Educational Institutions.—Boston is the centre of a large district in which are situated many notable educational institutions. Just across the Charles river in Cambridge are: Harvard university (founded in 1636), which, while never located in Boston, has had a profound influence on Boston life; Radcliffe college,

a women's college (founded in 1879) associated with Harvard; and the Massachusetts Institute of Technology (founded in 1861), famous for scientific training and research. Nearby are Boston college, a Jesuit institution (founded in 1863), Chestnut Hill; Tufts university (founded in 1852) at Medford; and Wellesley college, for women (founded in 1870), at Wellesley. In the city are Boston university (founded in 1839), with its numerous schools and colleges; Northeastern university (founded in 1898), noted for its engineering training; Suffolk university (founded in 1906); Portia Law school (founded in 1908); Emmanuel college, Roman Catholic, for women (founded in 1919); Emerson college (founded in 1880); and Simmons college (founded in 1899), as well as many of the schools and colleges of Boston college, Tufts university and Harvard university.

Public and Private Schools.—Boston's school system is the oldest in the United States. The present Boston Public Latin school was the first public school in America, established in 1635. Soon after its establishment it became, and remained, devoted mainly to preparing young men for college. A similar school, the Grammar school, now the Roxbury Latin school, was founded in 1645. These two schools survive, both as free schools, the first as a part of the Boston public system, the second as an endowed institution in which tuition is free to all boys living within the limits of the original Roxbury survey.

Libraries.—The Boston Public library, now in Copley square, is one of the most famous libraries in the world. It was founded in 1852 and for many years occupied a convenient site opposite the southern boundary of the common. Its present building was erected in 1888–95 at a cost of nearly $2,500,000 and enlarged in 1918. It is a very simple and striking building in the Italian Renaissance style. The library contains a statue of Sir Henry Vane by Frederick MacMonnies; in Bates hall, the main reading room and the corridors are busts of notable Bostonians, eminent writers and benefactors of the institution. The most famous decorations in the library are the three series of mural paintings. That by Pierre Puvis de Chavannes illustrates the ancient growth of literature and art. The John S. Sargent paintings with the notable frieze of the prophets and heavily decorated symbolic paintings depict the growth of religion. Edwin A. Abbey's contributions in the delivery room are illustrations of the legend of the Holy Grail.

The library contains more than 2,000,000 volumes. The central library has a lecture hall and maintains a course of free lectures each year. Among the special collections owned by or loaned to the main library are: the New England library collected by Rev. Thomas Prince before 1758; the private library of Pres. John Adams, one of the best existing collections of original letters bearing on the antislavery movement; and the gold medal presented to Gen. George Washington on the evacuation of Boston in 1776.

Other important libraries include the Boston Athenaeum, founded in 1807 and containing more than 400,000 volumes; the library of the Massachusetts Historical society with one of the largest and most valuable historical manuscript collections in the United States; and numerous specialized, technical and institutional libraries.

Art.—The Boston Athenaeum at one time maintained a large art gallery. This gallery led to the founding (1870) of another great endowed institution, the Boston Museum of Fine Arts, the art works of the Athenaeum (which include the well-known portraits by Gilbert Stuart of George and Martha Washington) being the nucleus of its collection. Its first building was situated on Copley square; its present building, on the upper part of Huntington avenue, was opened in 1909 and is one of the chief art museums of the United States. The museum's collection of Chinese and Japanese art is one of the most remarkable in the world. There are notable collections of classical, Egyptian and Indian art, as well as European and American paintings, prints, sculpture, decorative arts and textiles. The museum, which is free to the public, is privately supported.

The Isabella Stewart Gardner museum, in the Fenway near the Museum of Fine Arts, was built by Mrs. John Lowell Gardner between 1899 and 1903 in the likeness of an Italian palace to house the works of art that she had collected during the previous two decades. The Italian Renaissance paintings are notable. The arrangement of the galleries, unchanged since Mrs. Gardner's death in 1924 in accordance with the terms of foundation, is of interest as an example of the taste of a cultivated collector in the last years of the 19th century.

Musical Organizations.—Symphony hall, on Huntington avenue, is the home of the Boston Symphony orchestra. Founded in 1881 by Henry L. Higginson, banker and civic philanthropist, the orchestra is the chief musical organization of Boston and in the front rank in the United States. Symphony hall was erected in 1900. It is dignified and simple in its lines and its acoustics make it an ideal hall for music on a large orchestral scale. Nearby is the Jordan hall of the New England Conservatory of Music. There are three choral societies in Boston, the Handel and Haydn, the Cecilia and the Apollo clubs and various other vocal and instrumental organizations. The Boston "Pops" orchestra is also an important feature of the city's musical activity.

PARK SYSTEM

Boston's park system forms a semicircle around the city. The Marine park at South Boston is connected by a parkway with the Franklin, the park of greatest acreage, which contains besides much pleasant woodland, a zoo, an aviary, tennis courts, golf links, a children's playground and some beautiful gardens in which the natural beauties are stressed more than artificial landscaping. From Franklin park a parkway leads to the Jamaica pond, passing the Arnold arboretum, the Harvard college botanical garden which, being open to the public, is practically part of the system. On the shores of Jamaica pond is the Children's museum. From the Jamaica pond reservation the parkway extends along the Muddy river, which separates Boston and Brookline, to the Back bay fens and thence to the Charles river embankment. Boston common is connected with this system by the adjoining Public garden, laid out more conventionally than the natural gardens of Franklin park, with its tiny artificial lake on which are rowboats and foot-propelled "swan boats." From the Public garden a parkway runs through Commonwealth avenue to the Back bay fens. The Metropolitan District commission has reserved much wild land in the district, some of which is in West Roxbury, within the city limits.

See also references under "Boston" in the Index volume.

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(S. L. Co.; S. J. McK.; J. F. M.; W. M. W.)

BOSTON, a game of cards invented during the last quarter of the 18th century. It is said to have originated at Boston, Mass., during the siege by the British, and also by the officers of the French fleet, which lay for a time off the town of Marblehead; and the names of the two small islands in Marblehead harbour, which have, from the period of the American Revolution, been called Great and Little Misery, correspond to expressions used in the game. William Tudor, in his *Letters on the Eastern States* (1821), however, wrote that "A game of cards was invented in Versailles and called in honour of the town, Boston; the points of the game are allusive, 'great independence,' 'little independence,' 'great misery,' 'little misery,' etc. It is composed partly of whist and partly of quadrille, though partaking mostly of the former."

The game, played for high stakes, maintained its popularity in Europe, and to a lesser degree, in the United States until the middle of the 19th century, after which its favour steadily declined.

In the rules of Boston as recognized in English-speaking countries, two packs of 52 cards were used, both for cutting and dealing; rank was from the ace downward as in whist (*q.v.*). Four players took part, and there were usually no partners. The entire first pack was dealt out by fours and fives, and the second pack was cut for the trump, the suit of the card turned being "first preference,"

the other suit of the same colour "second preference" or "colour," while the two remaining suits were "plain suits." The different bids were called by various names, but the usual ones were: (1) to win 5 tricks, "Boston"; (2) (to win) "6 tricks"; (3) (to win) "7 tricks"; (4) to lose 12 tricks, after discarding 1 card that was not shown, "little *misère*"; (5) (to win) "8 tricks"; (6) (to win) "9 tricks"; (7) to lose every trick, "grand *misère*"; (8) to lose 12 tricks, after discarding 1 card that was not shown, the remaining 12 cards being exposed on the table but not liable to be called, "little spread"; (9) to lose every trick with exposed cards, "grand spread"; (10) to win 13 tricks, "grand slam." In French Boston the knave of diamonds arbitrarily won over all other cards, even trumps. A simplified version of the game has survived as solo whist (*see* WHIST). (A. H. MD.; G. MH.)

BOSTON FERN (*Nephrolepsis exaltata bostoniensis*), variety of the sword fern originated in cultivation. It was introduced in 1895 by F. C. Becker and named in honour of the city of Boston, Mass., in the vicinity of which it was discovered. It is a strong, free-growing plant, with drooping, dark-green foliage, and is much less stiff in habit than the typical sword fern. It is one of the best ferns for decorative purposes, growing well indoors in pots or baskets, and is hardy out-of-doors in gardens and rockeries in the southern states. From this mutant, or from variants derived from it, have arisen numerous remarkable forms with very finely cut, crisped or otherwise peculiarly developed leaflets. Among these are *elegantissima*, *robusta*, *magnifica* and *superbissima*, which are interesting also as examples of rapid evolutionary development.

BOSTONITE is a fine-grained, pale-coloured, gray or pinkish igneous rock, which consists essentially of alkali-feldspar (orthoclase, anorthoclase, microperthite, etc.). Some bostonites contain a small amount of interstitial quartz (quartz-bostonites); others have a small percentage of lime, which occasions the presence of a plagioclase feldspar (lime-bostonite). Other minerals, except apatite, zircon and magnetite, are typically absent. The bostonites have very much the same composition as the trachytes (*q.v.*), and many rocks of this series have been grouped with these or with the orthophyres. Typically they occur as dikes or as thin sills, often in association with nephelite-syenite.

BOSTON IVY (JAPANESE IVY) (*Parthenocissus tricuspidata*), a high climbing, much branched vine, with short adhesive tipped tendrils by means of which it adheres firmly to walls or other surfaces. Its leaves are variable, ovate to orbicular, simple to three-lobed or three-parted and shining above. Its fruit is a bluish-black berry. The species, and some of its varieties, are hardy and extremely useful climbers, thus making it one of the favourite vines in cities. The shining foliage which stands the smoke and dust unusually well changes to a brilliant orange and scarlet in autumn. (J. M. BL.)

BOSWELL, JAMES (1740–1795), Scotsman, friend and biographer of Samuel Johnson, revealed also by the publication of his journal in the 20th century as one of the world's greatest diarists, was born in Edinburgh on Oct. 29, 1740. His father, Alexander Boswell, advocate, laird of Auchinleck in Ayrshire from 1749, was in 1754 raised to the bench with the judicial style of Lord Auchinleck. The Boswells were an old and well-connected family, and James was subjected to a strong pressure of family ambition.

Alexander Boswell was hard-headed and undemonstrative, his wife retiring and mystical. James, a delicate child, was coddled physically but given Calvinistic instruction in the "last things." He grew up timid, afraid of hell, with painfully vivid images of fatalism fixed in his mind, and at the age of 12 suffered some sort of acute nervous illness.

Boswell hated the select day school (Mundell's) to which he was sent at the age of 5, and from 8 to 13 was taught at home by tutors. From 1753 to 1758 he went through the arts course at Edinburgh. An encounter with metaphysics in the logic class (1756–57) revived the terrors of his childhood and induced a serious depression. On his recovery, he threw off all outward signs of delicacy and attained apparently robust health. He was rather under average height and tended to plumpness, with very swarthy skin, black eyes and black hair. His expression was alert and masculine and he was conspicuously good-humoured. But his nervous limitation persisted, manifesting itself in recurrent periods of depression all the more painful for not being prostrating. And he never outgrew the adolescent faculty of entertaining incompatibles simultaneously.

His conduct began to give his father concern. Returning to the university in 1758 to study law, he became enthralled by the theatre and fell in love with a Roman Catholic actress. Lord Auchinleck thought it prudent to send him to the University of Glasgow, where he attended the lectures of Adam Smith. In the spring of 1760 he ran away to London and made his submission to the Roman Catholic Church. He had hitherto been completely continent and entertained notions of becoming a monk. But a blackguard man of letters, Samuel Derrick, introduced him to various ladies of the town and the earl of Eglinton, an Ayrshire neighbour, schooled him in Deism and brought him into the company of the young duke of York and of Laurence Sterne. Boswell discovered London and himself simultaneously. He was, he found, passionately fond of metropolitan culture, gregarious, high-spirited, sensual and attractive to women, and London offered just the combination of gross and refined pleasures that seemed to fulfill him. In order that he might stay permanently in London, he fixed his heart on a commission in the foot guards. When Lord Auchinleck finally went to fetch him (June 1760), he found him suffering from gonorrhea, an affliction that he was to endure many times in the course of his life.

From 1760 to 1763 Boswell was in open though unhappy rebellion. He studied law in his father's strict family and sought release from boredom in gallantry, in a waggish society called the Soaping club, and in scribbling, his crony and literary model being a young army officer, the Hon. Andrew Erskine. His publications (mostly in verse) give no indication of conspicuous talent. During these years he deliberately fashioned the personality which he was to show to the world, completing the unfinished structure of his good breeding with a façade of boisterousness, buffoonery and impudence. His famous vanity consisted simply in avowing what other people think but do not say. He had remarkable gifts as a mimic, and at this time exercised them freely.

Boswell came of age (on Oct. 29, 1761) still stubborn in his guards scheme. Lord Auchinleck then agreed that if he would pass his trials in civil law, he would supplement his annuity of £100 and allow him to go to London to seek a commission through influence. Boswell passed the examination in July 1762.

It was in anticipation of this great era in his life that he began, in the autumn, the journal which was to be the central expression of his genius. His great zest for life was not fully savoured until life was all written down, and he had a rare faculty for imaginative verbal reconstruction of his past in terms of average human perception. His journal is much more dramatic than most because he writes up each event as though he were still living through it, with no knowledge of anything that had happened later. People in his journal talk and are given their characteristic gestures. His gifts for the imaginative reporting of conversation have never been paralleled. If he made brief notes on a conversation soon after it occurred, he could at any distance of time recall "the heads and the very words of a great part" of that conversation and construct a miniature having the vividness and economy of fiction while keeping within the bounds of historical circumstance. His power of eliciting memorable conversation was no less remarkable. He had a generousness of mind which enabled him, as he once remarked, so to tune himself to the tone of any bearable man that that man would be as free with him as with another self.

Boswell's second London visit lasted from Nov. 1762 to Aug. 1763. Soon after his arrival, he was informed of the birth in Scotland of a son, Charles, for whom he arranged Anglican baptism. The mother (Peggy Doig) was probably a servant. He laid siege to a handsome actress, one Mrs. Lewis ("Louisa"), and paid for victory with an infection. He and Erskine roused Lord Auchinleck's fury by publishing a book of their own bantering letters. He met Oliver Goldsmith and John Wilkes. And on May 16, 1763, in the back parlour of the actor and bookseller, Thomas Davies, he secured an unexpected introduction

to Samuel Johnson, whose works he admired and whom he had long been trying to meet. Johnson was rough with him, but he kept his temper, went to call a week later, found himself liked, and the great friendship was cemented. There was condescension on both sides, Johnson deferring to Boswell's superior birth and Boswell to Johnson's superior wit and wisdom. Having become genuinely convinced that the guards scheme was not practicable, Boswell capitulated to his father and consented to become a lawyer. It was agreed that he should spend a winter studying civil law at Utrecht, and should then make a modest foreign tour. Johnson, with touching kindness, made a four-day journey to see him off from Harwich.

Boswell had been deeply affected by Johnson's piety and goodness, and in Holland made a sincere effort to study hard and to keep out of mischief. On Christmas Day, in the ambassador's chapel at The Hague, he received communion for the first time in the Church of England. He engaged in a sparring courtship with that exquisite ironist Belle de Zuylen (*see* CHARRIÈRE, ISABELLE AGNÈS ÉLISABETH DE), who told him that she found him odd and lovable. His strict program proved stimulating for a time, but palled when it had lost its novelty. He received word that his little boy had died. In the depression that ensued he had recurring nightmares of being hanged. He was discouraged to find that dissipation brought him more happiness than chastity and hard work, and soon lapsed into his former promiscuity.

From Utrecht Boswell traveled to Berlin in the company of the old Jacobite Earl Marischal, friend and counselor of Frederick the Great, but was never able to meet the king—his greatest and almost his only social defeat. In his tour of the German courts he was received with special graciousness by Karl Friedrich of Baden Durlach. Passing through Switzerland (Dec. 1764), he secured interviews with both Rousseau and Voltaire. His approach to Rousseau was a characteristic piece of bravura. Lord Marischal had provided him with a letter, but he chose to present one of his own describing himself as a man of singular merit.

Boswell stayed nine months in Italy, devoting himself systematically to sight-seeing. He established an intimacy with Wilkes (then outlawed) at Naples and traveled with Lord Mountstuart, eldest son of the earl of Bute, the chief target of Wilkes's scurrilities. His cherished dream of high intrigue—he made blunt proposals to three countesses almost simultaneously on arriving in Turin—finally came true in Siena at the very end of his tour, when Girolama Piccolomini, wife of the chief official of the city, fell deeply and touchingly in love with him.

The most original act of his life followed when he made a six weeks' tour of the island of Corsica (autumn 1765) to interview the heroic Corsican chieftain, Pasquale de Paoli, then engaged in establishing his country's independence of Genoa. Paoli succumbed to his charm and became his lifelong friend. On his return to the mainland, he sent off paragraphs to the newspapers, mingling facts with fantastic political speculation.

At Paris he met Wilkes again and was stunned to read of his mother's death in an English newspaper. He was disappointed not to see Rousseau, who had just left for England, but Thérèse Le Vasseur, Rousseau's mistress, accepted his offer of an escort. The passage turned into a farcical *voyage à Cythère*, Boswell vainly seeking compliments on his performance, and Thérèse (who was nearly 20 years his senior) reading him lectures on the art of love.

Boswell was admitted to the Faculty of Advocates on July 26, 1766, and for 17 years practised law at Edinburgh with complete regularity and a fair degree of assiduity. His cherished trips to London were by no means annual, and until 1784 were always made during the vacations. He had plenty of business though an uncomfortable amount of it consisted of causes which his father was to try. He was an able courtroom lawyer, especially in criminal cases, but in Scotland neither fortune nor fame could be won in the criminal court and an ambitious lawyer needed to give all and not part of his vacations to study. Also, Boswell hurt his reputation for professional soundness by emotional involvement in his clients' fortunes, and by resorting to extralegal tactics in matters *sub judice*.

In Feb. 1768 Boswell published *An Account of Corsica, the Journal of a Tour to That Island, and Memoirs of Pascal Paoli* and stepped into fame. France had unmasked its intention of annexing the island, and people were greedy for information about Corsica and Paoli. Boswell's book (which was promptly translated into French, German, Italian and Dutch) embarrassed both the French and British ministers, the French because they thought it might force British intervention, the British because they had already written off Corsica. The *Account* is a graceful *ad hoc* compilation; *The Journal of a Tour to That Island*, Boswell's first work exploiting his journal, is a minor masterpiece. Motives of propaganda caused him to present himself as a complete *ingénu* and to cut the tour to a mere frame for the memoirs of Paoli, but the result is still very pleasing. Paoli, probably wisely, is presented in the Plutarchan manner.

Between 1766 and 1769 Boswell amused himself with various well-hedged schemes of marriage, maintaining meantime a liaison with one Mrs. Dodds, a young grass widow. Their daughter Sally, like Charles, seems to have died in infancy. He ended by marrying (Nov. 1769) the only woman he had ever wanted to marry, his first cousin, Margaret Montgomerie. Lord Auchinleck was deeply disappointed, for the match brought neither lands nor money, and took a new wife himself on the very day of his son's wedding.

During the first few years of his marriage, Boswell was on the whole happy, hard-working, chaste, and confident of getting a seat in parliament, a good post in the government, or at the very least a Scots judgeship. Paoli visited him in Scotland in 1771; in 1773 he was elected to The Club; and later in the year Johnson made with him the famous tour of the Hebrides. He ultimately had five healthy and promising children. He was made an examinator of the Faculty of Advocates and one of the curators of the Advocates' library; he served twice as master of the Canongate Kilwinning Lodge of Masons, and declined nomination for the Grand mastership of Scotland. But by 1776 he began to feel strong intimations of failure. A headlong entry into Ayrshire politics—repudiated by Lord Auchinleck—had ranged him in opposition to Henry Dundas, who was then emerging as a political despot in the management of the Scottish elections. His practice was not becoming more notable. He began to drink heavily to recruit his spirits, not, as formerly, to give them vent. He returned to his old traffic with women of the town when separated from his wife by distance, by her pregnancy or by her frequent complaints. As early as 1778 it was obvious that she was critically ill with tuberculosis.

Between 1777 and 1783 he published in *The London Magazine* a series of 70 essays, significantly entitled *The Hypochondriack*, which deserve to be better known, though they do not engage his full powers. At the end of 1783, in the hope of attracting the attention of Pitt's new government, he published a pamphlet attacking Fox's East India bill. Pitt sent a chilly note of thanks but made no move to employ him.

Boswell succeeded to Auchinleck in 1782 and managed his estate with attention and some shrewdness. But he thought he could be happy only in London, and encouraged himself in the childish notion that he could be more successful at the English than at the Scots bar.

Johnson died on Dec. 13, 1784. Boswell decided to take his time in writing the *Life*, but to publish his journal of the Hebridean tour as a first installment. In the spring of 1785 he went to London to prepare the work for the press, but became diverted by dinners and girls and by the writing of a frothy pamphlet against Henry Dundas' bill for diminishing the number of the lords of session. Edmond Malone, a fellow-member of The Club but not previously a close friend, got sight of the work in progress and offered his daily assistance in preparing the remainder of the copy. Boswell's journals show little variation in literary excellence but in matter the Hebridean journal tops all the others. It comes from the soundest and happiest period of Boswell's life, the narrative of the tour is interesting in itself, and we get 101 consecutive days with Johnson. The book was a best seller, but it provoked the scornful charge of personal fatuity that has dogged Boswell's name ever since. His intelligence was not really in ques-

tion. Boswell had a good mind, and his imprudences and sins were of the sort that the world usually tolerates in artists. But he deliberately defied the basic and unchanging literary convention which rules that when a man writes about himself, he must somehow manage to make himself seem formidable. Boswell analyzed and recorded his own vanity and weakness with the objectivity of an historian; and in his Johnsonian scenes he ruthlessly subordinated his own personality, reporting the blows that Johnson occasionally gave him without constantly reassuring the reader that he understood the implications of what he had written.

In 1786 Boswell was called to the English bar from the Inner Temple and moved his family to London. Thereafter he had almost no legal practice. His principal business was the writing of the *Life of Johnson,* which he worked at irregularly but with anxious attention. The revision of manuscript and proofs was labyrinthine. Malone again gave him tactful support and sat with him during much of the rewriting.

Though straitened in income, he gave his children expensive educations. He visited Edinburgh only once after his emigration and then almost surreptitiously. Mrs. Boswell pined for Auchinleck and insisted on being taken there when her health grew desperate. Boswell felt that he had to be in London in order to finish the *Life* and to be at the call of the earl of Lonsdale, who had given him unexpected encouragement and caused him to be elected recorder of Carlisle. When she died (June 4, 1789), he was not at her side, and when he tried to detach himself from Lonsdale, he was treated with shocking brutality.

The *Life of Johnson* was published on May 16, 1791. Contemporary criticism set the pattern of acclaim for the work and derision for its author which was to receive consummate expression from Macaulay in his well-known essays (1832 and 1856). Boswell took intense pleasure in his literary fame, but felt himself to be a failure. His later years were prevailingly unhappy. His eccentricities of manner seemed merely self-indulgent in a man of 50 or over; people were afraid to talk freely in his presence fearing that their talk would be reported; and his habit of getting drunk and noisy at other people's tables (he was never a solitary drinker) made him a difficult guest in any case. But his five children loved him deeply, and he never lost the solicitous affection of Malone and a few other friends who recognized his worth and his need. He saw the second edition of the *Life* through the press (July 1793) and was at work on the third when a sudden illness put an end to his life on May 19, 1795.

The *Life of Johnson* will always be regarded as Boswell's greatest achievement, but we can now see that its unique values are derivative. It is the stretches of Johnson's conversation that make it superior to all other biographies, and those conversations were lifted bodily from the journal, sometimes with so little change that the journal-leaves served as printer's copy. The extended commercial publication of the journal, by proving his ability to compete with 20th-century authors on their own terms, has confirmed and added to his stature as artist. It is also for the first time giving the general reader a properly complex portrait of him as a man.

BIBLIOGRAPHY.—Boswell's private papers, long believed to have perished, were sold in 1927 and 1928 by his great-great-grandson, Lord Talbot de Malahide, to Lieut. Col. R. H. Isham, for whom Geoffrey Scott and F. A. Pottle edited a de luxe edition: *Private Papers of James Boswell From Malahide Castle* (18 vol., 1928–34; index, 1937). More papers were found at Malahide in 1930, 1937 and 1940. In 1930 C. Colleer Abbott turned up a large quantity of Boswell papers at Fettercairn house, Aberdeenshire, among the papers of Sir William Forbes, Boswell's executor. All these finds were ultimately acquired by Col. Isham, whose collection was purchased in 1949 for Yale university. *See* F. A. Pottle, "The History of the Boswell Papers," in Heinemann's limited edition of Boswell's *London Journal* (1951) and C. Colleer Abbott's introduction to his *Catalogue of Papers . . . Found at Fettercairn House* (1936). The "research" series of the Yale editions of the private papers of James Boswell will print most of the papers.

Among biographical studies may be cited Charles Rogers's memoir accompanying his edition of *Boswelliana* (1874); W. Keith Leask, *James Boswell* (1897); C. B. Tinker, *Young Boswell* (1922); Peter Quennell, "James Boswell, The Biographer," in *Four Portraits* (1945; U.S. title, *The Profane Virtues*); D. B. Wyndham Lewis, *The Hooded Hawk* (1946; reprinted as *James Boswell,* 1952). The commercially published volumes of the Yale editions are a virtual autobiography. Seven have appeared: *Boswell's London Journal* (1950), *Boswell in Holland* (1952), *Boswell on the Grand Tour: Germany and Switzerland* (1953), ed. by F. A. Pottle; *Boswell on the Grand Tour: Italy, Corsica, and France* (1955), *Boswell in Search of a Wife* (1956, 1957), ed. by Frank Brady and F. A. Pottle; *Boswell for the Defence* (1959, 1960) ed. by W. K. Wimsatt and F. A. Pottle; *Boswell: The Ominous Years* (1962) ed. by Charles Ryskamp and F. A. Pottle. C. B. Tinker's *Letters of James Boswell,* 2 vol. (1924) prints nearly 400 letters. F. A. Pottle, *The Literary Career of James Boswell* (1929) provides a full bibliographical account of Boswell's publications.

Boswell's *Journal of a Tour to Corsica* has been ed. by Sir Sydney C. Roberts (1923); Morchard Bishop (1951); and in *Boswell on the Grand Tour: Italy, Corsica, and France* (1955). Boswell's original journal of the Hebridean tour was published in 1936 by F. A. Pottle and C. H. Bennett and reprinted, with additions, in 1962; his printed *Journal of a Tour to the Hebrides* appears in the "Everyman Series" (1958), ed. by L. F. Powell, and with Johnson's *Journey to the Western Islands of Scotland,* ed. by R. W. Chapman (1924). The 3rd ed. of the *Life of Johnson,* 4 vol., (1799), by E. Malone was the last that Boswell had a hand in. J. W. Croker's ed. in 5 vol. (1831) made many identifications but was justly slated for its method. Much the most useful edition for scholars is L. F. Powell's revision, 6 vol. (1934–1950) of G. Birkbeck Hill's ed., 6 vol. (1887). (The fifth volume is the *Journal of a Tour to the Hebrides,* the sixth a massive index.) The best one-volume edition is that of the "Oxford Standard Authors," revised (1953) by R. W. Chapman with an introduction by C. B. Tinker.

Among critical studies may be mentioned Thomas Carlyle's two essays, "Biography" and "Boswell's *Life of Johnson*" (originally a review of Croker; 1831) in *Critical and Miscellaneous Essays;* A. E. Newton, "James Boswell—His Book," in *The Amenities of Book-Collecting* (1918); Geoffrey Scott, introductions to vol. 1–5 of Isham's *Private Papers* and especially vol. 6, *The Making of the Life of Johnson* (1928–29); D. A. Stauffer, *The Art of Biography in Eighteenth Century England,* vol. 1, pp. 411–455 (1941); B. H. Bronson, "Boswell's Boswell," in *Johnson and Boswell, Three Essays* (1944, reprinted 1946 as *Johnson Agonistes and Other Essays*); F. A. Pottle, "The Power of Memory in Boswell and Scott," in *Essays on the 18th Century presented to D. Nichol Smith* (1945) and "The Life of Boswell," in *The Yale Review* (Spring, 1946); C. Colleer Abbott, *Boswell,* Literary and Philosophical Society of Newcastle upon Tyne (1946). (F. A. P.)

BOSWORTH FIELD, BATTLE OF, an engagement of great historical consequence fought on Aug. 22, 1485, 12 mi. W. of Leicester, Eng., and 3 mi. S. of the small town of Market Bosworth, from which it was named. It was between King Richard III and Henry Tudor, then not technically earl of Richmond, for he had been deprived in 1471. Henry, latterly an exile in France, claimed to inherit the Lancastrian right to the English throne. He sought to prosecute his claim by force, and his victory at Bosworth, although it did not seem of particular consequence to contemporaries, firmly established the Tudor dynasty and all that it was to involve. To this end Henry landed at Milford Haven on Aug. 7, 1485, and reached Shrewsbury on Aug. 15, gathering only moderate support on the way. He then proceeded through Newport in Salop, Stafford, Lichfield and Tamworth, reaching Atherstone, on the Watling street and the Leicestershire border, on Aug. 20. There he met the brothers Stanley, both with strong contingents in the neighbourhood. Lord Stanley was Henry's stepfather, and Sir William Stanley had already been declared a traitor by the Yorkists. For the moment they both preferred to stand aloof, but they assured Henry of their support when the crisis came. Next day Henry encamped at White Moors, near Shenton, on the southwest edge of what was to be the battlefield. That night Richard's host halted three miles to the northeast on rising ground at Sutton Cheney. Lord Stanley was away to the southeast near Dadlington, and his brother lay northwest near Nether Cotton.

Reliable details of the battle are few. The only strictly contemporary account is in the *Historiae Croylandensis Continuatio,* but the writer was unacquainted with the site and says little about the actual fighting. Polydore Virgil wrote the first full account nearly 20 years later, and its limitations are obvious. The ground itself has been much altered by 18th-century enclosure and by the making of the Ashby canal and the Nuneaton to Ashby railway, both of which traverse the site. It appears that early on Aug. 22 Richard, a better soldier than his opponent, ordered the duke of Norfolk, commander of his vanguard, to seize Ambien hill, a slight eminence roughly midway between the opposing armies. He himself would then move up with the main body, followed by the earl of Northumberland, who commanded the rear. Henry had the same purpose, but was less expeditious, and his troops found Am-

bien hill occupied by the Yorkists, while their own progress was hampered by a marsh on its southern side. There followed a desultory and ill-organized engagement on the slope. The crisis came when the Stanleys moved against the Yorkist flanks and Northumberland failed to intervene. The Yorkist army melted away and there was no real pursuit, while Richard, preferring death, was unhorsed and killed in the bog. The Yorkists had about 8,000 men engaged, but it is probable that, at the last, they were outnumbered. Of the casualties nothing certain is known. (GY. T.)

BOTANICAL AND HORTICULTURAL SOCIETIES: *see* HORTICULTURE AND BOTANY, SOCIETIES OF.

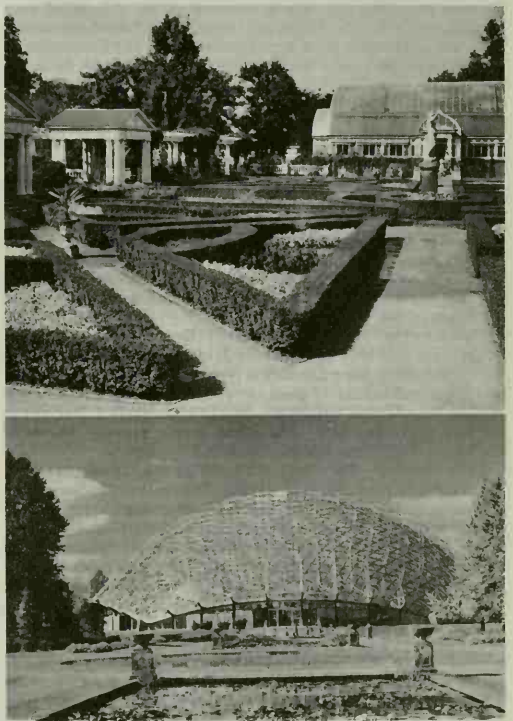
BOTANICAL GARDENS. The original concept of a botanical garden was that literally implied by the name; that is, a garden with the plants arranged according to some system of botanical classification. In the forerunners of the modern botanical garden, such as the gardens of simples commonly associated with schools of medicine in the 16th and 17th centuries, the planting was primitive and possibly based on the use of the plants, in medicine or otherwise, rather than on the more or less crude botanical concepts of the time. A botanical garden differs from a park, where the plants are usually arranged solely with reference to securing a beautiful landscape effect. The primary purpose of a park, moreover, is recreation, while that of a botanical garden has always been science and education. A botanical garden is properly defined as a scientific and educational institution whose purpose is the advancement and diffusion of a knowledge and love of plants.

A collection of living plants, out-of-doors or under glass or both, is always a major feature of botanical gardens, but the modern garden usually possesses, in addition, a herbarium, a library, experimental grounds for plant breeding and other investigations, laboratories, classrooms, lecture halls and sometimes botanical museums, together with scientific, educational and administrative staffs. Different institutions place the emphasis on different aspects of the work; this may be determined by climate, area, tradition, resources or ideals.

Botanical gardens have gradually developed by evolution from such gardens as the early olive orchards and the temple gardens, like that, for example, at Karnak, Egy., one of the earliest of which there is authentic record, dating from the reign of Tuthmosis III, about 1500 B.C. It seems probable that the very earliest gardens were utilitarian in purpose, for the growing of food and fibre plants and fruit trees. Temple grounds, however, were early planted; and to this practice we are probably indebted for the preservation of the maidenhair tree, *Ginkgo biloba*. One of the first gardens developed for the purpose of facilitating the study of plants was that of Aristotle, an ardent student of plants, who wrote books on botany, now lost. This garden was in charge of his pupil Theophrastus, who continued and improved it after the death of the master. It would thus appear that, in modern terminology, the first patron of botany of whom there is record was Aristotle (*c.* 350 B.C.) and the first "director" of a botanical garden Theophrastus, who also wrote books on botany, two of which are still in existence. Diogenes Laërtius is authority for the statement that Demetrius Phalereus provided Theophrastus with the necessary funds for improving this garden and thus became, after Aristotle, one of the first wealthy patrons of botany.

The history of botanical gardens during the period between those of antiquity and the 15th or 16th century appears never to have been traced in detail. During the 16th and 17th centuries the herbalists (predecessors of the modern botanists) began to cultivate private gardens for the purpose of plant study. Perhaps the best known of these is the garden of John Gerard in Holborn, London. These private gardens were the forerunners of the modern botanical gardens. The botanical garden idea spread rapidly in countries of older civilization during the 18th and 19th centuries. In the new world, botanical gardens were early established by John Bartram near Philadelphia in 1728, by André Michaux near Charleston, S.C., in 1787 and by David Hosack (the Elgin Botanic garden) on the site of Rockefeller centre in New York city in 1801. Under the patronage of Charles III of Spain a flourishing botanical garden was established in Mexico in 1788. Notwithstanding the phenomenal growth of the United States, the botanical garden idea was slow to take root, and it was nearly 60 years from the Elgin garden to the establishment of Shaw's garden (the modern Missouri Botanical garden), at St. Louis, Mo., in 1859. This garden appears to be the oldest existing botanical garden in America organized as an independent institution. The Cambridge (Mass.) Botanic garden, a part of Harvard university, was, at the time it ceased to exist in 1948, the oldest botanical garden in the United States; it was established in 1807.

Modern botanical gardens in all countries are organized along closely similar lines. There is a director with a scientific (and sometimes an educational) staff, a head gardener and a force of gardeners and labourers for the maintenance of walks, driveways, conservatories, borders and lawns. The director of a government-supported garden (*e.g.*, Kew near London; Edinburgh; Glasnevin at Dublin; Paris; Berlin; the United States Botanic garden in Washington, D.C.; Buitenzorg in Java; Singapore; Port of Spain in Trinidad; Hope and Castleton gardens in Jamaica; and others) reports to a governmental minister or bureau, and the financial support comes wholly or chiefly from governmental appropriations. For independent institutions (*e.g.*, Missouri Botanical garden at St. Louis, Rancho Santa Ana Botanic garden at Claremont, Calif., Boyce Thompson Southwest arboretum at Superior, Ariz., and others) there is a board of trustees who administer finances. Gardens that form integral parts of universities or other institutions (*e.g.*, Cambridge in England; the Hortus Botanicus at Amsterdam; Brooklyn in New York city) are administered by the trustees of the institution. A fourth group comprises gardens which are supported in part by municipal or other governmental appropriations and in part by private funds administered by a board of trustees, as is the case, for example, with the New York Botanical garden.



(TOP) JOHN H. GERARD; (BOTTOM) BY COURTESY OF MISSOURI BOTANICAL GARDEN, PHOTOGRAPH BY HEDRICH-BLESSING

MISSOURI BOTANICAL GARDEN IN ST. LOUIS, DATING FROM 1859

(Top) Formal gardens; (bottom) climetron, geodesic dome greenhouse, built in 1960

Various botanical gardens in Europe derive their support wholly or chiefly from the cities in which they are located, as, for example, Bath in England, Bern in Switzerland, Marseilles in France and Valencia in Spain.

Among botanical gardens that form an integral part of the botany departments of colleges and other schools or are closely affiliated with them may be mentioned the following: Aberdeen, Dundee and St. Andrews universities in Scotland; Birmingham, Cambridge and Oxford universities and the Royal Agricultural college at Cirencester in England; Trinity college, Dublin; those at the universities of Budapest in Hungary, Czernowitz and Cluj in Rumania, Cracow and Lwow in Poland, Prague in Czechoslovakia; those at Vienna in Austria, at Ghent and Liège in Belgium, at Copenhagen in Denmark, at the Catholic university in Lille, France, at the medical college and the veterinary college in Lyons, France, at Strasbourg and at Madrid; those at the universities of Bonn, Breslau, Göttingen, Halle, Munich and Würzburg in Germany, and at Athens, Greece, Groningen, Leiden and Utrecht in the Netherlands, Genoa and Modena in Italy, Kiev, Odessa and Leningrad in the U.S.S.R., Basel in Switzerland and the Jardins Alpins de l'Université de Grenoble, also in Switzerland; those at Nikko and Tokyo in Japan; the Botaniska Trädgård of the University of Helsinki in Finland; in the United States those of the University of California (Berkeley), Smith college (Northampton, Mass.), Mt. Holyoke college (South Hadley, Mass.), Michigan State university (East Lansing), the University of Michigan (Ann Arbor), the University of Minnesota (Minneapolis), the University of Pennsylvania (Philadelphia) and the Johns Hopkins university (Baltimore, Md.); and in Canada those of the University of British Columbia (Vancouver) and McGill university (Montreal). Harvard university maintains a botanical garden at Soledad, near Cienfuegos, Cuba—the Atkins institution of the Arnold arboretum.

By the early 1960s there were approximately 325 botanical gardens outside the United States. The more notable of these are mentioned below (dates in parentheses are dates of foundation).

Europe.—*Italy.*—The garden at Pisa, (1543, *fide* Emilio Chiovenda and Lavellée), founded by order of the grand duke Cosimo I de' Medici, is one of the earliest gardens devoted to the public study of botany; it became famous under its second director, Andrea Cesalpino. His work (*De plantis*, 1583) marks the beginning of modern systematic botany and influenced botanical science for more than 100 years. The Padua botanical garden, established by a decree of the senate of the republic of Venice enacted June 29, 1545, contends with Pisa for first place in antiquity. The controversy is discussed in C. Stuart Gager's "Botanic Gardens of the World." *Brooklyn Botanic Garden Record*, vol. 26, pp. 149–353. July 1937.

France.—The Muséum National d'Histoire Naturelle, Paris (1635), has long been known as the Jardin du Roi. Of naturalists who have worked there Lamarck is perhaps the most illustrious; he was appointed curator of plants in 1789. It is famous also for a remarkable school of botanical painting, of which P. J. Redouté is the best-known exponent. The garden proper, generally known as the Jardin des Plantes, occupies an area of 34.6 ac.

Great Britain.—The Chelsea Physic garden, London (1673), was established on the bank of the Thames by the Society of Apothecaries for the express purpose of advancing the teaching of botany and of providing study material for research and teaching. In the earlier years the garden grew medicinal plants in sufficient amounts to supply the members of the society with crude drugs in commercial quantities. The original plot of four acres was enlarged in 1722 by additional ground deeded as a gift by Sir Hans Sloane, with the provision that the growth of drug plants for commerce cease and the garden thenceforth be devoted exclusively to scientific and educational work. Its influence along these lines can scarcely be overestimated. Among its famous directors were Philip Miller, author of the classic *Gardener's Dictionary*, and John Lindley (appointed in 1835), author of *Flora Medica* and other important botanical works. Many important publications grew out of the work of the garden, including William Curtis' *Botanical Magazine* and *Flora Londinensis*, Lindley and Thomas Moore's *Treasury of Botany* and others. The private library of Charles Darwin is housed in the laboratory building.

The Royal Botanic gardens are located at Kew, near London (1759). The nucleus of the collections at Kew was the plants grown by Lord Capel, who came into possession of Kew house by marriage. Frederick, prince of Wales, leased the property about 1730, and after his death his widow, Princess Augusta of Saxe-Gotha, engaged a former pupil of the Chelsea garden, William Aiton, to develop a physic garden in 1757. From that year Kew ranked as a true botanical garden. The total area is 288 ac. It was Aiton who inaugurated the plan of sending botanical exploring expeditions to foreign countries. The material collected on these expeditions greatly enriched the scientific collections at Kew, and also knowledge of the vegetation of the world from the point of view not only of pure science but of economic botany as well. The gardens (as stated in a Kew guidebook) stand in relation to botanical science much as Greenwich does to astronomy. The botanical survey of the British commonwealth has resulted in the publication of floras of most of the overseas dominions. Among commercial plants distributed by Kew to new centres are those which yield breadfruit, pineapple, banana, tea, coffee, cacao, rubber, various fibres, timbers, dyes and quinine and other drugs. The quinine plant (*Cinchona*) was introduced by Kew from South America to India in 1860. Most of the crude rubber used extensively throughout the world is derived from trees of the Pará rubber plant (*Hevea brasiliensis*) raised from seeds collected by Sir Henry Wickham under the auspices of Kew in Brazil in 1875. Kew acts as botanical adviser to all governmental departments. The garden maintains a school of horticulture for the training of gardeners. It is visited by more than 1,000,000 persons annually. One of the most important publications is the *Index Kewensis*, an alphabetical list of all flowering-plant names published, with citations of the places of publication. This project was originally conceived and financed by Charles Darwin; it is kept up to date by supplements which appear at irregular intervals. The *Index Londinensis* (8 vol.) to the published illustrations of flowering plants, ferns and fern allies was prepared under the auspices of the Royal Horticultural society at the Kew garden. The *Kew Bulletin* contains the results of scientific researches by members of the staff.

Germany.—The Botanischer Garten und Botanisches Museum, Berlin-Dahlem, Ger. (1679), was established in Schöneberg, near Berlin, as an exhibition or model garden (*Mustergarten*). There it remained for more than 200 years. A new site was chosen at Dahlem, where in 1897–1907 the present garden was laid out under the direction of H. G. A. Engler, who was director from 1889 to 1921. The area is approximately 100 ac. It is primarily a research institute for botanical science and instruction of Berlin university. The plantations comprise five main sections: (1) plant geography; (2) morphology-ecology; (3) the arboretum; (4) systematic botany; and (5) economic plants. The botanical museum, which housed the large and extremely valuable library and herbarium besides public exhibits, was demolished in March 1943, during World War II.

Others.—Among other important European botanical gardens may be mentioned those at Amsterdam where Hugo de Vries (*q.v.*) carried on his investigations leading to the formulation of his mutation theory, Budapest (1771), Cambridge (1762), Oslo (1815), Coimbra, Port. (1773), Copenhagen (1600), Hanbury (Mortola, near Ventimiglia, Italy, 1867), Helsinki (1828), Leiden, Neth. (1587), Leningrad (1843), Madrid (1755), Rome (1884), Stockholm (Hortus Botanicus Bergianus, 1791) and Uppsala, Swed. (1787).

Asia and the Pacific Islands.—There are botanical gardens at Tokyo (1684); Sibpur, near Howrah, India (1787); Bogor, Java (1817); Hong Kong (1864); Peradeniya, Ceylon (1810); Melbourne, Austr. (1842); and Hobart, Tasmania (1844).

Africa.—Botanical gardens are located at Durban (1849) and Kirstenbosch at Cape Town (1913).

South America.—The gardens at Rio de Janciro (1808) and Buenos Aires (1892) are well known.

North America.—*Missouri Botanical Garden.*—This garden (St. Louis, Mo., 1859) is known locally as Shaw's garden, from the name of the founder, Henry Shaw, who first opened his garden to

the public about 1859. The area is about 75 ac.

The garden co-operates closely with the Henry Shaw school of botany at Washington university, St. Louis, members of the scientific staff of the garden serving as professors in the university. During the administration (1889–1912) of the first director, William Trelease, the *Annual Reports,* enriched with scientific contributions, became known throughout the scientific world. Under his successor, George T. Moore (1912–1953), the *Annals,* a scientific quarterly, and a monthly *Bulletin,* devoted mainly to the horticultural and floricultural activities of the garden, were initiated, and the scientific and educational work was expanded.

In 1925, 1,600 ac. of land 35 mi. S.W. of the city were acquired to be developed as an arboretum and to be used for maintaining plants injured by the smoke of the city. This serves as a source of plants for the city garden, affords areas for establishing a pinetum, a wild flower reservation and other features not possible in the city, and provides greenhouses for 20,000 orchids. The tropical station established in the Panama Canal Zone in 1926 was released to the Canal Zone government in 1937.

Arnold Arboretum.—This, at Boston, Mass. (1872), is the living tree museum of Harvard university. The principal collection of trees and shrubs was planted in 1886. The area of approximately 250 ac. includes meadow, hill and valley, and the permanent endowment is nearly $2,862,000. There is a library of about 50,000 volumes and many pamphlets, now combined with that of the Gray herbarium in Cambridge, Mass. Most of the herbarium of woody plants of the world (more than 500,000 specimens) has also been combined with the collections of the latter institution. Publications include: *Journal of the Arnold Arboretum, Arnoldia* (formerly *Bulletin of Popular Information*), *Sargentia,* which replaced the *Contributions* in 1938, the *Bradley Bibliography* (a guide to the literature of the woody plants of the world before the 20th century) and the *Bibliography of Eastern Asiatic Botany.*

As a part of the Arnold arboretum the Atkins institution of 230 ac. at Soledad, near Cienfuegos, Cuba, was developed as a tropical botanical garden. It has a small endowment of its own.

New York Botanical Garden.—Located in Bronx park (New York city, 1895), this garden comprises an area of approximately 280 ac.; its permanent funds exceed $2,500,000. In addition to extensive outdoor plantings there is a large range of conservatories. The museum building houses the public exhibits, the herbarium of more than 2,400,000 specimens, the library of more than 60,000 bound volumes and 150,000 pamphlets, together with classroom, lecture hall and administrative offices. A separate building contains laboratories for research in physiology and pathology. Free public lectures and classes in gardening and botany are given; the facilities of the garden are used by garden clubs, public schools and other groups. The garden was early devoted to botanical exploration of the West Indies and of continental North America, and later to that of northern South America. Publications include: *Garden Journal* (successor to the *Journal,* 1900–50), *Mycologia, North American Flora, Memoirs, Brittonia, Addisonia.* The garden is supported by both municipal and private funds. The first director was N. L. Britton (*q.v.*) (1896–1929). The garden is affiliated with Columbia university and offers graduate instruction also to students of Fordham university.

Brooklyn Botanic Garden.—This garden, in Brooklyn (New York city, 1910), includes an area of about 50 ac.; its work includes anything scientific or educational based upon plant life. Many popular courses are given for the public, both children and adults. Its program of public education is probably more extensive than that of any other botanic garden. There is a children's garden and children's greenhouse and building. Boys and girls frequently take consecutive voluntary instruction for periods of from five to ten years, finally entering upon a botanical or horticultural career or upon some other aspect of plant science or industry. Research work is in the experimental aspects of botany (pathology, genetics, physiology). Graduate work done at the garden has been credited toward advanced degrees by Columbia university and New York university. The garden co-operates extensively with public and private schools. Thousands of pupils with their teachers visit the garden in one year for instruction, and pupils are supplied annually with vegetable and flower seeds for planting in school and home gardens; more than 1,500,000 packets were distributed in 1943. The library, containing more than 25,000 volumes and as many pamphlets, is open daily to the public. The conservatories contain tender and tropical economic and other plants. The garden is supported in part by appropriations by New York city and in greater part by private funds. It was developed under the supervision of the first director, C. Stuart Gager (1910–43). Publications include: *Plants and Gardens* (successor to the *Record,* 1912–44), *Memoirs, Leaflets, Seed Exchange Lists* and *Guides* to the plantations and collections.

United States Botanic Garden.—This garden, at Washington, D.C. (1850), was initiated by act of congress, May 8, 1820, on a site of 5 ac., which was increased to 22.5 ac. in 1824. After about 20 years it was discontinued, and the property, which had been assigned to the Columbian institute for botanical garden purposes, reverted to the federal government. It was re-established by act of congress, May 15, 1850, on a site on the Mall. The name botanic garden was not applied to the site until 1856, when congress placed it under the supervision of the joint committee on the library. A preliminary report on the garden by the house committee on the library, Congressman Kent E. Keller, chairman, published in 1934, stated that the activities of the garden formerly consisted chiefly in the raising of ornamental flowering plants and cut flowers for members of congress and friends. This was discontinued by act of congress approved June 30, 1932. The garden was moved from the Mall to a new site south of Maryland avenue in 1933 and is conducted chiefly as a display garden. Botanical research and the botanical library and herbarium are administered by other branches of the federal government.

National Arboretum.—Established by act of congress, March 4, 1937, the National arboretum is located at Washington. The national congress in 1927 authorized the secretary of agriculture to establish a national arboretum on a tract of nearly 400 ac. on the Anacostia river about 4 mi. N.E. of the centre of Washington. The act provides that "the arboretum shall be administered by the Secretary of Agriculture, separately from the agricultural, horticultural, and forestry stations of the Department of Agriculture, but it shall be so correlated with them as to bring about the most effective utilization of its facilities and discoveries."

Boyce Thompson Institute for Plant Research.—This institution (Yonkers, N.Y., 1921) was established by a gift of William Boyce Thompson of approximately $10,000,000, the larger part of which was set aside as a permanent endowment. The institute was incorporated and the laboratories were opened in 1924. The stated purpose is the carrying out of every phase of research on plant life and the dissemination of information relative thereto. In 1928 a tract of about 325 ac. on the eastern edge of Yonkers was secured for the development of an arboretum, where it was planned to grow every hardy species of woody plant. This collection serves as a basis for the study of methods of propagation and of disease control. Publications include the *Contributions* and *Professional Papers.*

Others.—Among other botanical gardens in the Americas are the Letchworth Park arboretum, north of Portage, N.Y.; the Morton arboretum, Lisle, Ill.; and the botanic gardens at various colleges and universities, among them Marsh (at Yale university), University of Pennsylvania, Smith college, Mt. Holyoke college, University of Michigan and Michigan State university, University of California, University of North Carolina, Havana, Cuba, and Hamilton, Bermuda. *See* also ARBORETUM; HORTICULTURE.

(C. S. G.; H. W. RT.)

BOTANICAL SOCIETY OF AMERICA. This society, open to all who are interested in plants and plant science, was founded in its present form in 1906 when the union of the original society with the Society for Plant Morphology and Physiology and the American Mycological society occurred. The society was incorporated in 1939.

Its membership exceeded 2,000 in the second half of the 20th century, the members being largely from the U.S. and Canada. There is a significant body of foreign members and periodically up to 40 of these distinguished plant scientists are elected to cor-

responding membership. The society holds annual meetings for all members and the four geographical sections of the society also meet annually and separately. At these meetings, field excursions, symposia and presentation of the results of original research take place.

The society is broad in scope including seven topical sections, namely, general, teaching, paleobotanical, physiological, microbiological, systematic and phycological. Publications include the *American Journal of Botany* for research reports, the *Plant Science Bulletin* for botanical news and special articles and a biennial yearbook. (H. C. Bd.)

BOTANY (ARTICLES ON). The understanding of living organisms begins with botany. No known animal life, past or present, seems to have been capable of existing without depending upon the photosynthetic capacity of green plants; the earliest traces of plant life are three times as old as the most ancient animal fossils. The article BOTANY outlines the major branches of the science, and summarizes the development of its basic principles by such men as Linnaeus, Mendel, Darwin, etc. Another survey that will be helpful as a general introduction to the subject is BIOLOGY, in which plant life is discussed in the perspective of life as a whole.

PLANTS AND PLANT SCIENCE is designed as an elementary textbook. It explains the classification of plants; basic phenomena such as the alternation of generations; the anatomy and physiology of plants; the interrelationship of plants with their environment; and the meanings of the technical terms that botanists have adopted—terms that may seem forbidding to the beginner but that are useful because they compress a maximum of meaning into a minimum of space.

Articles devoted to primitive members of the plant kingdom include ALGAE; DIATOMS; FUNGI; and LICHENS. Individual articles are devoted to the more important fungi; *e.g.,* MUSHROOM; TRUFFLE; SMUT AND BUNT; YEAST.

Another primitive group of plants lacking differentiated roots, stems, and leaves is discussed in general outline in BRYOPHYTA, and treated in greater detail in the individual articles LIVERWORTS and Moss.

Along with the liverworts and mosses, the club mosses, horsetails, and ferns represent the transition of plants from aquatic to terrestrial life. HORSETAIL and FERN discuss these versatile groups, which range from tall treelike bodies to herbs so small as to go generally unnoticed.

Seed plants (Spermatophyta) are discussed in two general surveys: ANGIOSPERMS deals with flowering plants, the dominant plants of the earth, whose flower structures envelop the mechanism of reproduction; and GYMNOSPERMS describes the conifers and other groups associated with them because of exposed seeds. POLLINATION describes the methods of transfer of pollen from the anther to the pistil, as a consequence of which fertilization—a process in which the pollen tube reaches and combines with the ovum to produce a seed—is facilitated.

Articles dealing with broad classifications of plant life include GRASSES; TREE; VEGETABLE; WEED; and WILD FLOWER. Subdivisions of these groups are dealt with in separate articles. For example, GRASSES is supplemented by BAMBOO; BARLEY; RICE; WHEAT; etc.; and individual articles are devoted to major species of tree, vegetable, weed, and wild flower.

Separate articles deal with families of plants and individual species—for example, ROSACEAE and ROSE. Individual articles are devoted also to such groups as CARNIVOROUS PLANTS and POISONOUS PLANTS. Sectional combinations of genetically different varieties in a single plant, which used to be known, erroneously, as "graft hybrids," are discussed in CHIMERA.

FLOWER; FRUIT; and NUT discuss the biology and utility of these components of plants. Individual articles deal with specific types—for example, AZALEA, LILY; APPLE, STRAWBERRY; ALMOND, WALNUT. The embryonic development of higher plants is described in SEED. Other components of plants and their contributions to life processes are discussed in LEAF; ROOT; and STEM.

The principles of gardening are outlined in HORTICULTURE. Related articles include ARBORICULTURE; FRUIT FARMING; GRAFTING (IN PLANTS); LAWNS, CARE OF; PLANT BREEDING; PLANT DISEASES; and PLANT PROPAGATION. General information on growing plants indoors can be found in GREENHOUSE; HOUSE PLANTS. Soilless culture is treated in HYDROPONICS. The study of life processes by the cultivation of plant cells from root tips, meristems, etc., is described in TISSUE CULTURE.

Exhibits designed for the study of botanical specimens are discussed in ARBORETUM; BOTANICAL GARDENS; and HERBARIUM.

PHOTOSYNTHESIS describes the process by which the chlorophyll of plants, upon activation by sunlight, maintains life by renewing the earth's supply of oxygen and carbohydrates. A section of this article indicates how the world's food supply could be multiplied. Other aspects of this topic are treated in PLANKTON, which discusses the drifting plant life of the sea and corresponding forms of animal life; and in ALGAE: *Utilization of Algae.*

BACTERIOLOGY describes the minuscule forms of plant life that constitute a bridge between inanimate matter and higher organisms.

In the competition for the means of survival, dissimilar organisms sometimes enter into mutually useful relationships. Partnerships of this type between fungi and the roots of plants are described in MYCORHIZA.

A disputed group of organisms in the twilight zone between primitive forms of plant life and animal life, the Mycetozoa or Myxomycetes, are discussed in SLIME MOLDS.

The evolutionary history of plants, as written in the rocks, is discussed in PALEOBOTANY. The study of pollen grains and spores of immense antiquity has had a practical application in oil geology; this is described, along with the medical phase of pollen study, in POLLEN GRAINS. Pollen and spores of bygone geological eras are discussed also, in conjunction with the fossil remains of minute animals, in MICROPALEONTOLOGY.

The evolution of plants is treated, as part of the overall story of the development of living organisms, in EVOLUTION, ORGANIC, GENETICS; HEREDITY; and VARIATION. The methods of classification of plant and animal life are described in TAXONOMY.

Biographical articles summarize the achievements of the great leaders of botanical science.

Articles on botany necessarily contain much material of a technical nature. As far as possible, however, important general principles are explained in nontechnical terms in the introductory sections of its major subdivisions.

For a comprehensive view of the *Britannica's* resources on any topic the Index volume should be consulted, since various aspects of a subject may be discussed in many different articles.

BOTANY is the science which deals with plants. This article deals with the historical development of the science and with its main subdivisions; for a discussion of the form and function of plants *see* the article PLANTS AND PLANT SCIENCE.

Since plants are necessary to human life and since vegetation was conspicuous in the surroundings of the earliest human beings, it is natural that plants have always been of interest to man. It has been shown that at an early period men distinguished and named the kinds of plants they encountered. As civilizations developed, men began to arrange and record their knowledge of plants, and in this way botany began. Men's interests were manifold; as time went on, they concerned themselves not only with the kinds and names of plants but also with their structure, their mode of life, their chemical composition, the functions of their parts and their reproduction. Moreover, from the time man learned to cultivate plants, the study of plants embraced the proper methods of feeding, growing and propagating them, the breeding and selection of better kinds and the treatment of their diseases; in short, botany was the parent of many of the agricultural and horticultural sciences, and in this way has contributed greatly to human welfare.

Fundamentally botany remains a pure science, including any research into the life of plants and limited only by man's technical means of satisfying his curiosity. It has often been considered an important part of a liberal education, not only because it is necessary to an understanding of agriculture, horticulture, forestry, pharmacology and other applied arts and sciences, but also because to understand plant life is to know something of life in general, including our own.

Since man has always been dependent upon plants and sur-

rounded by them, he has woven them into his designs, into the ornamentation of his life, even into his religious symbolism. A Persian carpet and a bedspread from a New England loom alike employ conventional designs derived from the forms of flowers. Medieval painters and great masters of the Renaissance represented the divine persons surrounded by roses, lilies, violets and other flowers, which symbolized chastity, martyrdom, humility and other Christian attributes.

The Divisions of Botany.—The scope of botany is now so vast that the modern botanist cannot be expert in all its branches; he is a taxonomist, morphologist, physiologist or some other sort of specialist, according to the division of the subject in which he is most interested. These divisions are as follows: (1) taxonomy (systematic botany), the study of classification (including floristics, the identification of plants of particular regions); (2) morphology, the study of form and structure (including anatomy, which treats internal structure, and histology, concerned with the properties of particular kinds of cells); (3) physiology, the study of functions or behaviour (closely allied to biochemistry); and (4) genetics, the study of inheritance (hence connected with work on evolution). Such divisions are not absolute. It is necessary to know something of the structure of plants in any attempt to understand their behaviour. Since the taxonomist classifies plants on a theory of descent, he is also concerned with evolution. Cytology, the study of the individual cell, is partly morphology, partly physiology and partly genetics. Ecology, the study of plants in relation to their environment, is even vaguer in its definition, since it involves floristics as well as physiology, besides methods peculiar to itself; closely associated with it are plant geography (phytogeography), the study of plants in relation to the earth's surface, and plant sociology, the study of plant communities. Mycology is the study of fungi; and other groups of plants also may be studied by specialists who may refer to their subjects as algology (concerned with the algae), bryology (with mosses and liverworts) or pteridology (with ferns). Economic botany treats plants in relation to their uses. Plant pathology (phytopathology) deals with diseases of plants. Paleobotany, a division of paleontology, is concerned with extinct plants. Since the bacteria are usually classed as plants, bacteriology also is a division of botany; but because of its vast agricultural and medical applications and its special techniques, bacteriologists are highly specialized and usually not thought of as botanists. (*See* also PLANTS AND PLANT SCIENCE.)

Early History.—The roots of botany extend far into the past, and the subject, though it developed almost entirely in western Europe, is not limited by national boundaries, by races, languages or creeds. It apparently attained scientific status first among the Greeks. Aristotle left no authentic work on botany, but his pupil Theophrastus wrote, about 300 B.C., a work whose title is translated as the *Historia plantarum* or *Inquiry Into Plants*. This was an attempt to classify plants on philosophical principles and to describe their parts, habits and uses; it was based largely on Theophrastus' own observations but drew also on the reports of the scientists whom Alexander took with him on his conquest of Persia and India. Botany was represented among the Romans by the elder Pliny (*c.* A.D. 23–79), who assembled all the knowledge of his time in the 37 books of his *Historia naturalis*. This encyclopaedic compilation of fact and fable was drawn from approximately 2,000 books by more than 400 authors, and in its lack of originality may be contrasted with Theophrastus' work. At about the same time a Greek physician named Pedanios Dioscorides wrote a famous *Materia medica*, in which about 600 kinds of plants were briefly described and their medicinal uses cited. These classical works were lost to European scholars during the dark ages but rediscovered in the Renaissance, when they were promoted to the rank of authorities. Dioscorides in particular became the basis of further efforts to describe plants for the use of physicians. In the 15th and 16th centuries, with the development of printing, European physicians and botanists produced a number of herbals, based largely on Dioscorides and to a varying extent on original observation. Among the most valuable of these were those of Otto Brunfels (1532–37), Hieronymus Bock (1539), Leonhard Fuchs (1542) and Valerius Cordus (brought out by Konrad von Gesner in 1561 after the death of the author) in Germany; of Rembert Dodoens (1554, 1563), Charles de l'Écluse (1601) and Matthias de l'Obel (1570, 1571) in the Netherlands; of Pierandrea Mattioli (1544) in Italy; of William Turner (1551–62) and John Gerard (1597) in England. The increasing insistence on actual observation of the plants themselves was reflected in the woodcuts with which these books were illustrated.

Classification.—Since as a result of the revival of learning and of increased facilities for travel and study in Europe and Asia many more plants were becoming known, some botanists turned from medical botany to attempts to name and catalogue all known kinds of plants. The most celebrated work of this kind was the *Pinax theatri botanici* of Gaspard Bauhin (1623), in which approximately 6,000 species were listed and described. Other students were attempting to classify plants. In 1583 Andrea Cesalpino published his *De plantis*, in which the plant world was divided largely on the basis of characters of seed and fruit. A century later John Ray (1627–1705), one of the greatest botanists of all time, published a detailed scheme of classification, in which he divided flowering plants into monocotyledons and dicotyledons (plants with single and with double seed leaves), as they are still divided, and included many plant families that are still recognized. Ray insisted that botanists must consider all characters of a plant in determining its affinities, instead of relying, as Cesalpino had done and as Joseph Pitton de Tournefort was doing, on the characters of single parts (Tournefort used the petals of flowers); this is the distinction between a "natural" and an "artificial" system of classification.

The great Swedish botanist Linnaeus (1707–78) unfortunately followed Tournefort's method rather than Ray's when he published his "sexual system." It had been known since earliest times (*e.g.*, by the Egyptians and Assyrians) that pollen is necessary to the development of certain fruits. Nehemiah Grew in 1673 advanced a theory to account for the role of the pollen; and in 1694 Rudolf Jakob Camerarius published the results of experiments confirming the occurrence of sex in plants. Linnaeus based his 24 classes chiefly on the number of stamens in a flower; each class was divided into orders according to the number of styles. The simplicity of this system won it ready acceptance and thus stimulated botanical collecting and inquiry; but this very success was a detriment to botany by obscuring the beginnings of "natural" classification. A system which brought lily and barberry together in one order but separated sage and mint was not adapted to further the understanding of nature. Linnaeus' most valuable and lasting contributions were his careful descriptions of approximately 6,000 species arranged in genera (the same arrangement used today); his collation of the species he knew with the names and descriptions of previous botanists; and his rules of nomenclature. He introduced binomial nomenclature; *i.e.*, the naming of each species by two words, of which the first is the name of the genus to which it belongs, the second a qualifying word, usually an adjective (*e.g.*, white oak is *Quercus alba*, barley is *Hordeum sativum*, pear is *Pyrus communis*). The names of genera (*Quercus, Hordeum, Pyrus*) can be used for other species which are included in them, but each genus and each species has only one correct name, and that name is used for no other genus or species. Binomials appeared first in Linnaeus' *Species plantarum* of 1753, now the official starting point of plant nomenclature; they were immediately adopted by other botanists and greatly simplified all subsequent references to species. Only since 1753 has it been possible to trace a plant easily from one author to another.

Specialization.—Even in this early period, botany was becoming specialized. While many botanists were occupied only with the classes and names of plants, the foundations of anatomy were being laid by Nehemiah Grew and Marcello Malpighi in works which appeared between 1670 and 1674. Jans and Zacharias Janssen had made a compound microscope about 1590, and various models were available in the 17th century. Grew and Malpighi were able to distinguish such internal parts as the woody vessels and fibres, the cells of the pith and the resin canals. The word cell is traced to Robert Hooke in 1665. His concept of a cell (as

his selection of the word suggests) was of a hollow space surrounded by solid material; it was derived from examination of thin slices of cork, the cavities in which doubtless impressed him as similar to the cells of a honeycomb. It was long, however, before botanists realized that such cavities contain living matter (at least when they are young) and that plants are entirely composed of such units. The first morphologists thought of plants as formed of various sorts of elements, including vessels, fibres, bladders, etc. M. J. Schleiden, with his colleague the zoologist Theodor Schwann, is usually credited with the first statement of the "cell theory" in 1839; however, the idea that plants and animals are composed of the same units, and that their entire structure may be understood in terms of such units, was in the air at that time and was arrived at independently by a number of biologists, among whom may be mentioned René Joachim Henri Dutrochet (1824). With Robert Brown's description of the nucleus in 1831, and the recognition of the importance of the living matter of cells, named protoplasma by Hugo von Mohl in 1846, cytology began to take shape as a distinct science.

Physiology also had its beginnings in the time of Grew and Ray; its progress was dependent upon the development of the experimental method. While Grew, Linnaeus and others contented themselves with fantastic conjectures on the nutrition and growth of plants, Ray experimented on the movement of sap, the germination of seeds and other functions of plants. Stephen Hales in his *Vegetable Staticks* (1727) recorded the results of 124 experiments on flow and pressure of sap, loss of water by transpiration and exchange of gases with the air; he is regarded as the founder of plant physiology. Further understanding had to wait for the development of chemistry. Joseph Priestley in 1774 showed that plants in sunlight give off a gas, named oxygen by the chemist Antoine Laurent Lavoisier (who also named carbon dioxide). The relationships of these gases with plants were further elucidated by Jan Ingenhousz in 1779 and Nicolas de Saussure in 1804; the latter introduced quantitative methods into this study, and showed that water as well as carbon dioxide is absorbed and that the plant gains weight. Thus did the beginnings of knowledge of the manufacture of food in plants keep pace with chemistry.

The foregoing brief survey of the early development of botany illustrates its specialized fields. The state of the science in the middle of the 20th century may be conveniently treated under its several branches, broadly conceived; but it must be borne in mind that such a treatment is at several points arbitrary.

Taxonomy.—Attempts at a "natural" system of classification continued even during the popularity of Linnaeus' sexual system, the most notable being that of Antoine Laurent de Jussieu in 1789. In this, as in Ray's classification, many "natural orders" were described which are still recognized. Augustin Pyrame de Candolle (1778–1841) based his system on that of De Jussieu and used it in his great work (completed by his son), the *Prodromus systematis naturalis regni vegetabilis* (1824–73). The classic work of George Bentham and Sir Joseph Dalton Hooker, the *Genera plantarum* (1862–83), was framed on a modification of De Candolle's system. But the entire theory of classification was, as it were, reborn with the publication of Darwin's *Origin of Species* in 1859 and the subsequent acceptance of the doctrine of evolution.

It is sometimes difficult to understand just what the pre-Darwinians meant by a "natural" system. Sometimes it seems to have been an attempt to reveal the divine plan of nature, sometimes merely an effort to bring things together that seemed to "belong" together. Once evolution is accepted, however, the goal of taxonomy becomes a system in which species related by descent are placed in one genus, genera so related in one family and so on. The great work of Heinrich Gustav Adolf Engler and Karl Anton Eugen Prantl, *Die natürlichen Pflanzenfamilien* (1887–99; 2nd ed. 1924 *et seq.*), treats families as groups of related genera and places these families in a series supposed to represent their actual evolution from primitive to advanced. Since evidence of relationship is chiefly inferential, being derived from mostly morphological characters, such theories of relationship are subject to constant revision. Charles Edwin Bessey in 1915 proposed a scheme that was more in accord with modern concepts; it has since been variously modified, as, for example, by John Hutchinson in 1926.

The 19th and 20th centuries produced also an imposing array of manuals and floras of particular regions and of monographs of particular groups of plants, based on botanical exploration of almost all parts of the earth and the accumulation of specimens in the great herbariums at Kew, Paris, Geneva, Berlin, New York city, Cambridge, Mass., and Washington, D.C., and in many smaller collections. From the 6,000 species described by Linnaeus and the 100,000 conjectured by the elder De Candolle, botanists by the second half of the 20th century have come to an estimate of more than 300,000 species (many divided into subspecies, varieties, etc.), with several thousand new species being named every year. Paleobotanists are similarly busy extending knowledge of extinct plants. Ecologists and plant geographers have been responsible not only for floristic accounts of vegetation in various parts of the world but also for analysis of the causes of changes in vegetation. Such work is of great importance to foresters and to those concerned with conservation of natural resources.

Most of the taxonomic work outlined above was based on the morphological features of plants, chiefly on those visible to the unaided eye or with the help of a hand magnifier. Such work has been supplemented by evidence of relationship drawn from anatomy, cytology, genetics and plant geography, often involving experiments in transplanting or breeding. Modern taxonomy includes not only the results of botanical exploration (which still continues) but also the investigation of relationships by all known techniques. Taxonomists not only describe species from preserved specimens but also study the populations of living plants, which may or may not be easily fitted into the classical categories.

Closely associated with taxonomy is nomenclature. As the number of species increased, names also were multiplied; several names were often applied to the same group, and the groups were variously divided or combined by individual taxonomists. To resolve the resulting confusion, rules of nomenclature were formulated by a series of international botanical congresses beginning in Paris in 1867. International accord was reached with the publication of the third edition of the *International Rules of Botanical Nomenclature* in 1935, revised by action of the congress at Stockholm in 1950 and again by that at Paris in 1954 as the *International Code of Botanical Nomenclature* (1952). (*See* also TAXONOMY.)

Morphology.—The work of the great botanist Robert Brown from 1810 to 1850 opened the way to an understanding of the reproductive parts of plants, the transfer of pollen to pistil and the growth of the pollen tube toward the ovule. During the same period Wilhelm Friedrich Benedict Hofmeister published the first clear accounts of the two kinds of individuals which make up the normal life cycle of ferns, mosses and other plants. Investigation of the details of pollen and ovule and of the "alternation of generations" continued well into the 20th century. As a result of the work of such men as Philippe Édouard Léon van Tieghem in 1870, of Gottlieb Haberlandt in 1884 and of Edward Charles Jeffrey in 1900, cells were classified into their several types (whose functions were related to their structure), the different patterns in which these tissues occur were revealed, and their origin from undifferentiated tissues (meristems or regions in which new cells are formed) was described. Details of cell structure and particularly the mechanism of cell division were studied by cytologists, among whom Eduard Strasburger (1844–1912) was eminent. The name of Karl von Goebel (1855–1932) is associated with morphology in all its aspects, and his great work *Die Organographie der Pflanzen* remains a classic in this field.

In the 20th century attention has been focused on the meristems (tissues composed of cells retaining their power to divide), particularly at the tips of stems, and their relation with the new parts to which they give rise. This has even been treated experimentally; microdissection has been employed and the resulting changes have been related to normal morphology. The science of experimental morphology tends to bridge the gap between morphology and physiology.

Physiology.—The older plant physiologists experimented mostly with entire living plants in their efforts to understand their activities. Besides the early studies of sap flow and nutrition

already mentioned, there were experiments on tropisms (turnings) of plant parts in relation to light and gravity by Thomas Andrew Knight in 1806 and by Darwin in 1880; on the absorption of substances from the soil by Justus von Liebig and Jean Baptiste Boussingault about the middle of the 19th century; on osmosis and the pressures within cells by Hugo de Vries in 1884; and many other studies. A marked feature even of work so early as Knight's was its insistence on a "mechanical" explanation; that is, the description of the processes of living matter in the same terms as those used for nonliving matter. Chemistry and physics came therefore to be more and more important, and the attention of plant physiologists became more and more fixed on the physicochemical properties and processes of protoplasm. Since such studies may concern the composition and activities of individual cells, physiology here passes into cytology. The earlier work on nutrition led to numerous researches on the essentially biochemical problem of photosynthesis, the process by which green plants manufacture carbohydrates and oxygen from carbon dioxide and water; chief among the investigators was Julius von Sachs (1832–97). In the 20th century one-celled algae have been used in the attack on this problem and in the investigation of other fundamental processes such as respiration. In the study of the absorption of materials from the soil, the boundary between botany and soil science (pedology) tends to disappear. As a result of physical work on nuclear fission, radioactive materials have been used in the study of the entrance of atoms into the plant and their course within it.

Two significant developments of modern plant physiology may be cited to illustrate the trend toward biochemistry and biophysics. One is the study of substances which for lack of a better name are often referred to as "growth substances," such as auxin and the vitamins, which are widely distributed in plant cells and which are involved in the most important processes of living matter—often in the same way in plant cells as they are in animal cells; some of them are often compared with the hormones of animals. Understanding of the growth substances followed the greatly improved techniques for isolation and measurement of substances in minute quantities. The production of antibiotics by plants (*e.g.*, of penicillin by the fungus *Penicillium*) is also studied by plant physiologists. The other development is the study of tissues detached from the plant and kept alive under artificial conditions. Such tissue culture yielded information on nutrition and growth and was also pursued partly in the hope that from such often amorphous masses of living and growing cells something might be learned about cancer.

Genetics.—Although speculation about heredity goes back to the Greeks, the experimental study of inheritance is the youngest branch of biology, dating from the work of Gregor Mendel published in 1866 and unnoticed by other scientists until 1900. Mendel's success was based on treating the characters of plants as distinct units and on a mathematical analysis of their appearance in breeding experiments. The idea of unit characters led to knowledge of the genes, the units which control the development of characters. The improved cytological techniques of the 20th century made it possible to relate the genes directly with the chromosomes of cells, the threadlike bodies especially conspicuous during cell division; the genes have not yet been seen, but the exact location of many of them on particular chromosomes is definitely known. Modern plant genetics (*see* PLANT BREEDING) is concerned both with the improvement of domestic plants, by combining in the same race such desirable characters as heavy yield, resistance to disease and so forth, and with the more theoretical study of the nature and behaviour of the genes. Changes in chromosomes and genes, called mutations, occur naturally and are a principal cause of the variability of plants and animals and hence of evolution. The rate of mutation has been greatly accelerated in experimental organisms by irradiation with X-rays or other rays, and this has been used to study the nature of such changes. In plant cells the sets of chromosomes may be multiplied, so that one cell may contain from three to ten or even more sets instead of the normal one or two; chromosomes may also be added or subtracted in numbers less than complete sets, and may individually undergo reconstructions of various types. Such changes, like mutations, may be induced by irradiation as well as by certain drugs, such as colchicine. They are reflected in changes in the structure, appearance or behaviour of the plants in which they occur, and, since they may affect the reproductive cells and may prove permanent through many generations, may result in the origin of new races and so in evolution. They are therefore of interest to the taxonomist as well as to the geneticist.

For related articles, *see* BOTANY (ARTICLES ON); *see* also references under "Botany" in the Index.

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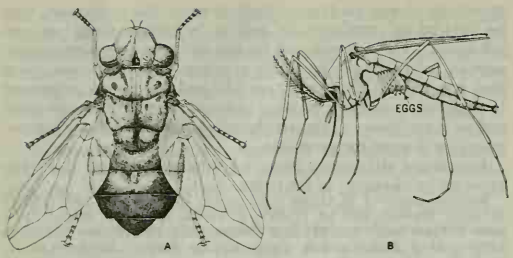
BOTANY BAY, an inlet 5 mi. south of Sydney, Austr., discovered by Capt. James Cook (*q.v.*) on April 29, 1770—the first European landing on the east coast of Australia. Cook's original name (Sting-Ray harbour) was changed by him in recognition of the wealth of new plants discovered there by the naturalist Joseph Banks (*q.v.*). Banks's too vivid impressions were responsible for the projected location there of the convict establishment (1788) under Capt. Arthur Phillip of the Royal Navy. A brief reconnaissance convinced Phillip that, because of poor soil and lack of water at Botany bay, a site on Port Jackson was preferable; but the name of Botany bay as a place of penal exile lingered on in British and Australian folklore. Botany bay is included in the suburbs of Sydney, with the Kingsford Smith airport to the northwest, an oil refinery on the southern headland and national reserves at La Perouse (named after the French navigator) on the north and around Cook's landing-place at Kurnell. *See* also AUSTRALIA, COMMONWEALTH OF: *History*. (O. H. K. S.)

BOTETOURT, NORBORNE BERKELEY, BARON DE (1718–1770), colonial governor of Virginia, was born in England. After military and parliamentary service he was made a peer in 1764, and four years later was appointed governor of Virginia. Popular with the colonial assembly at the outset and secretly in sympathy with their strong position of protest against the transfer of political prisoners to England, he nevertheless dissolved the assembly after it passed resolutions demanding exclusive powers of taxation. He attempted by correspondence with the British secretary of state for the colonies to bring about a repeal of all parliamentary taxes, but failed to modify the action of the parliament. His brief service of two years as governor had won the approval of the colonial assembly, and a life-size statue of him was erected by the assembly in Williamsburg, where he died on Oct. 15, 1770. (E. E. R.)

BOTEV, KHRISTO (1848–1876), Bulgarian patriot and poet whose lyrics are among the best in his country's literature and whose revolutionary activity did much to inspire its national revival, was born in Kalofer, central Bulgaria, on Jan. 5, 1848 (new style; Dec. 24, 1847, old style). Sent to Russia in 1863 to complete his education, he came under the influence of revolutionaries in Odessa. In 1867 he returned to Bulgaria but then fled to Rumania. There he lived in poverty, devoting himself to the Bulgarian liberation movement, of which his literary genius and talent for organization made him one of the leaders. He collaborated in the publication of several Bulgarian patriotic journals, and a collection of his own *Pesni u stihove* ("Songs and Verses") appeared in 1875. These few poems combine a consummate mastery of technique with a moving expression of his patriotic ideals and aspirations. Believing that the nation would rise against the Turks, Botev invaded Bulgaria with less than 200 companions on May 16, 1876, and reached Mt. Veslez in the western Balkans, but was there surrounded and killed, on May 20, by regular Turkish troops. There is a collected edition of his writings by A. Burmov (1940).

BOTFLY, a name applied to flies of the small families Gasterophilidae, Cuterebridae and Oestridae (*see* FLY), the larvae of



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HUMAN BOTFLY (DERMATOBIA HOMINIS)
(A) Adult; (B) eggs attached to mosquito

which are parasitic in mammals. The adult flies are robust and beelike in appearance, hairy but without bristles.

Horse botflies (Gasterophilidae) occur wherever horses are found. *Gasterophilus intestinalis* deposits its eggs on the horse's forelegs and body. When the horse licks itself, the eggs ingested hatch, and the larvae make their way to the stomach, where they attach by their heads and take nourishment from the stomach wall. Other species of *Gasterophilus* oviposit on the horse's nose and lips, and the larvae attach to the intestinal lining. Horse bots obtain sufficient oxygen from the contents of the alimentary canal.

The Cuterebridae include the North American and European deer nose bots, *Cephenomyia*, capable of 50-m.p.h. flight, perhaps the swiftest insects. Species of *Cuterebra* are subcutaneous parasites of small rodents, rabbits, opossums and monkeys. The human botfly, *Dermatobia hominis* attacks livestock and deer, rarely man. The female attaches her eggs to mosquitoes, stable flies or other insects, which in turn carry the eggs to the actual host. Body warmth of the host causes the eggs to hatch, and the tiny larvae penetrate the skin. In tropical America, *Dermatobia* causes great loss of beef and hides.

The Oestridae include cattle grubs (or warble flies, heel flies) and nose flies, all parasitic in large mammals. Viviparous *Oestrus ovis*, the sheep botfly, deposits active young larvae in the nostrils of sheep; the larvae develop in the nasal passages or sinuses and often cause in the host a nervous condition called blind staggers. Warble flies (*Hypoderma lineatum* and *H. bovis*) greatly disturb cattle when they oviposit on the animals' legs. The young larvae penetrate the skin, migrate through the body for several months, then come to rest beneath the skin of the back; here each larva causes a characteristic lump, or warble, which is perforated by a hole through which the larva breathes atmospheric oxygen. At maturity the cattle grub emerges and drops to the ground to pupate and transform into a fly. (G. W. Bs.)

BOTH, JAN (1618?–1652), Dutch painter and etcher, the leading master of the "Italianate" trend of Dutch landscape painting in the 17th century, was born in Utrecht about 1618. From 1638 to 1641 he lived in Rome; in the latter year he returned to Utrecht, where he became a prominent member of the guild but died prematurely in 1652 (buried on Aug. 9). His views of the mountainous and wooded surroundings of Rome, filled with golden sunlight and enlivened with figures of Italian peasants on their way to or from the market, show the influence of Claude Lorrain (whom Both met in Rome) but are masterpieces in their own right. The tradition according to which the figures in many of his paintings were done by his brother, Andries Both (born in Utrecht in 1612, lived in Rome *c.* 1633–41, died in Venice in 1641; known as painter and etcher of genre scenes), has not been borne out; in fact, no works of Jan prior to 1641 have been identified. The figures in his known landscapes were usually painted by himself, in a few cases by Cornelis van Poelenburgh, who also painted Both's portrait. Both's etchings, based on some of his paintings, are most delicately done; good impressions have become rare.

See *Magazine of Art*, 46:131–136 (1953). (W. Sw.)

END OF VOLUME THREE

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